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The Senegal River Basin Monitoring Activity, Phase I: Final Report[1]

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Table of Contents

Acknowledgements i

Synthesis 1

Summary 3
- 1. Introduction 6
- 2. Background 10
- 3. The Problem 13
- 4. Floodplain Agriculture: Recession and Irrigation 15
- 5. Intensification on the Floodplain 23
  - 5.1 Fisheries 24
  - 5.2 Livestock and Pasture 27
- 6. Environmental Effects 29
  - 6.1 Forestry 29
  - 6.2 Domestic Water 31
- 7. Other Costs 32
  - 7.1 Social and Political 33
  - 7.2 Electricity *noch einmal:* Sir Alexander Gibb & Partners 34
- 8. Recommendations 37

1. The History of the Middle Valley of the Senegal River 45

2. Population Dynamics in the Middle Valley 55
   - 2.1 Ethnic Structure 55
   - 2.2 Demographics of Waalo Cultivation 56
   - 2.3 Migration 61

3. The Development of the Senegal Valley: Background 64
   - 3.1 Irrigation in the Senegal Valley: An Overview 64
   - 3.2 OMVS and the Development of the Senegal Valley 65
   - 3.3 Controlled Flood/No Flood Scenarios 66
   - 3.4 Floodplain Productivity during the Transitional Period 69

4. Research Context 70
   - 4.1 Research Objectives 70
   - 4.2 Geographic Context 70
     - 4.2.1 The Middle Valley of the Senegal River 70
     - 4.2.2 Ecological Diversity 72
     - 4.2.3 Uncertain Impacts of Climate: The Drought 74
   - 4.3 The Sociocultural Context: Traditional Social Hierarchies 74

4.3.1 Nobility 76
4.3.2 Group-Specific Productive Activities 77
4.3.3 Social Transformation and Caste Affiliation 78
4.4 The *Leydi*: At the Crossroads of Society and Ecology 79
4.4.1 The Spatio-Temporal Dynamic of Environmental Management . . . 79
4.5 Demographic Context 80

5. Methodology 82
5.1 Site Selection 82
5.1.1 Doumga Rindiaw: Intermediary Zone where Agropastoralism Predominates 82
5.1.2 Boyenadji Roumde: Intermediate Zone where Agricultural Production Predominates 82
5.1.3 Thiemping: Riverine Agrofisheries Zone 84
5.2 Conceptualization of the Project 87
5.3 The Variation in Scale in the Collection and Analysis of Information 88
5.3.1 Intrahousehold Organization - The *Fooyre* 89
5.3.2 Interhousehold Organization - The *Galle* 89
5.4 Sampling Methods 89
5.4.1 General Census of the Research Sites 90
5.4.2 Methodology for Sample Stratification 98
5.5 Household Monitoring 109
5.5.1 Production Systems Survey 109
5.5.2 Household Budget Survey 110
5.5.3 Household Food Consumption Survey 110
5.5.4 Land Surveys and Field Mapping 110
5.5.5 Production Systems Monograph 110

6. Social Organization and Elements of Transition in *Haal Pulaar* Society in the Middle Valley 111
6.1 Hierarchization of Society 111
6.1.1 Systems of Inequality: Traditional Logic and Changes 111
6.2 The Hierarchization of Land Tenure: Recession Lands 113
6.2.1 Intervillage *Waalo* Land Holdings 113
6.2.2 Rights and Regulations Tied to Land Use 114
6.3 Elements of Transition in Society 120
6.3.1 The Role of Emigration 120
6.3.2 The Role of Modern Education 123
6.3.3 The Role of Irrigated Agriculture 125
6.4 The Challenge to Traditional Powers 125
6.4.1 Politics: The Two-fold Role of the Village Chief 125
6.4.2 Religious Power: Slow but Inevitable Change 126

7. Organization and Relations of Production in the Middle Valley 127

7.1 The Organization of Production before the Introduction of Irrigation . . . 127
7.2 Factors That Have Altered the Diversified Production System 128

8. Agriculture and Herding in Household Production Strategies 129
8.1 Introduction 129
8.2 Recession Agriculture 130
8.2.1 Doumga Rindiaw-Kaawel Landholdings 131
8.2.2 The *Waalo* of Thiemping 133
8.2.3 Boyenadji Roumde's *Waalo* 136
8.2.4 Control of Land and Crops in the *Waalo* 136
8.2.5 Profile of Plots and Household Holdings in the *Waalo* 146
8.2.6 The Organization of Work and Productivity in the *Waalo* 156
8.2.7 Harvests and Yields 167
8.2.8 Conclusions 171
8.3 Falo Cultivation 173
8.3.1 Site Description 174
8.3.2 Land Tenure 175
8.3.3 Landholding and Caste 176
8.3.4 Aspects of Production 177
8.3.5 Commercialization of Production 181
8.4 Rainfed Agriculture 183
8.4.1 Plot Sizes in Rainfed Cultivation 185
8.4.2 Conclusions 189
8.5 Herding 189
8.5.1 The Overall Condition of the Flock in the Regions of Kaawel and Doumga Rindiaw 190
8.5.2 The Status of the Herd 192
8.5.3 Methods of Cattle Acquisition 194
8.5.4 Implications for Family Herd Management 195
8.5.5 Conclusion 200
8.6 Fisheries 200
8.6.1 Introduction 200
8.6.2 Monitoring Fishing Activities 201
8.6.3 The Seasonal Fishing Cycle 202
8.6.4 Organization of Labor 204
8.6.5 Fishing Methods 205

9. The Role of Irrigated Agriculture in the Production Systems of the Middle Valley 207
9.1 Introduction of Irrigated Agriculture to the Middle Valley 207
9.2 The Perimeters in the Present Context of the Après-Barrage 207
9.3 Research Sites 209
9.4 Analysis of Small-Scale Village Perimeters 210

9.4.1 Land Tenure Relations 210
9.4.2 The Deterioration of the PIVs over Time 214
9.4.3 Funding Irrigated Agriculture 219
9.4.4 Production on the PIVs 230
9.5 Analysis of Intermediate Schemes 242
9.5.1 Characteristics of the Schemes 244
9.5.2 The Establishment of the Hamady-Ounaré Scheme 244
9.5.3 Outline of the 1989-1990 Rice-growing Season at Hamady-Ounaré 247
9.5.4 Conclusion 250
9.6 Conclusions and Outlines for Solutions 251
9.6.1 Avenues of Exploration 254

10. Household Budgets and Granary Stocks 257
10.1 Introduction 257
10.2 Methodology 258
10.3 Analysis of Household Budgets 260
10.3.1 Source of Household Revenues 260
10.3.2 Patterns of Household Expenditures 263
10.3.3 The Commercial Value of Local Farm Production 265
10.4 Monitoring Granary Stocks 266
10.5 Conclusions 268

11. The Agricultural Sector and Rural-Urban Dynamics in the Department of Matam 269
11.1 Introduction 269
11.2 Rural-Urban Dynamics 270
11.2.1 Population Growth Rate Patterns 270
11.2.2 Agricultural Production 274
11.2.3 Migration Incidence 276
11.2.4 Trade and Commerce 277
11.2.5 Education and Health Services 284
11.2.6 Conclusion 286
11.3 The Agricultural Sector, Employment, and Rural Income Generation . . . 287
11.4 Conclusion 292

12. The Importance of an Artificial Flood in the Wider African Context 294
12.1 Introduction 294
12.2 The Importance of Africa's River Systems for Riverine Populations . . . 294
12.3 The Nature of Riverine Production Systems and Their Dependence on Annual Flooding 295
12.3.1 Introduction 295
12.3.2 The Nature of Riverine Production Systems 295
12.4 Justification of an Artificial Flood 297

12.5 Policy, Management, and Environmental Constraints to Man-made Flooding . . . 298
12.5.1 Policy Constraints . . . 299
12.5.2 Management Constraints . . . 299
12.5.3 Environmental Constraints . . . 299
12.5.4 Summary . . . 300
12.6 Acknowledgements . . . 300

Pulaar-English Glossary . . . 301

Bibliography . . . 318

List of Figures

Figure 2.1 Persons Dependent on Waalo by Ethnicity/Place of Residence: Both Banks 1970-1973 . . . 58
Figure 2.2 Persons Dependent on Waalo by Ethnicity/Place of Residence: Senegal 1970-1973 . . . 60
Figure 2.3 Persons Dependent on Waalo by Ethnicity/Place of Residence: Mauritania 1970-1973 . . . 62
Figure 4.1 Geographic Representation of the Dominant Ethnic Groups in the Senegal River Valley . . . 71
Figure 4.2 Morphology of the Senegal River Valley . . . 73
Figure 4.3 Rainfall Data. Matam, 1949-1988. . . . 75
Figure 5.1 The *Leydi*: Socioecological Relationships in the Region of Doumga Rindiaw . . . 83
Figure 5.2 The *Leydi*: Socioecological Relationships in the Region of Boyenadji Roumde . . . 85
Figure 5.3 The *Leydi*: Socioecological Relationships in the Region of Thiemping . . . 86
Figure 5.4 Age Pyramid: Doumga Rindiaw . . . 92
Figure 5.5 Age Pyramid: Kaawel . . . 94
Figure 5.6 Age Pyramid: Boyenadji Roumde . . . 96
Figure 5.7 Age Pyramid: Thiemping . . . 97
Figure 6.1 Diagram of *Rem Peccen Tatabal* . . . 119
Figure 6.2 Genealogy of the Niokane Family in Doumga: Access to Land, Age Relationships, and Migration . . . 122
Figure 8.1 System of Compensation in Land for Harvest Foregone in Sharecropping Arrangements . . . 153
Figure 8.2 Status of the Herd Among the Peul: A Monogamous Household . . . 196
Figure 8.3 Status of the Herd Among the Peul: A Polygamous Household . . . 197
Figure 9.1 Access to the PIV for Caste Groups; the Case of Doumga Rindiaw . . . 213
Figure 9.2 Reasons Given by Farmers for Not Farming PIV Parcels (Doumga Rindiaw 1989) . . . 218
Figure 9.3 Revenue Sources for Irrigation; the Case of Doumga Rindiaw . . . 221

Figure 9.4 Migration Patterns in Doumga Rindiaw and Ndiawel from April to December 1989 225
Figure 9.5 Yields on Bosséa I in 1988 and 1989 243
Figure 11.1 Population in the Department of Matam 271
Figure 11.2 Commercial Centers in the Department of Matam 281
Figure 11.3 Diversified Production Among Statutory Groups in the Department of Matam 288

List of Tables

Tables 1-10 in the Synthesis:
Table 1: Irrigated Cultivation with Rice Valued at 136 FCFA/kg (SAED Market) 17
Table 2: Irrigated Cultivation with Rice Valued at 96 FCFA/kg (Local Market) 17
Table 3: Recession Cultivation with Sorghum Valued at 100 FCFA/kg 18
Table 4: Recession Cultivation with Sorghum Valued at 50 FCFA/kg 18
Table 5: Irrigated Cultivation with Rice Valued at 136 FCFA/kg (SAED Market) 20
Table 6: Irrigated Cultivation with Rice Valued at 96 FCFA/kg (Local Market) 20
Table 7: Recession Cultivation with Sorghum Valued at 100 FCFA/kg 20
Table 8: Recession Cultivation with Sorghum Valued at 50 FCFA/kg 21
Table 9: Distribution of Yields from Irrigated Rice Perimeters 22
Table 10: Fishing Revenues by Region 25
Table 2.1 Persons Dependent on Waalo Agriculture by Ethnicity and Place of Residence: Senegal (S) and Mauritania (M) (1970-73) 57
Table 2.2 Persons Dependent on Waalo Agriculture by Ethnicity and Place of Residence: Senegal (1970-73) 59
Table 2.3 Persons Dependent on Waalo Agriculture by Ethnicity and Place of Residence: Mauritania (1970-73) 61
Table 4.1 Caste Stratification of *Haal Pulaar* Society 76
Table 5.1 Ethnic Groups and Castes in Doumga Rindiaw 91
Table 5.2 Classification of Households in Doumga Rindiaw 101
Table 5.3 Castes and Household Typologies in Doumga Rindiaw (as a % of the total) 102
Table 5.4 Household Stratification in Boyenadji Roumde 104
Table 5.5 Castes and Household Typologies in Boyenadji Roumde (as a % of the total) 105
Table 5.6 Household Stratification in Thiemping 106
Table 5.7 Castes and Household Typologies in Thiemping (as a % of the total) . . . 107
Table 5.8 Sample Size and Percentage by Caste in Relation to Total Village Population at Thiemping 108

Table 5.9 Sample Size and Percentage by Caste in Relation to Total Village Population at Boyenadji Roumde 109
Table 6.1 Statutory Groups of Those Enrolled in the Schools in Doumga Rindiaw and Kaawel 124
Table 8.1 Control of *Waalo* Lands of Doumga Rindiaw According to Locality . . . 137
Table 8.2 Representation of Joom Ngesa on 180 *Waalo* Parcels of Doumga Rindiaw by Caste and Locality (Percentages by Locality) 138
Table 8.3 Control of *Waalo* Lands of Doumga Rindiaw by Galle and by Caste (galle in units; area in hectares) 139
Table 8.4 *Waalo* Tracts Controlled by Doumga Rindiaw Households (number of households) 139
Table 8.5 Area (in ha) of *Waalo* Tracts of Households and Castes in Doumga Rindiaw 140
Table 8.6 *Waalo* Area Cultivated by Caste and Land Tenure Arrangement in 1988-89 (Doumga Rindiaw) 142
Table 8.7 Differential Land Access by Caste in Thiemping *Waalo* (Cangay Dow Seyji) in Percent 144
Table 8.8 Evolution of Land Tenure Arrangements on Noussoum Yirlabe between 1975 and 1989 (as a % of total *waalo* area) 145
Table 8.9 Castes and Land Tenure Arrangements on Noussoum Yirlabe in 1989 (as a % of caste) 146
Table 8.10 Parcels Cultivated According to the Place of Residence of Cultivators on Doumga Rindiaw's *Waalo* 147
Table 8.11 The Evolution in Social Composition of Cangay between 1988 and 1989 149
Table 8.12 Landholding Status and Caste Composition of Refugees in Cangay 149
Table 8.13 Distribution by Size and Caste of Tracts Cultivated by Doumga Rindiaw Households in the Local Basins (by number of holdings) 151
Table 8.14 Distribution of Areas Cultivated on the Local *Waalo* by Households and by Castes in Doumga Rindiaw 152
Table 8.15 Areas Cultivated by Caste and Tenure Arrangement: *Waalo* and Village of Doumga Rindiaw (in hectares) 152
Table 8.16 Tenure Arrangements of *Waalo* Parcels Cultivated and/or Controlled by Households in the Kaawel Sample, in hectares (1989-90) 154
Table 8.17 Landholding Status, Caste and Plot Size in the Thiemping *Waalo* 154
Table 8.18 Labor Time Allotted to Agricultural Tasks; A Comparison of Doumga Rindiaw, Kaawel, Podor, and Boyenadji Roumde 161
Table 8.19 Areas Cultivated and Demographic Profile of *Waalo* Households in Doumga Rindiaw 162
Table 8.20 Labor Time by Gender and Age Groups in Doumga Rindiaw, Kaawel, and Thiemping (as a % of the total) 165
Table 8.21 Differential Landholding by Caste in Thiemping's Goulmbol Falo 177
Table 8.22 The Agricultural Cycle in Thiemping's Falo 178
Table 8.23 Labor Allocation in the Falo by Task and Gender 180

Table 8.24 Crop Yields in Thiemping and Tiguere Falo 181
Table 8.25 The Commercial Value of Garden Production in Thiemping Falo 182
Table 8.26 Labor Time by Age and Gender in Boyenadji Roumde's and Kaawel's Jeeri (in percentages) 187
Table 8.27 Labor Time by Gender and Agricultural Period in Kaawel and Boyenadji Roumde (as a percent of the total) 187
Table 8.28 Composition of the Herd at Kaawel (Original Sample [OS] and Working Sample [WS]) 192
Table 8.29 Status of Herd in Kaawel (survey of 6 households) 194
Table 9.1 Evolution in Caste Access to Irrigated Parcels as Supply Increases; The Case of Doumga Rindiaw 211
Table 9.2 Reasons Cited for Not Cultivating PIV Parcels; Bosséa I and II (Doumga Rindiaw rainy season 1989; 21 interviewed from Bosséa I and 26 from Bosséa II) 217
Table 9.3 Source of Revenues for Financing Irrigation among Various Landholding Categories. The Case of Two Perimeters in Doumga Rindiaw 220
Table 9.4 Mode of Financing Irrigation by Statutory Groups and Landholding Profiles (in percentages) 230
Table 9.5 Agricultural Labor Cycle in Rice Perimeters 232
Table 9.6 Task Differentiation by Gender in Doumga Rindiaw, Thially, and Tiguere Cire Perimeters 236
Table 9.7 Task Differentiation by Gender on Tiguere Cire during the Dry Gardening Season 236
Table 9.8 Labor Inputs by Age and Gender in Doumga and Thially Perimeters . . . 237
Table 9.9 Task Differentiation by Age Group on Tiguere Cire during Dry Season Gardening 238
Table 9.10 Labor Inputs on the PIV by Sample Households (as a % of the total) . . . 239
Table 9.11 Movement of farm labor in the production of rice and vegetables/legumes on Tiguere Cire 240
Table 9.12 Summary of the Performance of the UAI. Casiers A and B 252
Table 10.1 Source of Household Revenues in Doumga Rindiaw, Boyenadji Roumde and Thiemping 261
Table 10.2 Patterns of Household Expenditures in Doumga Rindiaw, Boyenadji Roumde and Thiemping 264
Table 10.3 The Commercial Value of Local and Imported Foods Consumed in Doumga Rindiaw, Boyenadji Roumde, and Thiemping 265
Table 11.1 Area and Production Figures for Flood Recession Sorghum, Department of Matam (1975-1982) 274
Table 11.2 Rate of Intensification for Irrigated Rice in Department of Matam 275
Table 11.3 Middle Valley Market Towns 277
Table 11.4 Local versus Imported Market Items 279
Table 11.5 Small Shop Volume of Trade in Grains (1989, 1990) 280
Table 11.6 Urban Enterprises in Matam and Ourossogui 285

900 years ago, the Arab historian, Abu 'Ubayd 'Abd Allāh b. 'Abd al-'Aziz al Bakri (1981:82) noted in his Kitab al-masalik wa-'l-mamalik *a remarkable agricultural system in the Senegal valley based on flood-recession cultivation:*

> *The inhabitants sow their crops twice yearly, the first time in the moist earth (thara) during the season of the Nil [i.e., Senegal] flood, and later in the earth [that has preserved its humidity].*

That system, which has provisioned a population for at least a millennium, is no less remarkable today. Despite being under continuous cultivation for such a long period, the floodplain shows little or no evidence of secular degradation, of a progressive deterioration in its productive capacity (King 1990). The annual flood also makes possible complementary exploitation of the plain by fishers and herders, it provides for woodland and pasture generation, and it supports biologically diverse wild and domesticated fauna and flora.

That system and the dense populations that depend on it are today under threat.

Synthesis

Summary

1. Introduction

Until recently, the prevailing assumption among donors, governments, and the regional multistate river basin development organization was that after a transitional period the artificial flood from the Manantali Dam would be terminated, and the Senegal River waters would be managed uniquely for hydropower, irrigation, and navigation. This position was supported by cost-benefit analyses that compared the values of hydropower and flood-recession agriculture. These analyses that favored terminating the flood ignored the full range of costs: hydrologic, environmental, economic, social, and political. In 1987, the Senegal River Basin Monitoring Activity (SRBMA) began to explore the hypothesis that a permanent controlled release from Manantali would be justified by environmentally sustainable increases in production, income, and employment. In 1989, the Government of Senegal identified itself with a more holistic approach to river basin development than "power-irrigation-transport," and with a reconsideration of alternative management strategies for the dam.

2. Background

Along the left bank of the Senegal, most of which is in a low rainfall sahelian zone, 800,000 people support themselves with a diversity of smallholder productive activities. They fish, rear livestock, and cultivate rainfed millet, flood-recession sorghum, and irrigated rice; and wage-labor migrants send home remittances. This diversified system, which in the Middle Valley is well-adapted to the floodplain environment, depends on the annual flood, and is threatened by the Manantali and Diama Dams, which may seriously alter basin ecology. The challenge to development planners is to devise a strategy minimizing the adverse affects of the dams while maximizing their benefits through the maintenance and enhancement of existing production systems, the improvement and possible expansion of irrigation, and the generation of hydroelectric power.

3. The Problem

The argument to terminate the contribution to the flood from the Bafing assumes a competition for scarce water. The principal hydropower consultant for the basin claimed that a controlled release would entail an annual power loss of 3.591×10^9 FCFA (@ 21 FCFA/kwh), a loss more than twice the production value of 50,000 hectares in recession agriculture (1.7×10^9 FCFA/year @ 34,000 FCFA/ha). These figures, which were maintained by the consortium responsible for drafting the Left Bank Master Development Plan until as late as December 1989, may be flawed on two points: (1) an overestimation of the losses in power from flood-recession farming; and (2) an underestimation of the total economic returns from floodplain production.

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4. Floodplain Agriculture: Recession and Irrigation.

Development initiatives in the basin remain narrowly focused on irrigation despite its historical record of rarely having met production or revenue objectives. This weak performance is attributable to (usually unspecified) labor and capital requirements that are too burdensome for many households that allocate most of their capital to food purchases and most of their labor to a risk-minimizing diversified production repertory. A comparison of net returns to land, labor, and capital indicates that in years of adequate flood and rainfall higher net returns are achieved to the scarcer production factors--labor and capital--from recession farming than from irrigation. A sound development strategy must place irrigation in its proper perspective, as *one, and only one,* of the elements in a complex production system.

5. Intensification on the Floodplain

Advocates of expanding irrigation seek rates of intensification of 160 percent, approximately twice the rate currently achieved on irrigated perimeters. Yet on the floodplain, the calendric succession of fish, grain, and livestock production already generates a rate substantially greater than that hoped for on the perimeters.

5.1 Fisheries

The interaction of rivers with the lateral floodplain is critical for the reproduction of freshwater fish. In predrought years, the per hectare production of fish was approximately 70 kg, or about 35,000 FCFA @ 500 FCFA/kg. When that figure is compared with the value of flood-recession sorghum of 34,000 FCFA/ha, as estimated by the hydropower consultant, for a total of 69,000 FCFA, it indicates the importance of fishing both for household food consumption and for income.

5.2 Livestock and Pasture

The floodplain supports large herds of ruminant livestock during the dry season that browse trees, shrubs, grasses, and post-harvest grain stubble, and that manure the fields. Flood reduction is likely to lead to a sharp decline in the carrying capacity of the plain. One estimate of this decline yields a potential annual loss of 17,500 FCFA/ha.

6. Environmental Effects

6.1 Forestry

Acacia nilotica, the dominant woodland species in the Middle Valley, depends for its growth and reproduction on periodic flooding. The woodlands seem already to have suffered from the droughts of the 1970s and 1980s, and permanent reduction of the flood might prove devastating. The tree contributes to soil stabilization and provides fuelwood, charcoal, livestock browse, and termite-resistant wood for construction.

6.2 Domestic Water

Aquifer recharge depends on the flood. The shallow aquifer provides the Middle Valley and the extensive surrounding lands with ready access to water for household and livestock use and for irrigating small vegetable gardens, especially those managed by groups of women. A reduction of the flood will cause a lowering of water tables, and alternative methods will have to be introduced to assure continued access. Boreholes tapping the deep aquifer may be the only solution, and these are costly to install and to operate. Even then, a sustained fall in groundwater levels will raise pumping costs, necessitate borehole rehabilitation and may lead to the inland movement of saline water in the delta.

7. Other Costs

7.1 Social and Political

By narrowing opportunities for a diversified production system, reduction of the flood may foster intense competition among individuals and groups for access to a reduced and homogenized resource base. This narrowing may also adversely affect the burdens of women, children, and the aged, who will remain in the valley while adult men seek remunerative employment elsewhere. As the rural exodus accelerates, the economic base of small towns in the region will deteriorate, since nongovernment employment in these urban centers is sustained largely by cash purchases from the rural sector.

7.2 Electricity

The hydrologic calculations of the engineering consultants to the regional river basin organization have informed the discussions on dam management, and they have fostered the notion of an incompatibility between power and controlled flooding. Their analysis asks what maximum amount of energy could have been produced continuously from 1904 to 1984 had there been a 50,000 hectare flood.[1] SRBMA's alternative calculations assume that in the very driest years, such as 1983-1984, there would be no artificial flood. The findings are that in 62 of 81 years there would have been sufficient water for both a 50,000 hectare flood and a guaranteed power output of 86 megawatts. Furthermore, in many of the 19 deficit years, there was sufficient water in the reservoir to have supported a controlled flood of the required volume for 50,000 hectares.[2]

8. Recommendations

On the basis of the above analysis, and on the separate SRBMA reports in hydrology, fisheries, agriculture, pedology, and socioeconomics, we propose a series of actions to be carried out under the overall coordination of the Government of Senegal's Cellule Après-Barrages, involving maximum participation of Senegalese individuals and organizations. These recommendations seek to assure integrated development that sustains the environment and generates income and employment along the left bank of the Senegal River Valley.

1. Introduction

1. SRBMA's work has been carried out in a changing policy environment reflected in the evolution of official Senegalese thinking about the artificial flood.[2] At the initiation of the research in 1987, the GOS identified itself with the OMVS position that the artificial flood was to be *transitional*, a temporary expedient to wean the floodplain population away from recession cultivation as new irrigated perimeters came on line. OMVS, the three member states, and the organizations lending for the Manantali and Diama dams agreed that, after the transition period, the dams would be operated to maximize hydropower generation and to raise the dry-season river flows to allow for riverine transport and more cost-efficient irrigation. This meant that the controlled September release from Manantali, adding to the unregulated flows from the Bakoye and Faleme rivers, would be terminated.

2. SRBMA began its studies testing an alternative hypothesis, that a controlled release from Manantali, lifting the Senegal's flow to flood levels, would be justified by environmentally sustainable increases in production, income, and employment. At that time, the World Bank accepted Sir Alexander Gibb & Partners' calculations that the artificial flood would engender an unacceptably high cost in forgone power (Andersen 1987). These calculations were based on assuring 100 percent power output in every single year from 1904 to 1984, despite the fact that no one advocating an artificial flood ever suggested that a release could be justified in such drought years as 1983-1984.

3. Although to this day OMVS holds to the position that the dams should eventually be operated without an artificial flood--indeed, OMVS maintains a lonely attachment to the notion of year-round barge transport from St. Louis to Kayes, despite the absence of commitment from any donor--Senegal (1989:16) first officially ventilated the possibility of an alternative strategy in January 1989. At that time, the Senegalese Minister of Plan and Cooperation, M. Djibo Ka, wrote:

> Monitoring the impact of the artificial flood is important because it will provide a sounder basis on which to decide whether to terminate it on the grounds that it unprofitably competes with hydropower generation, or to maintain it to some as yet undetermined time. Monitoring will also allow for appropriate agricultural interventions, involving both productive technology and plant breeding.

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[2] GERSAR/CACG. et al. (1990, Annexes:29) state that Flood "A" will inundate 144,000 ha of which 98,000 ha are on the left bank. They also state (1990, Annexes:19) that Flood "A" will allow for cultivation of 50,000 ha in the entire valley. With the ratio left bank:right bank=2:1, a Flood "A" would allow for approximately 33,000 ha of cultivated waalo land in Senegal.

4. That suggestion apparently so impressed the consortium (GERSAR/CACG. et al. 1989:38) contracted to prepare a Master Plan for the Development of the Left (i.e., Senegalese) Bank of the Senegal River, that in their provisional report in December 1989 they made the possibility of maintaining an artificial flood the central issue to be resolved:

> *La culture de décrue constitue un moyen traditionnel de valorisation des sols du lit majeur du fleuve Sénégal. Les conditions pluviométriques des 15 dernières années ont cruellement mis en évidence les aléas d'une telle production vivrière en période de sécheresse persistante. La mise en service du barrage de Manantali permet de recréer artificiellement la crue, pour pallier une déficience de la crue naturelle. La réserve d'eau destinée à la crue artificielle est, ou sera, en concurrence avec d'autres utilisations de Manantali, jugées prioritaires car apportant une plus value significativement plus importante:*
>
> - *cultures intensives sur périmètres irrigués en maîtrise de l'eau,*
> - *production hydro-électrique.*
>
> *Faut-il supprimer cette crue artificielle et à quel terme?*

5. The conclusion of GERSAR/CACG. et al (1989), based on Gibb's 100 percent guaranteed power output model, was negative: the benefits of an artificial flood, in terms of increased agricultural production on the floodplain, are less than the costs, in terms of reduced hydropower.[3]

6. Only six months later, there has been a 180-degree turn, a complete reversal of position (GERSAR/CACG. et al. 1990:110). No longer seeking 100 percent guaranteed power output, the consortium now asserts that the costs of an artificial flood are less than its benefits. No longer restricting the comparison to power and irrigation on the one hand, and flood recession cultivation on the other, the consortium now accords value to other flood-dependent productive activities, such as livestock raising and fishing, and to environmental effects, such as reforestation.

7. With the shift in the official position of the GOS, from opposing to embracing permanency for the artificial flood and to seeing a complementarity among recession farming, irrigation, and hydropower, at least until land under irrigation reaches 100,000 ha, SRBMA now finds itself confirming rather than challenging the establishment stance. Instead, therefore, of

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[3] IDA's hydrologist (Hollis 1990a and 1990b) demonstrates that an augmented flood released to coincide with the natural flood from the Faleme and Bakoye would require a smaller volume of water from the reservoir than Sir Alexander Gibb calculates for artifical flood "A." Hollis' analysis shows that from 1954 to 1964, the volume released would have fallen by 66 percent and from 1986 to 1989 the releases would have fallen by 19 percent. These are very significant savings of water and would provide for increased power output from the Manantali Dam.

providing detailed analyses of every element in the environmental and production system as we had initially anticipated doing, we shall consider these only briefly while concentrating on the one arena that remains problematic: comparing the cost and benefits of irrigation and recession agriculture.

8. SRBMA's findings provide strong support for Senegal's commitment to strengthening an environmentally sustainable, gender-sensitive, diversified production system along the left bank of the river: a system including rainfed farming of millet and other crops on sandy uplands during the brief rainy season, recession cultivation on the floodplain, irrigation, animal husbandry, and fisheries; a system that encourages growth of woodlands and pasture, assures safe and reliable water for domestic use, and facilitates the expansion of off-farm enterprises and employment.

9. In the first instance, the achievement of integrated development in the valley depends, as the June 1990 version of the Master Plan (hereafter indicated as PDRG, "Plan Directeur de la Rive Gauche") acknowledges, on the annual (or near-annual) flood. But it also depends on assuring the right mix of irrigation and flood recession farming. While a rapid expansion of irrigation has an obvious attraction, mainly because of its potential to increase yields per unit land, IDA's familiarity with irrigation--both in Senegal and more broadly in sub-Saharan Africa--suggests caution, a modest expansion carefully monitored. It is widely admitted, even by the most eager partisans of irrigation, that the Senegalese and African experience on perimeters of all sizes and with diverse systems of management has been disappointing: costs are much higher than anticipated; yields and rates of intensification are much lower;[4] farmers are reluctant or unable to invest capital and labor at recommended levels; farmer associations have proved to be unstable; pump downtime is excessive; fields need releveling sooner than expected; canals are often poorly maintained; etc., etc., etc. This poor performance, moreover, characterized a period when the State, through the Société d'Aménagement et d'Exploitation des Terres du Delta et du Fleuve Sénégal (SAED), prepared the land and provided necessary equipment and inputs at highly subsidized prices or even gratis. The New Agricultural Policy (1984) and the Structural Adjustment Program under which the Government of Senegal now operates call for a disengagement of the State from these actions, and a provisioning of equipment and inputs to farmers on irrigated schemes at prices that more nearly reflect their costs (Woodhouse and Ndiaye 1990).[5]

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[4] The term "artificial" here means "brought about by constructive skill," that is, not solely a function of nature. It does not mean "unreal" or "imitation."

[5] Sir Alexander Gibb & Partners is a member of the GERSAR/CACG. et al. consortium drafting the Left Bank Master Plan.

In the long run, the New Agricultural Policy expects farmers to assume the amortized costs of the perimeters as well.[6]

10. The fact that farmers seem eager to move to new perimeters while abandoning ones that are just a few years older--a process that has been labelled *irrigation itinérante*--should also signal caution. Clearly, irrigated schemes do best in their early years, once initial problems have been confronted and resolved. Lands are properly leveled; there has been no salinization of soils; equipment works; and both parcel holders and managers are enthusiastic and optimistic. This initially successful and subsequently deteriorated performance should influence the rate of bringing on new perimeters. Evaluations should be made not only in Years 1, 2, and 3, but subsequently as well, with appropriate monitoring mechanisms in place to identify precisely what works and what doesn't. Even though funding may be available to support a rapid increase in irrigated hectarage--figures as high as 5,000 ha/year of new land have been proposed--our findings strongly suggest a much slower, more experimental rate, predicated on careful land use analyses to assure not only that the perimeters are installed on technically appropriate lands, but also that they do not alienate the better flood-recession lands.

11. Even the alienation of poorer flood-recession lands is problematic. Households from castes without ownership rights to land may occupy the marginal areas of the floodplain (for example, higher parts of the basins that are flooded less often or for shorter durations), while members of the land-controlling castes hold the floodplain lands that are properly inundated in most years. If the marginal lands are appropriated for irrigation, compensation should be paid not only to their jural holders (*joom ngesa*), but also to those who farm them as sharecroppers or under other forms of loan or tenancy. Equity considerations in the extension of irrigation must be considered on a site-specific basis, with appropriate prior socioeconomic as well as technical appraisals.

12. It is in the spirit of seeking to contribute to sound, equitable, and sustainable economic development that we offer this analysis of river basin management in the middle Senegal valley. Although our stance is sometimes critical, we appreciate that present policies have been

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[6] As recently as last year, the World Bank (1989:89) noted that while it had encouraged the GOS to invest in rice schemes in the Senegal valley by projecting favorable results, "there was little indication that these results were based on detailed studies of production costs nor of the likely impact of development costs on the economic cost of additional rice output."

Some instructive figures are available for the right bank of the river. In 1984 Mauritania inaugurated a vigorous program of private investment in irrigation, and over 4,500 ha. of new perimeters were developed. "These efforts have led to dramatic increases in rice production, in the order of 14,000 tons of paddy for the period 1987-88. However, the farming intensity ratio dropped from 1.06 in 1985-86 to 0.69 in 1987-88, as the amount of developed, but non-farmed, areas increased from 316 ha. to 2,114 ha" (Dames and Moore 1990:2-4, citing SAAGRER/IRM).

elaborated on the basis of information available and with the intention of benefiting large numbers of persons. We would welcome at least as skeptical an examination of our work as we have given to that of others. We recognize too that without the excellent scientific inquiries carried out by hundreds of persons and many organizations, our exploration for alternatives would be severely hampered. Thus, we acknowledge with gratitude and admiration many of the studies that are cited herein, even where we may differ with their data, methodologies, analyses, or interpretations.

13. River basin development has the potential, if predicated on sound socioeconomic and environmental understandings, to benefit local, regional, and national economies substantially. Yet this potential is rarely achieved, and the huge sums invested in dams, dikes, irrigation systems, and hydropower installations typically provide disappointing and even negative rates of return, accelerate environmental degradation, and adversely affect the well-being of often densely settled riverine areas. In the following analysis focused on the middle Senegal valley, we offer suggestions on how better to realize the development potential of existing and planned river basin infrastructure.

2. Background

14. Following Guinea's withdrawal from the Organisation des Etats Riverain du Sénégal (OERS), in 1972 the remaining members, Senegal, Mauritania, and Mali, created the Organisation pour la Mise en Valeur du Fleuve Sénégal (OMVS). OMVS was charged with development of the Senegal basin, including the construction and operation of the Manantali high dam on the Bafing River in Mali, some 1,000 km upstream, and the Diama salt-intrusion barrage, 27 km from the mouth of the river in Senegal.

15. The Manantali dam, completed in 1988, is designed to control the downstream flow for (1) hydropower generation of 800 gigawatt-hours/year; (2) double-crop irrigation; and (3) year-round barge transportation from St. Louis on the Atlantic Ocean to Kayes in Mali.[7] Diama, completed in 1985, blocks the upstream migration of saline waters that previously travelled some 200 km during periods of low flow, and, after construction of a right bank dike, the dam will raise the level of fresh water to allow for more cost-efficient irrigation. By evening out the river flows--suppressing flood peaks and raising flows during the dry season--the dams will fundamentally affect basin ecology and production systems.

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[7] Even with government subsidies for agricultural inputs and for pumping, farmer indebtedness on lands managed by SAED is very high. By 1984, nonpayment of debts reached 255,000,000 FCFA (SAED 1986), "with the overall level of indebtedness running at a higher level on larger perimeters. This large unpaid debt was in turn a factor in persuading the state to withdraw from input and credit provision as part of the structural adjustment programme" (Woodhouse and Ndiaye 1990:7).

16. Approximately 1,700,000 people occupied the Senegal basin in 1985, of whom 692,000 were in Senegal, 583,000 in Mali, and 425,000 in Mauritania. According to GERSAR/CACG. et al. (1990:21), the left bank figures for 1990 are 119,800 people in Bakel Department, 200,300 in Matam, 186,400 in Podor, 302,000 in Dagana, for a total of 808,500 people, 75 percent of them rural.[8] For the Departments of Matam and Podor, which contain the bulk of the lateral floodplain, 95 percent of the population is rural. More than 100,000 smallholder households downstream from the dam practice a highly complex set of production strategies. Despite generally low rainfall--much of the basin falls in the sahelian climatic zone--this dense population is possible because in average years the area sustains two harvests, one dependent on summer rains on coarse sandy upland soils (*jeeri*) and the other dependent on late summer floods on the alluvial plains (*waalo*)[9] composed of very fine, water-retaining vertisols. In addition, some of the floodplain is colonized by nutritious grasses, shrubs, and trees that supplement the graze provided by crop stubble; thus, in the dry season, large ruminant herds move from sandy upland pastures to the waalo, creating an animal population whose density echoes that of the humans. Until the drought of the 1970s and early 1980s, many fish were captured in the river and on the floodplain, adding to the consumptive inventory of the region.[10]

17. Large irrigation schemes exist in the delta and the lower valley, and in the middle valley small village-owned and -managed irrigated perimeters have been developed since the mid-1970s, many with government assistance, adding a fifth element to the production array: (1) rainfed millet; (2) flood recession sorghum, maize, cowpeas; (3) irrigated rice (and, on a 7,500 ha scheme at Richard Toll, irrigated sugarcane); (4) livestock; and (5) fish.

18. This diversified production system is both constrained and supported by migration of young men who leave the area to search for wage labor and trading opportunities in urban centers and overseas. The area also supports a number of small commercial and administrative towns whose vitality depends in great part on the viability of the rural production system (Lericollais et al. 1990).

19. In their goal of insulating the region from the ravages of drought, the Diama and Manantali dams promise new prosperity. But, if the comparative evidence of African river basin development (Scudder 1988) is a reliable guide, the outcome is as likely to bring about an economic and environmental decline for those people most directly affected: the vast majority of the residents of the basin. Given the commitments that have been made by the three countries involved and by the international financial donor and lending community, is it possible to elaborate a management strategy for the river that mitigates the most severe negative consequences of the dams while still allowing reasonable utilization of the waters for hydropower and irrigation? We underestimate neither the task nor the economic and political constraints faced by the OMVS member states. The constituents for maximum hydropower generation and

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[8] In Matam, the costs of a new irrigated scheme run about 840,000 FCFA/ha for a PIV and between 4,210,000 and 5,580,000 FCFA/ha for an "aménagement intermédiaire."

[9] In the most current version of the PDGR (GERSAR/CACG. et al. 1990:57), the possibility of riverine transport is dismissed within parentheses: "(l'utilisation du débit garanti aux fins de la navigation n'est pas abordée dans cette étude)."

[10] The principal urban agglomerations in the valley, St. Louis and Richard Toll, account for approximately 86 percent of the nonrural left bank population.

large-scale irrigation might not be numerous but they are powerful and often persuasive. Urban consumers demand cheaper and more reliable sources of energy. A *raison d'être* of large parastatal and private corporations is the development of huge tracts of land. European, North American, Japanese, and Korean civil engineering and construction firms seek to develop larger perimeters, build dams, and install power lines in the Third World, especially as such construction has virtually halted in their own countries. Financial institutions increasingly find integrated rural development an uncertain mechanism for assuring timely repayment of their loans.

20. The Manantali Dam is supposed to be managed with a controlled release of reservoir waters every September, in principle topping up the flows from the unregulated Faleme and Bakoye Rivers, and creating thereby an "artificial" flood.[11] This release is conceived of as

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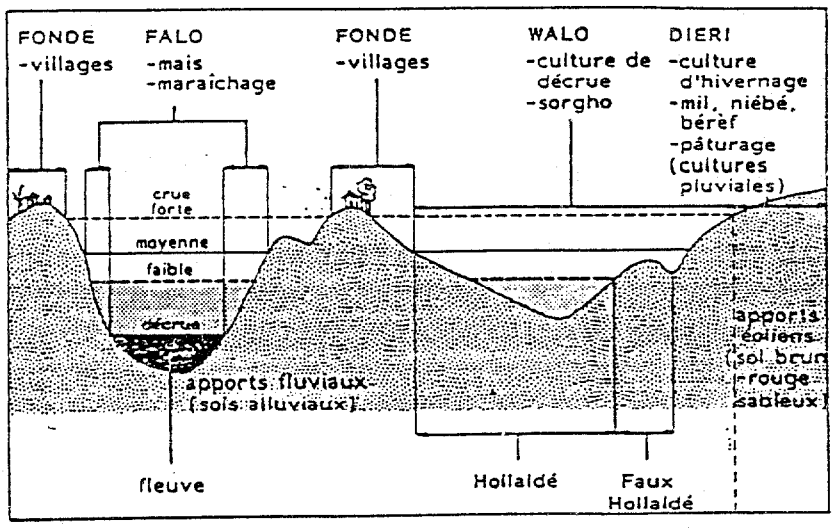
[11] The term "waalo" refers both to the lateral floodplain and to flood-recession agriculture. The waalo is itself divided into three geomorphological types, each appropriate to a specific type of farming: (1) *hollalde*, the lower areas of the inundated depression that are flooded almost every year, and planted in sorghum and cowpeas; (2) *falo*, the banks of the river and marigots with rich alluvial soils, planted in maize, sweet potatoes, and other nutrient-demanding crops; and (3) *foonde*, higher elevations with mixed sand-clay soils, that are inundated only by exceptionally high floods. Jeeri soils are not flooded.

Soil Types in the Middle Valley
(after van Lavieren and van Wetten 1990:8)



transitional, an opportunity for the riverine populations to continue their complex production system while slowly being weaned away from traditional agriculture to year-round irrigation. SRBMA has explored the hypothesis that the net benefits to local, regional, and national economies are greater under the artificial flood than under a water regime that markedly limits the flood to maximize hydropower and irrigation. Our research effort has been informed by a desire to see the rural residents of the Senegal Valley become beneficiaries rather than victims of development, while their urban compatriots also profit from more reliable electricity at potentially lower costs than currently paid.

21. In the remainder of this paper, we outline some of the findings of SRBMA and explore their relevance for the integrated development of the left bank of the Senegal valley. In the process we will compare them with some other recent proposals for river basin development,[12] and provide a set of recommendations for action.

3. The Problem

22. At the 21st OMVS Consultative Committee meeting in Bamako, 7-8 December 1989, the OMVS High Commissioner reiterated what was still the standard assumption that the artificial flood would be eliminated when it began to compete for scarce water. This would happen, the High Commissioner said, in the year 2000 when 95,000 ha in the valley would be under irrigation (USAID 1989). A supposed opposition between hydropower generation and flood recession cultivation was central to the thinking of Sir Alexander Gibb (1987), the OMVS' consultant on hydroelectric power, and was stated in the following way: the net benefit accruing from flood recession cropping of 34,000 FCFA/ha for a yield of 600 kg/ha is less than the cost of maintaining the artificial flood, based on losses in potential power due to these releases.

23. This hypothesis assumed that the power lost for each hectare flooded is greater than 34,000 FCFA; Gibb (1987) claimed that a controlled release will cause a loss of 171 GWh/year. At 21 FCFA/KWh, the lost electricity equals 3.591×10^9 FCFA, or more than twice the production value of 50,000 hectares in recession agriculture (1.7×10^9 FCFA). Although the

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[12] Lericollais et al. (1990) note that as riverine fish quantities plummeted during the drought, marine fish transported by truck from St. Louis on the coast replaced freshwater species. They believe this may create difficulties for local fishers who will seek to recapture the market when normal floods lead to a resurgence in freshwater numbers. For the mechanics of fish reproduction on floodplains, see Dunn (1990).

171 GWh would have been lost only in years such as 1982-1984, when it is hardly conceivable that anyone would have recommended an artificial flood, we will assume here that Gibb's calculations are correct. At the end of the paper, however, we will reexamine those calculations and suggest that they do not inevitably confirm Gibb's conclusion that an artificial flood is unduly costly in terms of forgone electricity.[13]

24. Our discussion incorporates a modified cost-benefit analysis. We recognize that conventional cost-benefit analysis has been widely and justifiably criticized for being too narrowly focused on measures that are easily quantified while ignoring others that prove unwieldy. For example, agricultural development--a shift from flood-recession agriculture to irrigation in this case--is often appraised uniquely for its expected direct impacts while its indirect and longer term impacts, such as environmental damage, are ignored or understated. In its review of twenty years' experience with rural development projects, the World Bank (1987) concluded that many of these projects failed to meet the rate of return projected at the appraisal stage precisely because the initial cost-benefit analysis excluded these other factors. The Bank felt that government and donor allocation of development resources could have been much improved had the indirect and longer term impact of projects been incorporated into the cost-benefit analyses. In the discussion below, we try to account for, and indeed calibrate, a broader spectrum of impacts than that with which development planners in the region have customarily dealt.

25. Cost-benefit analysis can produce misleading results for another reason as well. In the agricultural sector, different production regimes are often compared on the basis of crop yields per hectare without taking into account capital and labor constraints that may exist in a region. In promoting capital- and labor-intensive techniques to improve land productivity, projects frequently overlook the fact that there are alternative and potentially more remunerative uses to which scarce labor and capital can be put. The agricultural options appropriate to such situations may not be those improving the productivity of the land as much as those improving the productivity of capital and labor. This observation is, of course, not unique to us, and has been elaborated in detail in a number of World Bank-sponsored publications (for example Cernea 1985; de Wilde 1967; Lele 1975).

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[13] See note 4. In fact, there has not been a controlled release every September. Since the dam was closed, there were very modest releases in 1987, an uncontrolled release in response to a flood inflow in 1988, and no release at all in 1990. The controlled releases have rarely been greater than the inflow at Makana. September was chosen as the latest possible time for the flood so that waters released would be those already trapped in the reservoir. Hollis (1990a and 1990b) has shown that Flood "A" almost always occurs <u>after</u> the peak flows in the Faleme and Bakoye, and therefore, the release does not "top up" the natural peak on these two tributaries. As presently planned, Flood "A" will normally occur on the low and falling recession limb of the floods in the other tributaries.

4. Floodplain Agriculture: Recession and Irrigation[14]

26. Irrigated agriculture, on large schemes, on middle-sized schemes (*casiers intermédiaires*), and on small village schemes (*périmètres irrigués villageois* or PIVs), has been the major, indeed the only component of production in the Senegal River Valley that has received enduring government and donor attention in the years since independence. The World Bank, UNDP, and the French, Dutch, Italian, and American aid organizations, all have financed irrigation projects in the region. None has consistently met production or revenue objectives, or provided a favorable rate of return on investment, yet irrigation continues to be the centerpiece of development thinking in the area (although some donors have begun to evidence a disenchantment with the high costs and low returns from irrigation). Explanations for earlier failures focus either on technical considerations, implying that the solution is improved technology, or on the "mentality" of farmers who are reluctant to discipline themselves to the requirements of hydraulic agriculture. Little attention has been paid to the fact that, compared to other economic activities in the region--particularly flood-recession farming on the waalo and wage labor migration--a full commitment to irrigation is economically irrational. The comparative data demonstrate that irrigation is not a surer arena for farmer investment than flood-recession farming, though irrigation has provided some granary insurance against failed rainfed and recession harvests during droughts

27. The PDRG (GERSAR/CACG. et al. 1990) calls for an expansion of valley land in irrigation to reach 100,000 ha by 2015. At this point, we ignore the cost of bringing on new perimeters, and ask simply: are the yields from irrigation superior to those from flood-recession farming? All the documents agree that they are, and, indeed, our own field research confirms that yields per unit land actually in production are far
greater on the perimeters than they are in the waalo. Yet when net output is compared on the basis of all factors of production--production outlays and labor,[15] as well as land--the advantage of irrigation becomes questionable; when the amortized costs of developing the perimeters are included, that advantage evaporates.

28. The following analysis compares the performance of two production regimes--recession cultivation and PIVs--from the point of view of farmers in the middle Senegal valley. Later

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[14] We do not wish to imply that there is a single position embraced by all organizations involved in Senegal basin development. While OMVS focuses on the dams' contributions to hydropower, irrigation, navigation, and urban water supplies, the GOS, the World Bank, and others are also considering the impacts on the environment and on the capacity of the region to provide for a left-bank population expected to exceed 1,000,000 by the end of the century and reach 1.5+ million by the year 2015 (GERSAR/CACG. et al. 1990:21, 110).

[15] Our recalculations (from Hollis 1990a) are similar to those in GERSAR/CACG. et al. (1990).

sections examine the broader social costs of limiting the flood. The quantitative analysis of floodplain sorghum production uses data from 43 parcels in Thiemping and Doumga Rindiaw, and that of irrigated rice production uses data from 60 parcels in Doumga Rindiaw and Thially.[16] In examining net returns to all factor inputs, the particular objectives and constraints vis-à-vis agricultural production of both the GOS and river basin households are discussed.

29. Senegal's promotion of irrigated agriculture in the 1970s was largely in response to deteriorating economic conditions in the country. According to USAID's January 1979 Country Development Strategy Statement:

> Senegal lacks the strong mineral resource base to form the foundation for an industrial economy. Its options for the present are limited to an agro-economy. Senegal enjoys a comparative advantage in groundnut production, but stagnating yields, the widely fluctuating world market price for groundnuts, the recent droughts, and the requirement to purchase large quantities of food grains on the open market have convinced policy makers that increased food self-sufficiency is a viable goal for the country and that, if this goal is ever to be reached by the end of the century, considerably more attention must be paid to the rural areas. (USAID 1979: 41)

The GOS turned to the Senegal river basin as the area with the greatest potential in terms of food production and embraced the development of irrigation as the preferred strategy because of its promise to improve land productivity substantially. This expectation is supported by the figures in Tables 1-4. The figures of net output per hectare for the two production regimes in the study villages clearly favor the development of irrigation. Whereas the value of sorghum production per hectare averages 28,717 FCFA/ha (at 100 FCFA/kg of sorghum) and 14,275 FCFA/ha (at 50 FCFA/kg), the equivalent value for rice is 209,313 FCFA/ha (at 136 FCFA/kg of decorticated rice) and 124,934 FCFA/ha (at 96 FCFA/kg).

30. The development of irrigation in the Senegal basin, in fact, did not keep pace with projected plans, nor did the performance of the perimeters meet expectations. The government ended by underwriting much of the costs for the perimeters. As of 1988, the GOS was incurring a net loss of 120 FCFA per kg of rice produced domestically, and the opportunity cost of growing the rice, given low world prices, was of a similar magnitude (Engelhard 1989: 22). The very high cost associated with the development of irrigation, moreover, came at a time when the government faced serious public sector deficits. Thus, the GOS found itself investing

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[16] This section draws on field research conducted in 1988-1990. The authors wish especially to acknowledge here the work of John Magistro, based upriver from Matam at Thiemping; Madiodio Niasse, based downstream from Matam at Doumga Rindiaw; and Monica Sella, who assisted in the analysis of data.

Table 1
Irrigated Cultivation with Rice Valued at 136 FCFA/kg (SAED Market)[a]

Tenure	No. of Parcels	No. of Hectares	Gross output (kg)	Output (kg/ha)	Gross Value FCFA/ha at 136 FCFA/kg	Production Outlays		Net Output per ha at 136 FCFA/kg
						Land Use FCFA/ha at 136 FCFA/kg	Cash Inputs FCFA/ha	
Landowner	25	8.26	21,196	2,566.10	348,990	0	69,409	279,581
Lease	2	0.48	1,600	3,333.33	453,333	10,767	72,533	370,033
Loan	21	4.64	9,348	2,014.66	273,993	11,138	90,925	171,930
Sharecrop	12	2.98	5,261	1,765.44	240,099	112,999	80,236	46,864
TOTAL	60	16.36	37,405	2,286.37	310,946	24,058	77,575	209,313

[a] SAED buys paddy at 85 FCFA/kg. The conversion rate from paddy to decorticated rice is 62.5 percent. Thus the value of husked rice is estimated as 136 FCFA/kg. On the local market, which better reflects real costs than the SAED price, paddy sells for 60 FCFA/kg and husked rice for 96 FCFA/kg.

Table 2
Irrigated Cultivation with Rice Valued at 96 FCFA/kg (Local Market)[a]

Tenure	No. of Parcels	No. of Hectares	Gross output (kg)	Output (kg/ha)	Gross Value FCFA/ha at 96 FCFA/kg	Production Outlays		Net Output per ha at 96 FCFA/kg
						Land Use FCFA/ha at 96 FCFA/kg	Cash Inputs FCFA/ha	
Landowner	25	8.26	21,196	2,566.10	246,346	0	69,409	176,936
Lease	2	0.48	1,600	3,333.33	320,000	7,600	72,533	239,867
Loan	21	4.64	9,348	2,014.66	193,407	7,862	90,925	94,620
Sharecrop	12	2.98	5,261	1,765.44	169,482	79,764	80,236	9,482
TOTAL	60	16.36	37,405	2,286.37	219,491	16,982	77,575	124,934

[a] SAED buys paddy at 85 FCFA/kg. The conversion rate from paddy to decorticated rice is 62.5 percent. Thus the value of husked rice is estimated as 136 FCFA/kg. On the local market, which better reflects real costs than the SAED price, paddy sells for 60 FCFA/kg and husked rice for 96 FCFA/kg.

Table 3
Recession Cultivation with Sorghum Valued at 100 FCFA/kg

Tenure	No. of Parcels	No. of Hectares	Gross output (kg)	Output (kg/ha)	Gross Value FCFA/ha at 100 FCFA/kg	Production Outlay		Net Output per ha at 100 FCFA/kg
						Land Use FCFA/ha at 100 FCFA/kg	Cash Inputs FCFA/ha	
Landowner	17	33.94	12,154	358.10	35,810	0	220	35,590
Lease	1	1.1	330	300.00	30,000	3,000	2,500	24,500
Loan	10	22.15	7,814	352.78	35,278	3,381	142	31,754
Sharecrop	15	40.08	13,497	336.75	33,675	12,268	72	21,335
TOTAL	43	97.27	33,795	347.43	34,743	5,859	167	28,717

Table 4
Recession Cultivation with Sorghum Valued at 50 FCFA/kg

Tenure	No. of Parcels	No. of Hectares	Gross output (kg)	Output (kg/ha)	Gross Value FCFA/ha at 50 FCFA/kg	Production Outlay		Net Output per ha at 50 FCFA/kg
						Land Use FCFA/ha at 50 FCFA/kg	Cash Inputs FCFA/ha	
Landowner	17	33.94	12,154	358.10	17,905	0	220	17,685
Lease	1	1.1	330	300.00	15,000	1,500	2,500	11,000
Loan	10	22.15	7,814	352.78	17,639	1,691	142	15,806
Sharecrop	15	40.08	13,497	336.75	16,838	6,134	72	10,631
TOTAL	43	97.27	33,795	347.43	17,372	2,929	167	14,276

heavily in a capital-intensive agricultural scheme while trying to cope with serious budget constraints.

31. For farmers, irrigation was an attractive production alternative in the early 1970s because of the extended period of low precipitation and the poor or nonexistent floods at that time. Farmers could not meet their household food requirements with rainfed and floodplain cultivation alone. But with the return of normal rainfall in the 1980s, irrigation lost some of its appeal. Farmers' apparent disaffection for irrigated rice -- notwithstanding its impressive per hectare yields relative to those for floodplain sorghum -- stems from the intensive use it makes of household revenues and labor, both scarce and, at the same time, very important resources in the production strategies of river basin households.

32. Protecting food security and minimizing risk are the chief aims of Middle Valley residents. Although household production of cereals is central to achieving this objective, off-farm generated income is increasingly relied upon to complete diets and cover periods of scarcity. Findings from Thiemping and Doumga Rindiaw indicate that expenditures for food items predominate in household budgets. In 1988-89, purchases of food constituted 78 percent of household expenditures in Doumga Rindiaw and 82 percent (6 percent for locally produced items and 76 percent for imported items) in Thiemping. Money for these expenditures came mainly from non-agricultural activities. In Doumga Rindiaw, about 67 percent of household revenues came from migrants' remittances, military and civil service pensions, and petty commerce. In Thiemping, the figure was almost 76 percent, and in Boyenadji Roumde, the third village in our sample,[17] nonagricultural activities contributed about 71 percent to household income. Clearly, household income is a resource vital to maintaining food security. Therefore, from the standpoint of the farmers, it makes good sense to give priority to that agricultural activity that is least intensive in the use of household revenues. The ratio of output to outlays shows that at both sets of prices floodplain sorghum brings higher returns to production expenditures than does irrigated rice production. Tables 5-8 demonstrate that the gross output-to-outlays ratio is much more attractive for waalo sorghum (1 to 5.61 and 1 to 5.77) than for irrigated rice (1 to 2.32 and 1 to 3.06).

33. The allocation of labor time over a diversified set of production activities, both on and off the farm, reflects the spatial and temporal strategies Senegal basin villagers have devised over many years to accommodate the risk inherent in activities that take place under harsh economic and environmental conditions. Floodplain agriculture is particularly suited to such a strategy as it yields relatively high net returns to labor and thereby contributes to household food stocks while freeing labor to engage in other productive activities, some of which, for example migration, are potentially very remunerative. Again, the tables indicate clearly the advantage floodplain sorghum maintains over irrigated rice. While irrigated rice farming requires labor inputs of 501 to 727 days per hectare, floodplain sorghum calls for inputs of 23 to 62 days per hectare. The average output per person day for sorghum in monetary terms is 629 FCFA/day (at 100 FCFA/kg of sorghum) and 313 FCFA/day (at 50 FCFA/kg). For rice, the equivalent figures are 341 FCFA/day (at 136 FCFA/kg of rice) and 203 FCFA/day (at 96 FCFA/kg).

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[17] The PDRG (GERSAR/CACG. et al. 1990:82) dismisses out of hand the possibility that labor availability constrains irrigated production. Noting that population growth exceeds the anticipated rate of bringing on new perimeters, they insist that *"aucun risque de manque de main-d'oeuvre n'est à craindre."* On the other hand, the PDRG also acknowledges (ibid.:118) that flood-recession cultivation is attractive to farmers because it is capital and labor saving: *"les cultures pluviales et les cultures de décrue n'engendrent pas de charges monétaires, ce qui permet de les engager sans risques. En outre, elles sont peu exigeantes en main-d'oeuvre . . . ."*

Table 5
Irrigated Cultivation with Rice Valued at 136 FCFA/kg (SAED Market)

Tenure	No. of Parcels	No. of Hectares	Gross Output (kg/ha)	Net Output per ha at 136 FCFA/kg	Production Outlays FCFA/ha	Ratio of gross Output to Outlays	Labor days/ha	Net Labor Output FCFA/ day
Landowner	25	8.26	2,566.10	279,581	69,409	5.03	611	457
Lease	2	0.48	3,333.33	370,033	83,300	5.44	727	509
Loan	21	4.64	2,014.66	171,930	102,063	2.68	681	252
Sharecrop	12	2.98	1,765.44	46,864	193,235	1.24	501	94
TOTAL	60	16.36	2,286.37	209,313	101,633	3.06	614	341

Table 6
Irrigated Cultivation with Rice Valued at 96 FCFA/kg (Local Market)

Tenure	No. of Parcels	No. of Hectares	Gross Output (kg/ha)	Net Output per ha at 96 FCFA/kg	Production Outlays FCFA/ha	Ratio of gross Output to Outlays	Labor days/ha	Net Labor Output FCFA/day
Landowner	25	8.26	2,566.10	176,936	69,409	3.55	611	289
Lease	2	0.48	3,333.33	239,867	80,133	3.99	727	330
Loan	21	4.64	2,014.66	94,620	98,787	1.96	681	139
Sharecrop	12	2.98	1,765.44	9,482	160,000	1.06	501	19
TOTAL	60	16.36	2,286.37	124,934	94,557	2.32	614	203

Table 7
Recession Cultivation with Sorghum Valued at 100 FCFA/kg

Tenure	No. of Parcels	No. of Hectares	Gross Output (kg/ha)	Net Output per ha at 100 FCFA/kg	Production Outlays FCFA/ha	Ratio of Gross Output to Outlays	Labor days/ha	Net Labor Output FCFA/ day
Landowner	17	33.94	358.10	35,590	220	162.79	51	698
Lease	1	1.1	300.00	24,500	5,500	5.45	62	395
Loan	10	22.15	352.78	31,754	3,523	10.01	23	1,381
Sharecrop	15	40.08	336.75	21,335	12,340	2.73	54	395
TOTAL	43	97.27	347.43	28,717	6,026	5.77	46	624

Table 8
Recession Cultivation with Sorghum Valued at 50 FCFA/kg

Tenure	No. of Parcels	No. of Hectares	Gross Output (kg/ha)	Net Output per ha at 50 FCFA/kg	Production Outlays FCFA/ha	Ratio of Gross Output to Outlays	Labor days/ha	Net Labor Output FCFA/ day
Landowner	17	33.94	358.10	17,685	220	81.40	51	347
Lease	1	1.1	300.00	11,000	4,000	3.75	62	177
Loan	10	22.15	352.78	15,806	1,833	9.62	23	687
Sharecrop	15	40.08	336.75	10,631	6,206	2.71	54	197
TOTAL	43	97.27	347.43	14,275	3,097	5.61	46	310

34. For farmers, then, floodplain agriculture is an extremely important element in the production system both because of its relatively high returns to production expenditures and labor, and because it effectively minimizes risk. For the government, especially with the recent thrust to curb public expenditures, floodplain agiculture may also turn out to be attractive. Indeed, there is reason to believe that productivity levels on the floodplains could be increased substantially without requiring parallel and huge investments in research, infrastructure, and management.

35. The figures in Tables 1 through 8 are useful for comparing the performance of floodplain and irrigated agriculture, and they imply that the returns per unit land favor irrigation, while those for labor and production outlays favor recession cultivation. The net returns to factor inputs presented for rice production, however, may mask the disappointing experience of many farmers on village perimeters. More telling in this regard are the figures in Table 9 (also presented in Figure 1), which shows the distribution of area rice yields for the sample parcels. Although the average returns enabled farmers to recoup the costs of production, they did not always leave sufficient revenues to finance the next season's rice crop, and for many farmers with below-average yields, even production costs could not be met out of returns from the harvest. With rice at 96 FCFA/kg, only landowners and leaseholders netted enough to reinvest in irrigated rice production.

36. Such poor performance on the perimeters originates in their heavy production expenses and labor requirements and in customary land distribution and inheritance practices that gradually undermine producer group cohesiveness. Field research in the three study sites has demonstrated that households often prefer to allocate their limited cash and labor resources elsewhere, either to meet more immediate and pressing needs as in the case of household food purchases, or to achieve higher returns to these factor inputs, for example on the flood plains or from migration. To divert household revenues and labor to other activities or uses, most households are obliged to cut costs on the perimeters and to employ women, children, and young adults on the perimeters. Farmers did not use phosphates in Doumga Rindiaw in 1988 and 1989, and the majority limited the use of urea to 50 kg per 0.30 ha plot, instead of applying the

recommended dose of 100-150 kg. On Bossea I, the perimeter at Doumga Rindiaw, the data reveal that over 80 percent of labor in 1988 was undertaken by those between the ages of 5 and 24, thereby permitting older sons to migrate in search of wage labor. As a result of these practices, yields on the PIVs suffer.

37. In Doumga Rindiaw, the distribution of parcels has tended to accord with traditional practice. Particularly early on, when irrigated land was limited, de facto preference was given to elders, those from noble landholding castes, and men. These did not always coincide with those most in need of parcels and/or equipped with the requisite funds and labor resources to farm them. Moreover, the devolution of agricultural activities to relatives, sharecroppers, women, and children by those not interested or able to cultivate the PIVs has made it difficult to maintain the group cohesion and cooperation so critical to the proper functioning of perimeters.

38. Similarly, adherence to customary land inheritance procedures has meant that parcels of deceased plot holders are passed on to relatives, some of whom may be women, children, or migrants absent from the village. This seriously disrupts the unity of producer groups, as both

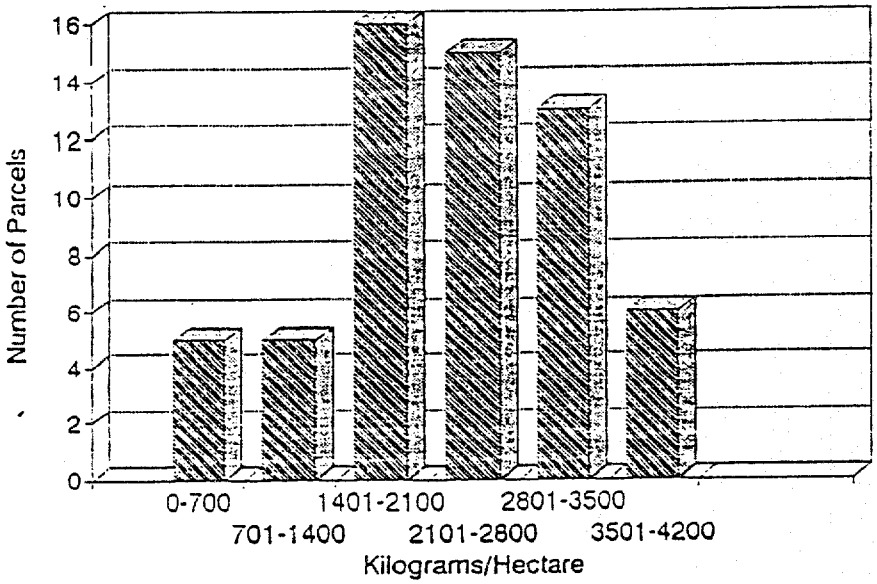
Distribution of Yields from Irrigated Rice Perimeters

Table 9

Range (kg/ha)	No. of Parcels
0 - 700	5
701 - 1400	5
1401 - 2100	16
2101 - 2800	15
2801 - 3500	13
3501 - 4200	6

Mean = 2,210
Std. Dev. = 926.38

Figure 1



women and children are excluded from the management meetings and absentee holders can contribute little to the day-to-day functioning of the perimeters.

39. It should also be noted that because households consume the bulk of what they produce, the funds for irrigated production do not come directly from the sale of rice. Thus, at the beginning of each rice season farmers must tap other revenue sources. Some households are fortunate in that they have a relatively stable source of income from migrants' remittances. Other households, however, must rely on more precarious sources, such as loans or sale of

livestock. In either case, because revenues are not always sufficient to cover the full costs of rice production, farmers must cut costs. Consequently, harvests are poor and the repayment of loans and growth of herds are made difficult. All too often, farmers end by abandoning their parcels, as in fact occurred in Doumga Rindiaw in 1988.

40. It has been claimed by advocates of rapidly expanded irrigation that the labor intensivity of the perimeters retards the rural-to-urban exodus. To date, this has not been the case. The returns from labor migration exceed those from local production activities for so many people that labor is often scarce in the Middle Valley. This scarcity is less critical in rainfed and in flood-recession agriculture than on the perimeters because the former are far less labor intensive. The paradox of the PIVs is that effective production on them requires both a good deal of liquid capital and a large and stable labor supply, but the relatively poor returns to both encourage labor to seek remunerative employment elsewhere.

41. The solution to these problems lies not in the abandonment of irrigation, but in placing it in proper perspective as one, and not necessarily the most important one, of a number of elements in a complex production system. The overall productivity of this system and returns to labor can be enhanced by the appropriate management of the Manantali Dam. But for people to make the necessary investments in sustainable agricultural production, they must be assured of continued and secure access to critical inputs, notably land, both irrigated and flood recession, and water.

5. Intensification on the Floodplain

42. A recurrent problem with irrigated production in the Senegal River Valley is its failure sustainably to achieve satisfactory rates of intensification. According to the PDRG (GERSAR/CACG. et al. 1990:96), the current annual rate of intensification for both PIVs and *aménagements sophistiqués* is only 0.83: that is, of the total surface developed in perimeters, only 83 percent is farmed in a given year.[18] The PDRG hopes to bring that figure up to 160 percent after six years of operation on a new or rehabilitated perimeter. Past performance suggests that such figures may be difficult both to attain and to sustain.

43. But such performance is already achieved on the floodplain, and without direct environmental, infrastructural, or external management cost. According to SRBMA studies, almost 100 percent of the cultivable plain that is flooded in any given year is in fact farmed. In November-December, after flood waters have receded, fields (waalo and falo) are planted. The harvest is three months later, in February-March. In addition, these recession fields also contribute to a "crop" of fish, and a "crop" of livestock and livestock produce. The calendric

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18 Production figures refer to decorticated rice and not to paddy, and the data are for the 1988 season in Doumga Rindiaw and the 1989 season in Thially. Sorghum figures are for 1989. Two sets of prices for sorghum and rice are utilized to account for the varying prices farmers received depending on when grain was sold and to whom. Net output figures are calculated by subtracting land use and cash input costs from the value of gross output/hectare. No labor costs are imputed. This approach is based on actual prices paid and costs incurred, and therefore leaves less room for research bias than do conventional calculations that impute values to unpaid inputs. Returns to capital are calculated by dividing gross output value/hectare by production outlays/hectare. Net labor output is calculated by dividing net output/hectare by the number of person-days/hectare.

succession of floodplain exploitation--fish, grain, livestock--generates a rate of intensification that is not even imagined on the perimeters.

44. Let us examine each of these in turn, and attempt a rough calibration of their productive values.

5.1 Fisheries

45. The interaction between rivers and their lateral floodplains is critical for the reproduction of freshwater fish. That interaction is characterized by periodic flooding in which the main river channel and floodplain "side arms, oxbow lakes, marshes, swamps, pools, and the network of tributary streams" merge, and then separate as the flood waters withdraw (Ward and Stanford 1989:59-60). During the flood phase, nutrients on the plain surface dissolve in the water, and provide nourishment for freshly hatched and small fish. When the flooding is stopped or limited by storage reservoirs upstream from dams, there is invariably a resultant decline in the numbers of fish downstream. "In a 145-km reach of the Missouri river, flow regulation that resulted in a 67 percent loss of inundated floodplain area, was accompanied by a greater than 80 percent decrease in fish catch" (ibid.:60, citing Whitely and Campbell 1974).

46. The gentle slope of the middle Senegal valley--3 cm/km--facilitates the interaction between the river and the lateral plains, and the reproduction of most species of freshwater fish is adapted to the flood:

> *. . . la Vallée du fleuve Sénégal était une importante zone de reproduction de poissons d'eau douce (Tilapia, Silures). . . . Les inondations sont d'une grand importance pour le cycle vital de la plupart des poissons et des crustacés dans la vallée. Après l'inondation les plaines et la dépression inondées forment un habitat favorables à la reproduction et à la croissance pour les organismes aquatiques. Grâce à cela la biomasse de poissons et de crustacés augmente au cours de la période d'inondation.*
>
> *Aucune grande inondation ne s'est pas produite ces dernières décennies à cause de la grande sécheresse, et la pêche a disparu presque totalement de la vallée* (van Lavieren et van Wetten 1990:23).

47. While there is a good deal of recognition of the negative effects of a marked reduction in the annual flood on the reproduction of downstream fish populations, there has been little incorporation of that understanding in the cost-benefit calculations of the flood/no-flood scenarios. Recall Sir Alexander Gibb & Partners' statement that the costs of power forgone exceed the returns from flood-recession agriculture, estimated by Gibb as 34,000 FCFA/ha and by us as an average in 1988-1989 of between 14,275 and 28,717 FCFA/ha. What happens to that figure if returns from fishing are added to those from recession farming?

48. According to Dames & Moore (1989:6-31/2), termination of the flood "will lead to a loss of approximately 500,000 ha of floodplains in the Middle and Lower Valley. . . ." Reizer

(1988) sees the loss at 400,000 ha on which fish reproduction depends. Gannett Fleming (1978) noted that there is an average fish production of 70 kg/ha/year. If this is true, then the per hectare value of fish (at 1990 prices of 500 FCFA/kg) is 35,000 FCFA, which added to Gibb's estimated returns from flood-recession farming yield 69,000 FCFA/ha. For the area as a whole, using Reizer's more conservative estimates, these figures indicate an annual yield of 28,000 metric tons. According to the USAID-sponsored "Senegal Natural Resources Management Assessment" (Grosenick et al. 1990b:110), in the pre-dam period "the Senegal river fisheryproduced 28,000 tons per year (some experts say 30,000 tons) and supported 10,000 full-time fishermen. In addition, it supported many part-time fishermen, providing supplemental protein for their families." This same document notes that the dams--appraised as contributing to insulating the region from drought--will cause an "artificial permanent drought" (ibid.).

49. Reizer (1988:264-267), using data from 1966-1968, years of "vaches grasses" when fish sold for 25-50 FCFA/kg, and from 1970-1972, years of "vaches maigres" when the price was 50-100 FCFA/kg, approximately one-tenth of current values, calculates the average annual income for fishers from both sales and autoconsumption as follows:

Table 10 Fishing Revenues by Region

Region	No. of Fishers	Total Revenue (FCFA)	Individual Revenue (FCFA)
Lower Delta	1,700	160,000,000	94,000
Upper Delta	2,200	260,000,000	120,000
Valley	6,200	560,000,000	90,000
Guiers	300	25,000,000	83,000

50. It is not the presence of the Manantali dam per se that will lead to such a drastic decline in downstream fish (in the way that North American dams, for example, have interfered with the upstream spawning migrations of Atlantic and Pacific salmon). Fish will disappear because the floodplains will no longer be accessible to them except in a few years. According to Robin Welcomme (1979:256), freshwater fisheries expert at FAO, managing Manantali with a permanent artificial flood will provide an environment for normal reproduction:

> The biology and ecology of the majority of fishes inhabiting floodplain rivers shows them to be extremely sensitive to any restriction of the floodplain and any modification of the flood cycle. . . . [An] important feature is the provision of sufficient water to produce

a flood which will have the characteristics needed for the reproduction of fish species. This is a question of both quantity and timing which have to be based on an adequate knowledge of the biology of the fish species. Controlled releases of water have been tried in some systems, and on the Pongola river a series of experimental floods have successfully filled the lagoons and induced breeding. . . .

51. Citing the work of Davies (1979), Ward and Stanford (1989:60) note that "many flood-dependent fish species resorb gonadal products in the absence of an annual flood and many will not spawn unless terrestrial vegetation is inundated. However, by managing releases from the dam to accommodate spawning migrations and terrestrial-aquatic interactions, it may be possible to sustain a fishery in the regulated riverine-floodplain system."

52. Reizer (1988:345, emphasis in the original), who has carried out ichthyological studies in the Senegal basin for more than 25 years, emphasizes the importance of the artificial flood for maintaining the productivity of the fishery:

> ***La création de la crue artificielle minimale en août est, pour certaines espèces au moins, une condition indispensable à leur survie. La potentialité de reproduction sera affectée*** par la diminution de la surface de frayères disponsibles en année de forte hydraulicité, mais aussi par une augmentation au moins correspondante en année de faible hydraulicité. Sous la condition donc qu'une crue artificielle minimale (c'est-à-dire submergeant les seuils) soit créée en août, le bilan final sera positif.

53. SRBMA's senior advisor on fisheries, Ian Dunn (1990), points out that the shallow nutrient-rich waters on the floodplain support a seasonal fishery with high production and consequently a high potential yield. The seasonality of the fishing is naturally controlled by problems of movement of the fishermen over the floodplain during the high water period. This restriction in fishing activity allows the young fish to reach a larger size before they are at risk of capture. The floodplain is of central importance, says Dunn, since only a small fraction of the total fish population derives from basic production of the main river channel itself. It is therefore theoretically possible to increase the overall offtake by controlling the discharge from the flood areas by means of sluices. In this way, the shallow water areas are maintained for longer periods with more fish growth.

54. Although the drought and overfishing led to a depletion of fish stocks in the valley, we anticipate that the artificial flood will contribute to a near restoration of predrought populations on the inundated portions of the floodplain, since the rapidity with which fish mature in tropical waters usually leads to a fast recovery. Under normal conditions, the density of the population of adult spawners has small effect on the success of future recruitment until the number falls below a critical low level. The requirement to maintain target levels of electricity means that the lowest flows in the main channel will be 20 to 30 times greater than their historical minima. Such flows will provide a much improved refuge for the residual fish stocks at the end of each flood season. That is, increased dry season river flows will support larger stocks of fish, and the regular fall flooding will ensure their continued reproduction on the floodplain. Large-scale

irrigation could, of course, adversely affect this process of reproduction, especially if the waters become polluted by agricultural chemicals--herbicides, insecticides--running off the perimeters.

5.2 Livestock and Pasture

55. The floodplains of the middle Senegal River valley constitute a critical dry season source of graze and browse for large herds of ruminant livestock in an area of sahelian rainfall regimes.[19] In June, with the beginning of the rainy season, most of the animals are herded onto the sandy upland (jeeri) regions, extending from the valley to the Ferlo, where rains and range fires encourage fresh grass flushes and where surface waters, pools formed by rainfall, and boreholes ease the often arduous task of watering stock from dug wells. As the rainy season draws to a close, in September-October, the animals move to the thin belt of harvested millet fields, browsing the stubble and manuring the land. This, indeed, is the pattern of transhumant herding throughout the sahel, and by the beginning of the new year both the quantity and quality of forage declines, and animals begin to draw down their own fat, sometimes losing up to 40 percent of their body weight before the summer rains return.

56. But the floodplains of the Senegal valley provide a third element, enabling the herds not only to survive but actually to prosper during much of the dry season. Following the *waalo* harvests in February-March, animals are moved onto the plains, where they browse the sorghum and maize stubble, the *Acacia nilotica*, and other trees and shrubs, and where they graze palatable grasses that colonize uncultivated areas of the plain. Although their coverage is limited to the *upper* valley region, Dames & Moore (1989:6-12/13) provide a description of forage that is suggestive for other parts of the valley:

> Floodplain ranges are important in the project area and are found along the Senegal River between Gande and Ambidedi, and along the Faleme and Karakoro Rivers. Because these environments are less risky than those further from the river there are high population densities of people and livestock, resulting in degradation of this resource in some areas. These areas naturally support perennial grasses such as *Andropogon pseudopricus* and *Schoenfeldia gracilia*, and important tree species such as *Acacia seyal, A. nilotica, Combretum glutinosum*, and *Boscia senegalensis*. Range degradation decreases with distance from the river indicating the importance of water to livestock production. . . . In a well-managed state floodplain range carrying capacities between 1.5 and 5 TLU/ha are feasible. . . .

57. L. Diarra (1988:17), who examined grass changes in the inner delta of the Niger in Mali, concluded:

> Inadequate rainfall during 1980-1986, *coupled with frequent flood deficits*, considerably changed the plant composition and biomass production on vetiveria and eragrostis

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[19] Boyenadji Roumde, downstream from Matam, was studied by Christophe Nuttall.

grasslands in the Niger floodplain. . . . Thousands of hectares formerly under perennial cover were rendered unproductive by unpalatable annual grass species, *Leptadenia hastata* bushes and termite mounds. The stocking capacity of the grasslands decreased drastically as a result of the diminished grazing reserves (emphasis added).

58. Van Lavieren and van Wetten (1990:10), citing South Dakota State University (1982), state that the alluvial plains constitute excellent pasture, capable of supporting 0.8-1.07 Tropical Livestock Units/ha/yr at the beginning of the dry season and having an average year-round carrying capacity of 0.41-0.54 TLU/ha.[20] This is to be compared with carrying capacities of 0.23 TLU/ha/yr on sudano-sahelian pastures and of 0.11 to 0.05 TLU/ha/yr on sahelian pastures.

59. This allows for the following worst-case calculation. Assuming a total cessation of the flood,[21] the carrying capacity of the lateral plains would be reduced from ca. 0.5 to ca. 0.15 TLU/ha/yr (a generous estimate for rainfed sahelian pastures with clay soils), a drop of approximately 70 percent. (On 400,000 hectares of floodplain, this results in a diminution of livestock from 200,000 to 60,000, or a decline of 0.35 TLU/ha.) Assuming 200 FCFA per kilogram of liveweight (a conservative figure to capture the value of meat, dairy produce, hides, manure,[22] and social functions), this converts to a per hectare loss of 17,500 FCFA. Putting

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[20] The PDRG notes a variety of rates of intensification, from a high of 88 percent (p. 86) to a low--*"le taux actuel de mise en valeur des aménagements"*--of 70-80 percent. SAED's figures for intensification rates on rice perimeters in Matam are much lower. In 1978, of 1,095 hectares prepared for irrigation, only 299 or 27 percent were actually cultivated. In 1979, 42 percent were cultivated; in 1980, 64 percent (a figure never again attained); in 1981, 59 percent; 1982, 43 percent; 1983, 44 percent; 1984, 44 percent; 1985, 40 percent; and in 1986, of 4,997 hectares prepared for irrigation, only 1,740 hectares or 35 percent were actually in paddy.

[21] *"Dans les cuvettes de plaine d'inondation des graminées pérennes comme* Oryza longistemmata, Echinochloa stagnina *et* Vossia cuspidata *constituent une ressource alimentaire très importante pour le bétail. Ces cuvettes, ressemblant à des 'bourgoutières', sont aussi d'une grande importance pour les poissons et pour l'avifaune"* (van Lavieren et van Wetten 1990:10).

[22] The concept of "carrying capacity" (CC) is controversial, and estimates for a particular rangeland vary widely because of (often) unstated assumptions about what it entails. De Leeuw and Tothill (1990:2, following FAO 1988) define it "as the maximum possible stocking of herbivores that rangeland can support on a sustainable basis. . . . Estimates of CC are commonly based on the assumption that livestock require a daily dry matter (DM) intake equivalent to 2.5% to 3.0% of their body weight. Thus, for a TLU of 250 kg of weight, 2.3 to 2.7 t of dry feed per annum is needed. To calculate an appropriate balance between forage supply and demand three multipliers are additionally required to adjust for: (1) grazing efficiency (the proportion of total herbage livestock can harvest; (2) forage loss (due to trampling, fouling, decomposition, etc.); (3) proper use, which is the maximum proportion of forage that can be grazed without causing rangeland deterioration. . . . Although each of these

it positively, each hectare of inundated floodplain used for grazing contributes a value of 17,500 FCFA to its gross productivity.

60. The average annual value of output per hectare of inundated floodplain from these three forms of production is thus 14,275 to 28,717 FCFA for recession cultivation of sorghum, 35,000 FCFA for fish, and 17,500 FCFA for livestock, totaling 66,775 to 81,200 FCFA.

6. Environmental Effects

6.1 Forestry

61. Trees are exceptionally important to the environment, especially in resource-poor countries such as Senegal, and, given global climate concerns, also important worldwide. Northern industrial countries, whose consumption of fossil fuels is the major cause of rising CO_2 levels, should seek to protect Third World woodlands from destruction. The Senegal River Valley was a heavily wooded region for so modest a rainfall profile, and the principal element in these woodlands is the *Acacia nilotica ("gonakié")*. Deforestation has had two causes: overcutting, especially for fuelwood and charcoal making, and drought.

62. After successive years of deficient rainfall and low river levels that led to a decline in the soil humidity necessary to sustain the gonakie forests,[23] the tree has proved to be reasonably hardy, and the floods of 1986, 1988, and 1989 have led to a good deal of natural regeneration. A permanent termination of the Bafing flood at Manantali, however, would lead to rapid deforestation. "If seasonal inundation is no longer available then there will be no *Acacia nilotica*" (Grosenick et al. 1990b:83). In addition to being the major source of fuelwood in the region, the tree supplies vast quantities of charcoal that is exported to urban areas like Dakar despite regulations prohibiting it. Sixty-three percent of Senegal's primary energy is provided by wood, and in rural areas that figure rises to 99 percent (ibid.:91). According to GERSAR/CACG. et al. (1989:22), fuelwood requirements for rural areas of Matam Department exceed production by 110,660 m^3/year. (The study optimistically projects a reduction in demand and an increase in production such that the annual shortfall is 66,161 m^3 in the year 2000 and only 1,444 m^3 by 2015. The data on which so optimistic a scenario is based are hardly persuasive.) The tree's dense water-and-termite-resistant wood is used in construction, the pods

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three factors need consideration, most estimates have used a single multiplier that combines adjustments for all." For a review of the controversy about the meaning and utility of "carrying capacity" as a guide for action, see Horowitz and Little (1987; see also Barrett 1989).

[23] The uncontrolled flows from the Bakoye and Faleme tributaries will continue, and these are sometimes sufficient in themselves to constitute a good flood. During wet periods, such as 1954-1964, the aggregate flows from these unregulated tributaries would have exceeded artificial Flood "A" in almost every year. In dry periods their flows are too low. The drought since 1972 has reduced the contribution of both tributaries to the combined flow at Bakel.

are browsed by livestock,[24] and both the pods and the bark contain tannin used in curing hides.

63. The major recent environmental analysis of the river basin estimates the annual productivity of a well-developed gonakie stand at 8.2 steres/hectare (van Lavieren et van Wetten 1990:24). The tree also contributes to soil stabilization on the floodplain. According to one specialist (Gritzner 1988:82),

> The significance of the loss of riverine forests has not been fully appreciated in the Sahel. Field observations along the Senegal River made in 1979 and 1980 indicate that rates of erosion along the river have dramatically increased as the flood-plain has been stripped of its protective vegetative cover, particularly the extensive stands of *Acacia nilotica* so important as a source of charcoal. . . . The rates of erosion on the flood-plains of the Senegal will almost certainly result in levels of sedimentation and salinization far in excess of those currently anticipated by agencies involved in the further development of the Senegal River Basin.[25]

64. Finally, the trees that are made possible by the periodic floods also steady the flow of flood water down the floodplain.[26]

65. Even if the dam is managed to allow for modest floods, or the flows from the uncontrolled Faleme and Bakoye rivers prove sufficient to inundate much of the plain in many years, the *A. nilotica* forests may still be at risk, because the upland areas they occupy are likely

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[24] We do not have clear understandings of the fertility value of manure on Senegalese cultivated fields, although for one area in Mali, "Wilson (1984) estimates increased yields of three to five times over unmanured, periodically fallowed fields. . . ." (Grosenick et al. 1990:115). The nitrogen content of the manure is highest when animals have browsed relatively fresh high-quality forage, such as still-green sorghum stalks on *waalo* fields that have just been harvested. This manuring is the only external fertilization these fields receive. Livestock--both transhumant and locally owned agropastoral herds--probably contribute importantly to the productivity of flood-recession cultivation, although the magnitude needs to be documented with empirical study.

The herds also contribute to the productivity of floodplain fisheries. "The dung dropped by the cattle, estimated at about 500 kg $hm^{-2}yr^{-1}$ . . . converts much of the dry-season primary production into readily dissolved organic and mineral nutrients which have an important impact on the chemistry of the floodwaters . . . " (Welcomme 1979:238).

[25] "*. . . la régénération naturelle des Gonakiés exige une inondation temporaire de graines*" (van Lavieren and van Wetten 1987?:43).

[26] ". . . in arid regions of India, [*A. nilotica* constitutes] the chief diet for goats and sheep. Pods contain as much as 15 percent crude protein" (NAS 1980:98).

to be flooded only in peak years, and since, in the absence of contrary management strategy, the dam will be operated to reduce the peaks (as well as the troughs), flood waters may reach these higher grounds much more rarely than they do at present. We do not, of course, know the extent to which embanked irrigation perimeters will raise flood levels, and whether this will mitigate the effect of lower overall river flows on woodland regeneration.

6.2 Domestic Water

66. We have discussed the effects of ending the flood on recession agriculture, fisheries, livestock, and wood supplies. At this point we turn to the question of domestic water supplies: if the flood is reduced, how will villagers obtain water for domestic use?

67. Our finding (Hollis 1990a and 1990b) that the shallow aquifer is recharged primarily by infiltration of flood waters is seconded by GERSAR/CACG. et al. (1988:14) in the Matam master plan, and by van Lavieren (1987?:38).[27] This surface aquifer is exploited by villages throughout the floodplain with shallow wells to draw water for human and animal consumption and, especially among village women, for hand irrigating garden crops. The reduced flood recharge may lead to a drying up of these wells, and force users either to travel considerable distances to draw water directly from the river and marigots, with attendant health and sanitation risks, or to have boreholes drilled to tap the deep aquifer. To provide several hundred thousand middle valley residents with new, safe, and reliable sources of potable water will be an extraordinarily costly undertaking, and one that has not been adequately considered in the documentation for the region.

68. It is difficult to specify the costs of drilling boreholes without hard information on depth.[28] In 1983-1988, one rural water supply project in Senegal (Horsfield 1988), funded by

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[27] Although biodiversity is not a topic that SRBMA has been able itself to investigate, there is evidence that the *A. nilotica* forests contribute to an impressive range of wildlife in the region: *"L'importance des peuplements de gonakiés comme habitat recherché par plusieurs espèces de faune, mammifères aussi bien qu'oiseaux, est indéniable. La majorité des espèces de mammifères qui survivent dans la région du fleuve y trouvent abri et nourriture. Plusieurs espèces d'oiseaux font leurs nids dans les arbres. Le déclin des surfaces de peuplements de gonakiés a donc également un impact négatif sur la faune de la région"* (van Lavieren and van Wetten 1990:42). One might speculate that if the reduced flood leads to a reduction in natural floodplain vegetation, the remaining birds will have no recourse but to attack the standing grain, increasing preharvest losses. Gritzner (1988:71) points out that large quantities of rice on major Senegal Valley irrigation schemes were consumed by "black-faced diochs, long-tailed glossy starlings..., knob-billed geese, and other granivorous birds, as well as insects and rodents..."

[28] As argued by Hollis (1990b), the incorporation of data from the upper catchment in Guinea is critical for effective management of the Senegal River Basin. It is important, for example, to understand the rate and downstream effects of deforestation in the Guinea Highlands

British Overseas Development Administration, drilled and equipped 18 boreholes, providing safe and reliable potable water for approximately 85,000 people, at a total cost of £6,107,000, or £340,000 per borehole. Each equipped borehole served approximately 4,700 people. If we estimate conservatively the need to provide new potable water supplies to 300,000 left bank villagers, 64 wells would have to be drilled at a total estimated cost of £19,200,000 (or approximately 9,590,400,000 FCFA). If these 300,000 villagers occupy 100,000 hectares of floodplain, the per hectare cost of providing safe, reliable drinking water, over the useful life of the well, is approximately 96,000 FCFA plus annual maintenance and operating costs.

69. Assuming a useful borehole life of 30 years, the simple average annual per hectare cost would be 3,200 FCFA.

70. Yet even tapping the deep aquifer may not be an enduring solution if, as GERSAR/CACG. et al. (1988:14) indicate, both the shallow and the deep aquifers are recharged by the flood: "*L'alimentation de tous ces aquifères se fait en général plutôt par les eaux d'inondation que par les pluies.*"[29]

71. In conclusion, it appears that if the Bafing flood is terminated, new and expensive means of provisioning residents of both the Senegal valley and broad adjacent areas of Senegal and Mauritania domestic water supplies will have to be found.

7. Other Costs

72. It is important not to fixate on the quantities presented in the above analysis, but to consider the implications of their direction. The cumulative weight of SRBMA's findings tips the cost-benefit analysis away from a decision to terminate the artificial flood toward a management policy that seeks to optimize the benefits of water control for the broadest range of constituents: electricity consumers, small-scale agricultural producers, irrigation farmers, herders, and fishers. It shifts the decision away from one that would increase the vulnerability

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and the Fouta Djallon. "There is an abrupt rise and fall of flood peaks in the absence of the buffering effects of a wooded catchment" (Ward and Stanford 1989:60).

[29] It was hoped that the OMVS Groundwater Monitoring Project, which operated from January 1985 through June 1990 with a hydrogeological observation network of some 500 village wells and 569 piezometers located in the Senegal Valley west of Bakel, would have provided firm evidence on how these aquifers are recharged. Although much raw data was collected, according to the project's final report, time did not allow for analyses other than for the delta and Manantali regions. It goes on to note that a topic remaining to be studied is "the natural recharge of alluvial aquifers and deep aquifers underlying the Senegal River valley" (OMVS/ISTI 1990:1). Since the data and an appropriate computer program are available at OMVS in St. Louis, it is to be hoped that such a study will be undertaken in the near future.

of the downstream environment to one that predicates economic development on a sound and sustainable environmental base. And it raises substantial questions about the desirability of pursuing a rapid expansion of irrigated perimeters at the expense of flood-recession cultivation.

73. We could rest the argument here. But there are other relevant issues that at least should be considered, although only one of them lends itself to a quantitative analysis.

7.1 Social and Political

74. We have outlined some of the economic costs of an abrupt simplification of the complex and diversified production system that currently exists on the lateral floodplains of the middle Senegal valley. The progressive domination of irrigation over all other productive activities--recession cultivation, herding, fishing, forestry--will generate not only economic costs that exceed the anticipated gains, but also great social and political costs,[30] as ethnic and social segments that now have *complementary* access to resources (in the succession of fishing, farming, and herding), will find themselves in intense *competition* for a shrinking resource pool. Note that while the expansion of irrigation is very slow, currently at a net increase of less than 2000 ha/year on the left bank, the impacts of a cessation of the flood on all other components of the production system are profound and immediate.

75. In 1989 we witnessed the tragic consequences of such a competition along the right bank of the river, as Mauritanian elites in anticipation of a simplification of the production system acted violently to assume control over strategic resources, expropriate lands and forcibly expel local peoples (Horowitz 1989). In retrospect, these events should have been predicted. Although Senegal, unlike its neighbor to the north, is without a tradition of ideological apartheid, we are not at all sanguine that potentially violent conflict over land will not occur along the left bank too.

76. There will be a perhaps less spectacular but also profound impact of a reduction of the flood, particularly a suppression of the peak flood, on social and economic equity among the riverine population. The middle Senegal valley, homeland of the Haal Pulaar, is a highly stratified area, in which status is reflected in differential access to land. The dominant landowners control the best *waalo* lands, that is, those that most often receive a useful flood. Others are more likely to have holdings in the higher reaches of the basins that are flooded less frequently because they require greater river flows. If the peak flows are cut off, the the lands of farmers who are not
members of landholding castes will become flooded even less often than they are now, which will adversely affect their ability to produce even for their own consumption. The dam may thus

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[30] GERSAR/CACG. et al. (1990:69) note the cost (in milliards FCFA) of equipping villages in the Podor area with boreholes is 4.5, in Matam 5.0, and Bakel 1.3. Their total is 11.8×10^9 FCFA.

intensify the existing stratification by worsening the economic position of those who do not have assured access to the better farmlands.

77. Equity relating to age and gender must also be considered in the anticipated shift from a diversified production system to one focused more exclusively on irrigation. As we have pointed out above, the capital costs of irrigation and the relatively poor returns from labor on irrigated fields encourage a heavy labor migration from the valley. This migration attracts young adult men to seek employment in urban areas of Senegal and overseas, and leaves behind children, the elderly, and women, who must then assume more of the burden of productive activity. Since irrigation is the most labor-demanding of all agricultural work, and since women, especially, will still have all their other domestic obligations, the leisure time available to them, and to children and old people, will become increasingly scarce. In addition, women have been discriminated against in the allocation of parcels on the perimeters. Moreover, older women may find that one of their off-farm employment opportunities, marketing locally caught fish in the villages, disappears as the reduced flood lowers fish yields.

78. A flood that is too small will lead not only to a progressive decline in household income and in the capacity of the environment to produce useful crops, but also to an accelerated exodus from the area. Europe has already shown a disinclination to welcome laborers from the Third World whose positions are increasingly filled by migrants from southern, central, and eastern Europe. After the integration of the European Economic Community in 1992, Europe may be effectively closed to Africans. Soninke and Pulaar men will find Dakar the almost exclusive target destination of their escape from the dam-driven, economically and environmentally degraded valley. How will Dakar receive them? What are the possibilities for expanding urban employment? What will be the effects of this migration on the urban quality of life, on housing, on crime, on violence? Are these not also "costs" to be factored into the Gibb equation?

79. Finally, there are likely to be adverse effects on off-farm employment in the region's small towns and secondary cities if the magnitude and duration of the flood proves inadequate to sustain a vigorous on-farm economy. In addition to housing government employees--whose number may be markedly reduced as part of the structural adjustment program--
these small urban centers provide employment to commercial and artisanal workers, whose livelihoods depend in large part on serving the needs of farmers, fishers, and herders.

7.2 Electricity *noch einmal:* Sir Alexander Gibb & Partners[31]

80. Management strategies for the Manantali Dam have been informed largely by the hydrological calculations of Sir Alexander Gibb & Partners. Using both their data and their estimates of the volume of water needed to generate a flood allowing cultivation of 50,000 ha

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[31] The effects on potable water supplies of terminating the Senegal flood may be felt first in the delta region, for example, in the city of St. Louis, where the shallow aquifer is already saline and the "sweetness" of the deep aquifer may depend on pressure from the flood.

("Hydrogram A"), we asked the question: in how many years from 1904-1984 (the period included in Gibb's simulations) would there have been both enough water to allow a 50,000 ha flood *and* a guaranteed 86 megawatts of installed power? This question may be segmented into separate parts:

(1) In how many of these years would a 50,000+ ha flood have occurred with no additional release from Manantali?

Gibb (1987) presents the results of a simulation designed to follow water flows and reservoir levels while guaranteeing a minimum output of 86 megawatts. In 62 of the 81 years (76.5 percent), the average monthly flow at Bakel in August, September, or October is equal to or greater than 7.5×10^9 m^3, the volume required for a Hydrogram A flood. Therefore, in only 19 of 81 years (23.5 percent) would a controlled release have been necessary (although such a release might have helped flood a still larger area of the plain).

(2) How much release would have been required in those deficit years to bring the flood to a minimum 50,000 ha, and what would the effect of that release have been on hydropower generation?

The 19 deficit years are:

1907**	1942	1978
1913	1944	1979
1914	1972	1980
1921**	1973	1981
1940	1976	1982
1941*	1977	1983
		1984

In three of those years, just an additional 100 m^3/sec (**) or 200 m^3/sec (*) in any one month of the quarter would have created the target flood.[32]

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[32] In this report we have not considered the health and nutritional costs of the changed water regime. It is clear that across tropical Africa, the extension of irrigation has led to increased frequency of malaria and schistosomiasis--*"les casiers d'agriculture irriguée constituent un habitat idéal et permanent pour la prolifération des moustiques"* (van Lavieren 1987?:12)--and possibly to impoverished nutrition, especially of infants and pregnant and nursing mothers if the schemes have a negative impact on the food supply. It is important not only that the relationship between disease vectors and river basin development be understood, but that effective and timely mitigative actions be taken. Unfortunately, states and donors who readily invest in the infrastructure of irrigation are much less enthusiastic about equipping the schemes with sanitary facilities or assuring that monocropping and heavy reliance on agricultural chemicals do not adversely affect nutrition and health.

81. Although the simulated peaks for these 19 deficit years were not high enough to assure a 50,000 cultivated hectare flood, the monthly data from the simulation shows that in many of these years the reservoir would have contained sufficient water to reach the requisite flow. In fact, analysis of the 86 megawatt simulation shows that, except for 1913, a year infamous in West African history for the severity of its drought, *for every other year from 1904 to 1977 the reservoir would have been filled to capacity before the end of October, and waters would have poured through the spillways of the dam through most of October and November.* Every drop spilled in excess of the amount required to generate 86 megawatts throughout the year could have, if required, been directed through a controlled release to augment the peak monthly flow during the critical flood period. In only 8 of 81 simulated years (9.9 percent), did the reservoir not reach its full capacity: 1913, 1977, 1979-1984.

82. Gibb asks what is the amount of power that could have been produced 100 percent of the time had the reservoir been tapped to bring river flows to a 50,000 ha flood, and concluded that this condition would assure only 34 megawatts, an unacceptably low level. They therefore conclude that there is an irreconcilable conflict involved in guaranteeing both a flood and the desired power output of 86 megawatts.

83. This conclusion, uncritically repeated by Dames & Moore (1989), masks the fact that *in most of the 81 years 86+ megawatts would have been generated with no difficulty.* The disastrous drop to 34 megawatts is a consequence of attempting a flood in 1983-1984, the lowest rainfall years on record! In fact, another Gibb simulation (Phase 1 - Volume 1B, pp. B/10-B/13) shows that in 95.2 percent of the time (925 months out of 972), Manantali would have generated a minimum output of 74+ megawatts along with an annual controlled flood of 50,000 ha. Power dropped below that level in only 47 months (4.8 percent), and 37 of these months occurred during the record drought of 1980-1984.

84. The most recent version of the PDRG (GERSAR/CACG. et al. 1990:57) acknowledges the untenability of requiring a 100 percent guaranteed output in all years:

> *la forte discordance introduite dans la série hydrologique de référence (1904-1984) par les récentes années sèches fait qu'un critère de réussite fixé à 100 percent pour l'obtention d'un objectif (débit régularisé, crue artificielle ou production d'énergie hydro-électrique) conduirait à* pénaliser *l'ensemble des projets. Pour cette raison, les objectifs ont été calés sur un taux de garantie de 95 percent (5 années sur 100 d'échec). Ce préalable fixé, l'utilisation du stock de Manantali se pose en termes de* concurrence *comme déjà décrit dans ce rapport.*
>
> *<u>Prioritairement</u>:*
>
> *- entre la crue artificielle et la production d'énergie*
> *- entre la crue artificielle et l'irrigation*

Secondairement:

- entre la production hydro-électrique et l'irrigation, de façon temporaire et lorsque l'irrigation aura atteint un stade de développement proche du seuil des 100,000 ha.

En résumé, on peut dire que la présence d'une crue artificielle réduirait le débit régularisé garanti (à 95 percent) de plus de 60 percent (pour la plus petite des crues artificielles) et l'énergie hydro-électrique garantie (à 95 percent) de plus de 10 percent, ces taux de réduction augmentant notablement pour des crues artificielles plus conséquentes, de type B et C.

En tout état de cause, il serait possible de fournir un débit régulé moyen garanti (à 95 percent) de 150 à 200 m^3/s pour des crues artificielles, respectivement, de type B et A. Ces débits sont jugés suffisants pour couvrir l'ensemble des besoins en eau dans la vallée pour une surface irriguée totale (rives gauche et droite) de 100,000 ha.

85. We are naturally pleased to find our concerns about the Gibb calculations of the effect of an artificial flood on potential hydropower shared by the consortium responsible for drafting the Left Bank Master Plan.

8. Recommendations[33]

86. The discussions leading to these recommendations are found in this synthesis report and in the sections of the final report concerning hydrology, fisheries, agriculture and soils, rural-urban linkages, and socioeconomics. In carrying out these recommendations, maximum involvement must be made of Senegalese institutions and individuals, including residents of the Senegal River Valley.

87. During Phase One of the Senegal River Basin Monitoring Activity (SRBMA-I) the following changes and new needs have begun to influence the development arena for the region:

- a financial crisis that led to the implementation of Senegal's New Agricultural Policy and structural adjustment program calling for a progressive disengagement of the State from direct involvement in agricultural operations (including ending State subsidies for agricultural inputs to farmers and ending the State's role in agricultural marketing);

- an increasing interest in the "private" sector in development;

- an increasing awareness of the need for environmental sustainability in development;

[33] This review of Sir Alexander Gibb's material draws heavily on work by IDA senior research assistant Curt Grimm and by IDA consultant hydrologist Dr. G. E. Hollis.

- a declining European receptivity to African migrant labor;

- ethnic conflict and violence in the region, resulting in, among other things, the expulsion of thousands of black Africans from Mauritania and their settlement along the left bank of the river;

- an annual rate of population growth estimated at 2.6 percent;

- recent locust infestations and a 15-year period of drought and poor or absent river floods that decimated yields from rainfed and flood-recession cultivation; and

- the need for greater food security throughout the country.

The recommendations that emerge from Phase One of SRBMA's research are offered within the context of these events.

88. Support for a Sustainable Diversified Production System. We recommend that the dam be managed to support a diversified production system in which environmental sustainability and socioeconomic growth-with-equity are acknowledged as guiding principles. This implies that dam managers will release the volume of water from the Manantali reservoir that will maximize floodplain production and environmental sustainability consistent with the requirements of hydropower and irrigation. At present there are no turbines at Manantali, and water resources are adequate for the existing perimeters. At this time, therefore, it would clearly be premature to initiate a management strategy based on PDRG "scenario A," which limits the area of cultivable floodplain inundated to 50,000 hectares. Furthermore, as discussed in detail in SRBMA's hydrological reports (Hollis 1990a and 1990b), the current timing of Flood "A" is not optimal, since it comes after the peaks from the unregulated tributaries (see Paragraph 91).

89. Groundwater Recharge and the Availability of Groundwater for Irrigation.[34] A controlled flood should become a permanent feature of the water management of the valley also because the groundwater in the alluvial, surface, and deeper aquifers of the valley, and probably those over wide areas of northern Senegal, are recharged primarily by the infiltration of flood water through the floodplain. Wells drawing on these aquifers are critical for the supply of water to villages and livestock, and are used for watering of women-managed vegetable gardens. The water quality effects of enhanced groundwater recharge through the percolation of irrigation water should be monitored through the existing Groundwater Monitoring Network. While there is interest in using groundwater for irrigation, such schemes should not be implemented prior to a full understanding of their effects on water quality and availability. When groundwater-

[34] Note that we, and Gibb, are working with monthly averages. It is possible that daily flow data might demonstrate that the peaks during those months were indeed sufficient for the flood, although the cumulative data for the month appears to be deficient.

river relationships are better understood, consideration should be given to the joint use of surface and groundwater resources.

90. Monitoring, Evaluation, and Research. To make up for critical gaps in current understandings, we recommend the immediate establishment of an integrated Senegal River Basin monitoring, evaluation, and research activity, coordinated by the Cellule Après-Barrages. This means that CAB will require increased staffing in the social and environmental sciences and an expanded capacity for documentation and data management. Training programs for Senegalese personnel should be instituted, either in-country or abroad as necessary, where essential skills are lacking.

91. Hydrology and Management of the Artificial Flood. While the synthesis report points to major socioeconomic and environmental lacunae in understanding Senegal Valley production systems, there are also fundamental shortcomings in our hydrological understandings, and these shortcomings render current attempts to manage the controlled releases from Manantali extremely problematic. The management rules for Manantali should aim at augmenting the natural flood from the uncontrolled portion of the upper catchment rather than endeavoring to follow artificial flood Hydrograph "A." This would have the effect of requiring less water; it would normally lengthen the growing season for flood-recession crops; and it would reduce the frequency of undesirable double-peaked hydrographs. The present real-time forecasting model developed for the river is inadequate to guide augmentation of natural flood flows because it gives only a two-to-three day forecast of flow at Bakel. A real-time hydrological forecasting model, incorporating both a rainfall/runoff component and a hydraulic component based on river levels, should be developed that will furnish two-to-three week forecasts of the flow at Bakel. To build such a model, links must be established with Guinea in order to obtain the necessary rainfall and flow data for the uppermost parts of the Senegal catchment. In addition, the feasibility of extending the existing METEOSAT-based telemetering of real-time climatological data should be investigated.

92. Flooding Mechanisms in Cuvettes.

(1) The blockage and restriction to the flow of water into cuvettes and along distributary channels should be investigated prior to implementation of a low-cost program of dredging and excavation at critical points. This program will assist both cuvette inundation and water supplies for irrigation. Plans for the construction and management of sluices where distributaries leave the main river should aim at the integrated management of water levels for the benefit of fishing, flood-recession cultivation, and irrigation.
(2) The complexity and variability of flow directions on the floodplain together with significant flows in some places requires that embankments not obstruct floodways. Locating irrigation schemes on higher and sandier lands within cuvettes will reduce the costs of embankments and lower the rise in flood levels. Flood-level rises are caused by a reduction in the storage capacity of the floodplain produced by embanking perimeters. The construction of temporary roads across distributary channels should be undertaken only where there will be no adverse effects

downstream and where the entire structure will be fully removed before the ensuing flood season.

(3) Sufficient data exist to elaborate a physically based deterministic model simulating the actual processes of inundation of the floodplain from Bakel to Kaedi and probably to Richard Toll. The model will need to operate on a daily basis.

93. Effects of Irrigation on the Floodplain. It is critical that large schemes *not* be designed so that their drainage into the existing marigots and then into the cuvettes will cause rapid salinization of the cuvette, groundwater, and eventually large parts of the perimeter itself. It is further recommended that any move to replace the bridges on the Matam-Ourossogui road with a continuous embankment be viewed with extreme caution. Such a replacement will seriously impede flood flows down the floodplain, and there is a danger that, during a large flood, floodwater will pass through the town of Matam which is lower than the crest of the embankment. On the scheme currently being erected near Boyenadji, it is recommended that the marigots be dredged so that drainage water can discharge via non-return flaps into the Diamel, and that an extensive floodway be left through the perimeter so that floodwater from the Dioulol, Navel, and Thiemping cuvette can pass through to the Diamel and beyond.

94. Hydrological Studies.

(1) Top Priority. A real time flow forecasting model with a forecast horizon of at least two weeks must be developed for Makana and Bakel.

(2) Very High Priority. There should be test releases of sustained base flows from Manantali to permit studies of the fate of the released water. Special attention will have to be given to water levels in the river between existing gauging stations, water levels in distributary channels and the current metering of rates of flow at critical points.

(3) High Priority. Stage boards should be established in each of the cuvettes selected for intensive study and at strategic locations along the distributaries and marigots. These boards should be read daily during the flood seasons, preferably by observers resident in local villages. The stage boards will have to be carefully leveled to yield elevations in m IGN.

(4) Medium Priority. Flow volumes into critical cuvettes and long important channels should be metered repeatedly during flood passage so that their movements can be calculated and relationships established between the slope of the water surface among stage boards and the discharge.

(5) Medium Priority. A new physically-based model of the hydrology of the valley needs to be developed and calibrated with the existing wealth of data for the river and the scanty but adequate data on water levels in distributaries and cuvettes, groundwater levels, and the extent of flooding. The new model will have to take into account the flooding and drainage processes for individual cuvettes; groundwater-surface water relationships; withdrawals of water, inculding

irrigation, that are foreseen; and the return of drainage water to the river. The main aims of the model will be the determination of the water levels that will be attained in the dry season under different development scenarios and the extent of flooding during the release of the artificial, or augmented, flood from Manantali. There is sufficient data on the physical hydrology of the river and floodplain to begin this modeling work immediately, but new data will be needed for model testing and verification.

(6) High Priority. Monitoring of the OMVS/USAID Groundwater Network should be continued and the data entered into the existing data base.

(7) High Priority. A report should be prepared on the groundwater resources in the Middle Valley using the OMVS/USAID Groundwater Monitoring Project's database. The study should include consideration of the effects of changing the flood regime on groundwater in the wider region.

(8) Low Priority. There should be some investigation of the soil moisture in waalo lands emphasizing recharge/drainage relationships, the significance of rainfall amount and timing, and the processes of evaporation and transpiration.

(9) Medium Priority. While flows from the uncontrolled parts of the upper basin are reported to have exceeded Artificial Flood "A" in 52 of the 68 years from 1903-1971, there is some evidence that the recent drought years have significantly lowered the proportions of flow at Bakel that come from the Faleme and the Bakoye. A study of temporal trends in relationships between rainfall and runoff and between the relative contribution of each tributary is needed. The study should accompany the present investigation of the effects of different operating regimes at Manantali on the actual flow at Bakel.

(10) Low Priority. An overview should be prepared on sediment movement because little attention seems to have been given to its transport on the floodplain, and to sediment and nutrient deposition in Middle Valley cuvettes.

95. Remote Sensing and GIS. There is a lack of firm documentation on the relationship between the volume and duration of flood waters and the extent of area inundated. The various "hydrograms" proposed for management of the Manantali Dam are the products of simulations, and appear not to have been empirically verified, nor have claimed relationships between the area of cultivable floodplain inundated and the area actually under recession agriculture. Some of these issues could be resolved by a retrospective examination of satellite imagery, involving, for example, the participation of the Centre de Suivi Ecologique, combined with ground-truthing. We make the following recommendations:

(1) The existing work of mapping flood extent from SPOT imagery should be continued in 1990 and thereafter for at least five more years, and 1989 satellite images for the valley should be obtained and analyzed. The analyses should clearly distinguish areas flooded by the river from those flooded by rainfall and runoff.

(2) Consideration should be given to the analysis of LANDSAT scenes dating back to 1972 to allow fuller understandings of floodplain inundation and the relationships between flows and areas inundated. It would also be useful to distinquish areas flooded from those actually cultivated.

(3) A digital terrain model of the valley should be created using ARC-INFO. This will serve as a base both for the OMVS geographic information system and for the hydrological modeling proposed.

96. Dam Release Simulations. We recommend simulating the dam's releases of different sizes against the historical record to indicate what their effects would be on the following year's reservoir capacity.

97. Agronomic Research.

(1) Agronomic research to increase the productivity of land, labor, and capital in agriculture--especially to improve per hectare yields on flood-recession fields--is essential and might best be undertaken by the Institut Sénégalais de Recherche Agricole (ISRA), in collaboration with SAED. There is general agreement on the desirability of improved productivity on the floodplain, but few concrete efforts are being undertaken to achieve it. In the PDRG list of research themes to be carried out (GERSAR/CACG. et al. 1990:77), none deals with waalo agriculture. Yet there is considerable agreement among scientists that such research would have a high payoff:

> Despite the risks of crop loss, the cultivation of wetlands and floodlands tends to be more sustainable than most tropical rainfed farming because salts are washed away, and fertile silt is often deposited by floodwaters. . . . There would seem to be considerable scope for improving flood recession agriculture and for extending the area under such use. Floodplains and swamps can be made to drain faster by cutting drainage channels, thereby extending the growing season and improving security of harvest, and if the channels remain full, providing a source of irrigation water during dry periods" (Barrow 1987:192-193).

(2) GERSAR/CACG. et al. (1989:13) concede that waalo yields can be increased from 550 kg/ha in 1990 to 900 kg/ha in the year 2000, and to 1,000 kg/ha by 2015. Similarly, van Lavieren (1987?:20), noting how rarely irrigation in the Senegal Valley actually yields two harvests a year, and how it is possible to increase flood recession yields to 800-1000 kg/ha, wonders *"s'il faut appliquer ces changements agricoles rigoureux de façon absolue. Il semble opportun de reconsidérer l'importance de la culture dans le Walo, qui est adaptée au milieu naturel ainsi qu'aux traditions de la population."* It is interesting to note that prior to the great expansion of Senegal valley irrigation in the 1970s, there was a good deal of interest in improving both rainfed and flood-recession yields (Chevreau and Poulain 1972; Poulain et al. 1968; Sapin and Reynard 1968; and, more recently, Watt 1986). Some of the agronomic research activities to be undertaken include:

- plant genetics, to develop more stress-tolerant, pest-resistant, less-water-demanding varieties; and/or shorter cycle varieties that mature before the onset of the extremely hot dry season;

- fertilizer responsiveness, if a method can be developed for delivering fertilizers, given the fact that planting awaits the recession of surface waters;

- small-scale infrastructure to increase the efficiency of flood waters (e.g., sluices on the marigots, dikes);

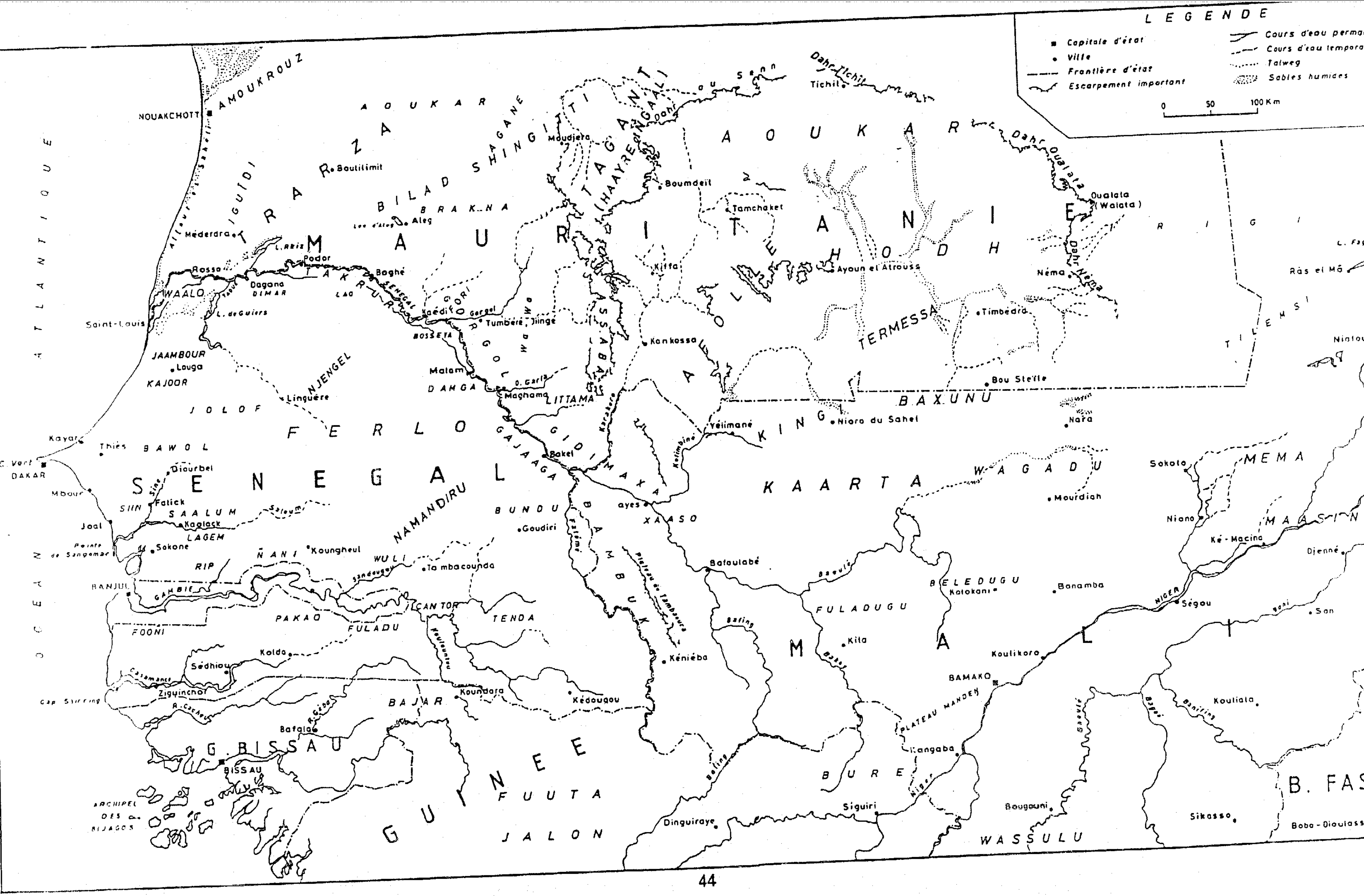
- better integration of livestock on waalo fields; and

- cultivation techniques to increase the efficiency of labor, spacing, intercropping (for nitrogen fixation, shade).

98. Environmental Research. Environmental research and monitoring should also be undertaken, perhaps involving a consortium of Senegalese (for example, SAED, ISRA) and other organizations (such as Centre de Suivi Ecologique [CSE], ENDA, ORSTOM), again as coordinated by the Cellule Après-Barrages. For example, the PDRG (GERSAR/CACG. et al. 1990:126) speaks of the "necessity" for destocking animals in the Senegal valley, yet no evidence is presented to indicate that herd size so consistently exceeds carrying capacity that the productivity of the range is threatened. On the other hand, CSE has stated that no evidence exists to show that the region is being desertified. Appropriate monitoring would focus on soils, water, and trees. Monitoring tree growth is especially critical as different flood regimes are likely to affect the sustainable yield for fuelwood, construction, and forage.

99. Socioeconomic Monitoring and Research. Finally, and perhaps most importantly, a valley-wide monitoring of the socioeconomics of smallholder producer households should be undertaken, including considerations of land tenure, labor requirements, price policy for agricultural and for rural consumer products, and linkages between the countryside and small administrative and marketing centers. In close coordination with the CAB, the Institute for Development Anthropology will be developing an appropriate monitoring protocol during 1990-1991. The long-term implementation of that protocol, and the analysis of the findings, should be carried out by the various national and international organizations concerned.

100. Conclusion. If the record of the twentieth century is a reliable guide to the future, our analysis suggests a management strategy for the dam that allows for a release from Manantali in all but the very few years when in August and September both reservoir levels and river flows are too low. There is little reason why the Manantali dam cannot be operated to generate hydropower at desired levels, to allow for a reasonable level of irrigation in the valley, and to enhance downstream ecology, productivity, income, employment, and social justice.


LEGENDE
Capitale d'état
Ville
Frontière d'état
Escarpement important
Cours d'eau perma
Cours d'eau tempora
Talweg
Sables humides
0
50
100 Km
OCEAN ATLANTIQUE
NOUAKCHOTT
AMOUKROUZ
AOUKAR
TRARZA
IGUIDI
Boutilimit
BILAD SHINGITTI
AGANE
BRAKNA
Aleg
Mederdra
Rosso
L. Rkiz
Podor
WAALO
Dagana
DIMAR
Saint-Louis
L. de Guiers
TAKRUR
LAO
Boghé
Kaédi
GORGOL
Tumberé
Jiinge
BOSSEYA
Matam
DAMGA
Maghama
LITTAMA
Moudjeria
TAGANT
HAAYRE NGAAL
Boumdeit
Tamchaket
AOUKAR
Tichit
Dahr Tichit
Dahr Oualata
Oualata
(Walata)
MAURITANIE
ASSABA
Kiffa
HODH
Ayoun el Atrouss
Néma
Dahr Néma
Timbedra
TERMESSA
Kankossa
AFOLLE
Bou Stelle
BAXUNU
KINGI
Nioro du Sahel
Nara
Yélimané
RIGI
Râs el Mâ
TILEMSI
JAAMBOUR
Louga
KAJOOR
NJENGEL
Linguère
JOLOF
FERLO
Kayar
Thiès
BAWOL
C. Vert
DAKAR
Diourbel
SENEGAL
Mbour
SIIN
Fatick
SAALUM
Kaolack
LAGEM
Joal
Sokone
Pointe de Sangomar
NAMANDIRU
NANI
Koungheul
RIP
WULI
Tambacounda
BANJUL
GAMBIE
BUNDU
Goudiri
GIDIMAXA
Bakel
GAJAAGA
ayes
XAASO
BAMBUK
Falémé
Plateau de Tambaoura
KAARTA
WAGADU
Mourdiah
Sokolo
MEMA
Niono
MAASINA
Ké-Macina
Djenné
Bafoulabé
BELEDUGU
Kolokani
Banamba
FULADUGU
Ségou
NIGER
San
PAKAO
FULADU
CANTOR
TENDA
FOONI
Kolda
Sedhiou
Casamance
Cap Skirring
Ziguinchor
R. Cacheu
BAJAR
Koundara
Kédougou
Kénieba
Kita
MALI
Koulikoro
BAMAKO
PLATEAU MANDEN
Koutiala
Bafata
G. BISSAU
BISSAU
ARCHIPEL DES BIJAGOS
GUINEE
FUUTA JALON
Dinguiraye
Siguiri
BURE
Kangaba
Bougouni
WASSULU
Sikasso
B. FAS
Bobo-Dioulass

1. The History of the Middle Valley of the Senegal River

The Middle Valley of the Senegal River stretches from the confluence of the Falémé to the confluence of the Tawé. It conjoins a number of the former Gajaaga states to the east, with the Waalo states to the west. Between Demban Kani to the east and Dagana to the west lies the former state of Takrur, renamed Fuuta-Tooro, whose theoretical boundaries are the Tagant to the north (Haayre Ngaal) and the northern rim of the Ferlo depression to the south. The region had the name of Fuuta-Tooro during the time of Fulbe domination, which continued uninterrupted from the beginning of the 12th century until modern times. During this period, the Fulani dominated the political and cultural spheres, while assimilating various traits from ethnic groups who preceded them in the region: Seereer, Soninké, Wolof, and Moor.

The people today called the Toucouleur (that is, the inhabitants of Takrur) include the *sebbe* (sing. *ceddo:* the warrior caste—in this case, non Pulaar speakers strongly influenced by the fulani culture), and sedentary *Fulbe* who intermarried with these groups to the point where it is virtually impossible now to distinguish between *Fulbe and Toucouleur*. The segmentation of Fulbe society reflects this reality. Besides the various tribes and factions that formed, one can distinguish between the more sedentary and interracially mixed Fulbe waalwalbe (Fulbe of the *waalo*, recession land on the floodplain), and the purer, more nomadic Fulbe *jeeri*.

Their economies are virtually identical, based essentially on agriculture, animal husbandry, and fishing. These key activities underlie the social structure with its hierarchy of values that has evolved over time as each successive ruling power took advantage of its position to impose its ideology and its conception of the world and of society. The history of the Fuuta has been punctuated by a number of dynasties.

1. *The Jaa Oogo Kingdom* (508-720) was ruled by blacksmiths to whom has been attributed if not the introduction, then the diffusion, of iron working: extraction, melting, and conversion into metal. Arriving originally from the Southeast, from Namandiru (upper Ferlo), they ruled the valley for almost two centuries. Little is known about their ethnic composition. They were probably Soose, a combination of Malinké, Wolof, and Seereer influence.

2. *The Tonjon Kingdom* (720-826) was a Sereer kingdom of indigenous farmers and fishermen who rejected the dominance of the blacksmiths and founded an agrarian civilization, which profited enormously from the technological innovations introduced or spread by the Jaa-Oogo. With the Sebbe (Wolof), they form the *cuballo* (plur. *subalbe*: fisherfolk caste) element of society, making use of the diverse resources of the river, the *kolaade* (sing. *kolangal*: recession basin) flooded during the rainy season, and the recession *beeli* (small ponds) that provide rich yields of fish up until the end of the dry season. At the same time, they began recession agriculture on the *falo* (recession lands on the banks of the river) and on the *kolaade*. The titles of *jaltaabe, teen, dumel*, and *jagodin* are held for the most part by *subalbe* dignitaries of Seereer or Wolof origin.

Moreover, they must have dominated the *Fulbe in the Fuuta* with whom they had lived in the Sahara and the Sahel during the era when these regions enjoyed ample rainfall. The movement of the 350-400 mm isohyets toward the south, coinciding historically with pressure from the Berbers in the north, pushed the Fulbe, the Sereer, the Wolof, and the Soninke southward in a mass migration.

It is most likely that the *Subalbe* adopted from the Sereer the belief in river spirits (*munuuji*) to whom libations must be offered at certain times. The Fulbe make such offerings when they cross the river with their herds; they pour milk in the river before receiving permission from the *jaaltabe* or the *teen*. The opening of the fishing season in other regions along the river begins with similar rituals.

3. *The Manna Dynasty* (826-1082) was founded by Soninké originating from the Haayre (Assaba and South Tagant), whose own origins, as tradition ɔuld have it, are in the Wagadu. They conquered the Fuuta at the expense of the Tonjon and founded a dynasty that strongly influenced the economic, sociopolitical, and religious development of the Takrur. Before the conquest, they had served as intermediaries between the Islamicized Arab-berber merchants and populations in the valleys. Through this intermediary, the Middle Valley was integrated with international trading networks linking the Mediterranean with Sudano-Sahelian Africa. At the same time, they served as links between large transsaharan trading centers and the mines of Bure and Bambuk. They thus added commercial speculation to the traditional rural activities of the Takrur (agriculture, stock raising, and fishing). They are among those who helped convert the Berbers south of the Sahara to millet eating (Al Bakri 1965:316).

They were the first *jula* to be converted to Islam even before the advent of the reign of War Jaabi. They founded the first Koranic schools, which were responsible for the extensive Islamicization of the sedentary populations well before the launching of the Almoravid movement.

After their alliance with the Almoravids, in an emancipatory movement against the domination of the Tunka of Wagadu, they eventually fell victim to their allies at the end of the 11th century. Even after their defeat and concomitant loss of political power, their influence remained strong because they represented the first *Toorobbe* (sing. *tooroodo*: the marabout caste) elements in Toucouleur society: the Ture, Baro, Kebbe, Dukke, Koreera, Gassama-Jaabi, Sibi, Saaxo, Sumaare, Silla, Talla, and Traore families. Soninké immigrants accompanying the conquerors in the Takrur enriched the *sebbe* and *subalbe* elements in Takrurian society and strengthened the position of artisans of all types.

The subsequent fulanization of these Soninké elements was not accompanied by changes in patronyms. This fulanization did not happen before the arrival of the *Fulbe* from Termes.

4. *The Kingdom of Laam Taaga* (1082-1122) took power from the Soninke through the successful Almoravid movement led by Abubakr Ibn Umar Lamtuni. Less than fifty years of Berber domination was not enough to alter significantly the nature of the foundations laid by

nearly three centuries of Soninké domination. Most of the Berber characteristics that left an indelible mark in the region were assimilated ethnically and culturally, even if they laid claim to Lamtuna, Arab, or Cherif origins. A vestige of this influence is represented by the minority *capaato caste* (plur. *safalbe*: the Moorish caste). There are very few remaining Takrurians who are a mixture of Arab, Black, and Berber blood, despite the claims of many *Toorobbe* and Islamisized *Fulbe* to descendency from Yemen, Egyptian, or Syrian Arabs.

The Laam Taaga dynasty did not subjugate the entirety of the Takrur. It occupied a marginal position in northern Damga and the Littaama. The Moors of Littaama, many of whose ancestors were black Africans, are among the few to lay claim to the region of Maghama even though their rule never extended beyond this zone and never reached the heart of the Middle Valley, that is the Gorgol Basin, where the Manna and the Tonjon maintained their capital. The Laam Taaga were ousted by the Jaawbe Fulbe, or the Laam Termes, who had expanded their rule from Termes to both the interior delta of the Niger and to the Middle Valley of the Senegal.

5. *The Laam Termes* (1122-1456) ruled over the Takrur until the middle of the 15th century, at which time the Fuuta Tooro was integrated to the Jolof fiefdom for a period of fifty years. Despite the presence of the *Fulbe* in the Fuuta Tooro from time immemorial until the fall of the Almoravides, they were always in a subservient position. Their rise to power in the Termes, in the Maasina, and in the Fuuta Tooro, has placed them in a dominant position within the Fuutanke society. To a greater degree than the *Deeniyankoobe* (sing. *Deeniyanke*: see subsection 7), they have played an important role in the fulanization of the populations in the Senegal Valley. Scholars such as A. Bathily (1989) date these interventions to just after the 14th century, but this author believes the process of assimilation of the Soninke can be traced to 1122, the estimated date of the conquest of Takrur by the Jaawbe Fulbe over the Berbers of Almoravid origin.

It is during their rule that the principal tribes emerged who divided the territory among themselves and integrated animal husbandry and agriculture on the *jeeri* (rainfed lands) and the *waalo* (recession lands on the floodplain). These tribes initiated the sedentarization and Islamic conversion of the *Fulbe*. The clearing of the *kolaade* and the creation of settlements simultaneously in the jeeri (*ruumano*) and in the waalo (*seedaano*) greatly facilitated the seasonal migrations between the *jeeri* and the *waalo*. The establishment of settlements came about through the appropriation of recession lands and of major water points in the *jeeri* and the *ferlo* (grasslands).

They were among the first to shape the *Pullo* ideology that still today is reflected in Fuutanke culture, even after the political triumph of the *Tooroodo* party at the end of the 18th century. Here, as in Kingi, Baxunu and Jafunu, they lived alongside the Soninké on whom they imposed their culture. With them, the ideology of herder-warriors eventually took the place of that of farmer and merchant. Their presence influenced the system of place names in the country right up through Tagant.

For a long time, the Ardo (a title given to the head of certain *Fulbe* tribes or families) resisted the pressures exerted by the Walata Moors with the help of their Hontorbe warriors. Their fierce resistance in the struggle against the Moors was reinforced by the realization of the stakes at hand: freedom or servitude. From the southern Tagant, they conquered the alluvial plain of the Fori and the traditional capital of Tumbere-Jiinge. From there, they extended their area of conquest to Namandiru, situated to the east of the *ferlo*. They became masters of the whole of the region from Haayre Ngaal (Tagant) to Namandiru (upper ferlo). Having settled for the most part on the right bank of the river, the Ardo (Laam Termes) governed a number of provinces through the intermediary of civil servants called *hoolaabe*. The dynasty collapsed following an uprising of Namandiru dignitaries who paved the way for the conquest of the region by the burba Jolof Cukli in 1456.

6. *The Domination of the Jolof* (1456-1506). The young burba Cukli, after having overthrown the Nammandiru, set his sights on the Fuuta. The conquest was effected through the occupation of the region by *Sebbe* military chiefs, the *Fa*rba (among whom the *Farba Jawal, the Farba Waalalde, the Farmbaal, the Farba Erem*, and the *Laam Tooro* are the most powerful). Every year, the *Farba* sent a tribute to the burba collected from the *Fulbe* tribes or clans over whom they ruled. This Jolof domination of the Fuuta Tooro set in motion massive migrations of the principal *Fulbe* tribes toward the Sahel or to the Southeast. These *Fulbe* migrations provided the backbone for the formation of the *Jaalaalo* kingdom and for the destabilization of the Mansa Empire and its subprincipalities.

But 1506 marks the beginning of a period of anarchy that will last 20 years (1506-1526). During this time, a civil war broke out among the *Farba* over control of the region. These hegemonic conflicts greatly facilitated the subsequent conquest of the region by Koli Tenella.

7. *The Deeniyanke Dynasty* (1512-1776). The Deeniyanke dynasty followed that of the Jaalaalo founded by the *Fulbe (Yaalalbe, Ururbe, Wolaabe, and Feroobe*) who fled the Fuuta Tooro after the conquest of the country by the burba Jolof Cukli. The *Jaalaalo* kingdom, due to its hegemonic rule in the region, consolidated its power from Kingi to the Fuuta Jallon and to Wassulu, stirring up discontent among a coalition of Songhay, Jaara, Mali, and the Portuguese because the kingdom seriously threatened the hegemonic aims of some, the territorial integrity of others, and the economic interests of all.

After the death of Tenella, founder of the Jaalaalo kingdom in 1512 who died at the hands of the Songhay, his son Koli Tenngella could no longer retain power in the Bajar because of the military strength of his enemies and because of the famine, and therefor tried to reconquer the Fuuta Tooro and defeat the Jolof with the help of the remnants of his father's army and soldiers recruited from the Bajar kingdom. This marks the beginning of the epic of Koli, a *deeniyanke* who with his *Koliyaabe* troops conquered all the enemies encountered en route and founded what the Portuguese called the Empire of the Great Pullo, which stretched from the Fuuta Jallon to the Lower Valley. The conquest of the Fuuta Tooro was greatly facilitated by fratricidal conflicts among the *Farba*.

The Fuuta Tooro, which was already subdivided into well-defined territorial units controlled by the *Farba Sebbe*, the *Teen*, the *Jaaltabe Subalbe*, and the *Ardo*, was redivided by Koli. He integrated his troops with the conquered troops by allocating to them a certain amount of power. He provided for his relatives, the *Deeniyankoobe* and *Yaalalbe*, and his allies and compatriots, the *Saiboobe* and *Koliyaabe*, by redistributing territory without plundering the former rulers of the country. These actions were carried out through a policy of matrimonial alliances between the conquerors and the conquered. He gave the *kolaade* to the victors, but at the same time he strengthened the rights held by the former landholders over a good portion of their land.

In the Fuuta Tooro where the Islamic faith was still taking hold, a class of marabouts (the *Toorobbe*) emerged, open to all those, regardless of ethnic origin, who undertook Arab-Islamic studies as a veritable profession and who took it upon themselves to extend the Islamic framework to the rest of society.

The political strategy of the *saatigi* (a title given to Deeniyankoobe kings) was to ally with the ascending classes through the allotment of jeeri and waalo fields, and by granting the most prominent men within these classes their daughters, who were richly endowed in waalo lands, slaves, and animals. The crisis of the maraboutic war (Shur-Bubba) that bloodied the Bilad Shingitti and spread south to the northern states of Senegambia starting with the Fuuta, shook the foundations of the *Deeniyanke* dynasty during the last quarter of the 17th century. The defeat of the Moorish marabouts made possible by the coalition of the legitimist dynasties (Trarza and Brakna emirates) and the kings of Fuuta, Waalo, Jolof, and Kajoor, worked in the favor of the *Deeniyankoobe Saatigi*.

They paid heavily for the help of the Moor emirs by agreeing to give them part of the tithe of the harvests (the *zakat*). The Moors interpreted the action as a clear sign of dependence of the Black states in general and of the Fuuta in particular. It became known as the *muudo horma* (the *muud* is a volumetric measure of about 3 to 3.5 litres), offered in exchange for protection.

This dependence was strongly challenged by marabouts who, beginning in the middle of the 18th century, formed a *Tooroodo* party. Although the *Saatigis* manipulated Waalo land to solicit support of the marabouts, the latter fought their benefactors both in the name of Islam and in the name of national independence. The *muudo horma* no longer carried any significance, given that the Fuuta was completely Islamicized. Besides, the perpetual raids (razzias) by the Moors on riverine populations provoked an exodus of people from the right bank to the left bank. It was extremely important to bring an end to these developments, to liberate the country from the rule of the Moors, and to reform political power by providing a substructure based on the Koran and the Sharia (Islamic law). Under the efficient leadership of Ceerno Sileymaan Baal, the *Deeniyanke* dynasty was overthrown in 1776, the Moorish rule rejected, and a new political regime of Islamic influence installed under the direction of an *aalmaami* (the head of the theocratic state). The first person to hold this post was Abd el Kadar Kane.

8. The *Aalmaamyat* (1776-1881) took up where the Satigi left off by assigning itself the duty of defending the region against *Bidaan* (White Moors) invaders from the North and the jeeri Fulbe raiders from the South, the Wolof from the West, and the Bambara from the East. Under the energetic leadership of the first *aalmaami*, waalo lands were used for settlements and defense.

Villages of *Sebbe* or *Subalbe* peasant soldiers were established on the banks of the river to guard strategic crossings and prevent passage of invaders. These peasant soldiers were endowed with *bayti* (lands of the "Muslim community") to assure their economic independence and to provide them with the means to carry out their duties as defenders of the territory. The settlement of the *jeejegol* zones (intermediate zones between the jeeri and the walo) was systematized by similar procedures carried out to bar the roads to looters from Njengel. The villages of the *jeejegol* could in times of need provide help either to communities in the *daande maayo* (the secondary river bed) or to those in the jeeri.

Once the *muudo horma* was abolished, all of the produce of the *zakat* was earmarked for the needy and to finance the education of children entrusted to marabouts and imams. Judicial questions were placed in the hands of *cadi* (Islamic magistrates) who, if settlements could not be reached peacefully rendered justice in the name of the sharia. It was perhaps under these circumstances that the *zaket* originated, a payment to Toorobbe marabouts who at times assumed the multiple roles of village chief, imam, and teacher.

After the eviction and death of the first *aalmaami* at the close of thirty years of almost absolute power, the aalmaamiyat was taken over by the traditional *Fulbe* and *Toorobbe* dignitaries who had strongly resented the sovereignty of Abd el Kadar. The *Toorobbe* were forced to make considerable concessions to these dignitaries in order to consolidate their forces. From that moment on, against the stipulations of the regime's constitution, pressure groups formed around the principal maraboutic families (particularly the Ly and the Wane) to establish and consolidate family power.

During this period, control over waalo land was abused by certain *aalmaami*, in particular Yusuf Sire Ly, to establish a set of clients. At the same time, the harvest tithe lost its Islamic character and instead became a land payment to the benefit of landowners. This perversion of the institution and the betrayal of the message left by the founding fathers of the aimaamiyat were denounced by El Hadj Umar Taal when he initiated his reform movement. The regime lost its legitimacy by enfeoffing itself to the expanding French colonial power, to the detriment of national unity and cohesion.

Between 1850 and 1881, colonial powers attempted to combine their interests in commerce, land, and power. Attempts to confiscate land were opposed by fierce resistance on the part of land holders and peasants whose livelihood and survival were closely tied to the land, in particular to the waalo.

9. *The Present.* Generally speaking, the principal economic activities (agriculture, animal husbandry, and fishing), are closely linked despite appearances to the contrary. These activities form the basis of the structure of *Fuutanke* society with its three principal groups: farmers (*remoobe*), fishermen (*awoobe*), and herders (*aynaabe*). All other economic activities and social formations derive from them.

Agriculture, the most important of the economic activities of the Fuuta, is open to everyone without exception. It bestows honor on those who practice it and diminishes no one, while at the same time assuring the independence of those who engage in it. To farm, one must only be able to put up the effort and withstand the fatigue associated with it.

J. Barrau and R. Portères estimated that between B.C. 9000 and 5000 plant species that had formerly been gathered began to be cultivated. They believe that within the "Western African heartland," the Senegambian along with central Niger, served as the region's granary for sorghum, finger millet, and rice (Hist. G. Afrique 1980, T.I., pp. 725-744).

Although Munson (1972) and A. Holl (1983) do not confirm the presence of sorghum in the Dhar Tichitt, Al Bakri and Al Idriss provide evidence of recession agriculture and of the marketing of surplus produce in the 11th and 12th centuries in the Lamtuna Berber regions of the North (Al Bakri 1965:310).

In the 17th century, when demographic development and the international slave trade prevented the extensive utilization of available agricultural land, European onlookers could have been led to believe that land was not a commodity. "Land," wrote Chambonneau, "is neither bought nor sold. People make use of the land at will. . ." Based on this observation, he proposed a detailed settlement plan to the Marquis de Signelay in 1686 because "the land is not considered a commodity to them, being held communally and changing hands every year with no permission asked (Archives de France, Col. 06-1, fol. 4 recto).

In fact, the availability of land does not necessarily indicate a lack of ownership. The *saatigi*, and under him, the *aalmaami*, controlled all the land in the kingdom. They could allot fallow lands to individuals, families, or groups of people. They could transfer land utilized by one family to another more needy family. Certain *saatigi* and *aalmaami* did not hesitate to make use of this power when politically or socially necessary. Others even abused their privileges to establish a base of power, create a clientele, or provide dowries for their daughters married to marabouts.

In his struggle against the Moors and *Fulbe of Njengel*, Aalmaami Abdul widely donated *kolaade* to communities of *sebbe* warriors, whom he installed for defensive purposes at strategic river crossings. This type of allocation could be directed at any of the socioprofessional categories, but most often targeted *Lawokoobe Fulbe* and marabouts.

Practically all of the large land holders or *joom* held rights allocated from a central power to whom they paid a tribute called *ndoodi*. Generally speaking, the degree of control over jeeri

land is more limited than over waalo land, where control is complete. If a *joom* is the holder, control is not absolute or individualized in the Roman sense of the term, to include the right to exploit and abuse at will. In fact, it is the entire family who is the joom. The titled *joom*, generally the oldest male member of the family, acts as the manager of the collective property, the *joowre* (directly translatable as the "collection" of indivisible goods), which belongs to the familial community. Each established household receives a plot of land designated for subsistence activities, called *ngesa nguurduba*. Young, unmarried, circumcised men receive a small plot of land, a *ciifol* (a strip) called *njeylaari* to use for their personal needs. They work on this small plot of land after they have completed their requisite number of hours of work for the head of the family, who provides both their food and clothing.

Joowre lands are also assigned to household slaves, especially when the slaves marry and establish their own households. These plots are often quite large, enabling the slaves to earn an income often greater than that of their masters. In return, they must work for their masters, on average four half-days per week. After meeting this obligation, they work intensively in their own fields, from dawn to nine in the morning, and again all afternoon.

While performing work for their masters, they engage the help of their young children on their own fields because the children don't necessarily have the same master; slave status is passed down through women. Female slaves and their children have the same master whether the children are legitimate or not. Children do not inherit their father's fields except by agreement with the father's master.

The rest of the property is subdivided and allocated to individuals. Some plots are rented annually for one growing season, while others are rented for several years, or in perpetuity. Long-term agreements are arranged with the families of the partners of the joom who took part in the clearing of the land by ax (*jambere*) or fire (*jeyngo*). The tenants of these fields can under no circumstances be dispossessed of their lands by the *joom* as long as they are paying their customary fees (*njoldi, asakal, doftal*) or their special fees (*cootiigu*).

The *njoldi* is a symbolic tax levied annually and paid by the tenant at the beginning of the season, which starts with the recession of the river waters. The value of the tax rarely surpasses the price of a sheep.

The *asakal* is simply a tithing of the harvest usually required of all cultivators, *joom* and tenant alike. It is an Islamic regulation defined rigorously by the Koran and is delivered either to the chief of the village or to the imam of the village community. It has happened that the joom has held both positions. Originally, tenants were responsible for the religious tithe plus an additional 10 percent *on the remaining portion of the harvest to go to the joom.* Subsequently, at an unknown time and for unknown reasons, the *joom* for all intents and purposes renounced his customary land fees and accepted only the religious *asakal*. The *asakal*, amassed from all rented land, is collected and redistributed by the oldest male (the *mawdo lenyol*) among the members of the family in proportion to their familial responsibilities. The

mawdo receives the largest part, the *gedal manngu*. The *asakal* collected from fields farmed by family members is redistributed outside the family.

The *doftal* is a labor prestation by the tenant to the *joom*. The work is carried out on fields the joom cultivates himself, generally during the field preparation. It happens that, in the course of the season, the *joom* chooses a day when all of his tenants will work together on a given field for a half day. It is evident that the number of individuals available for this work depends on the number of rented fields. On this day, the *joom* will deliver the midday meal to the fields. On other special occasions, for example when a house roof is being constructed, the *joom* may call on a tenant to help. But in this specific case, the entire village community becomes involved, not just the individual tenant.

The *doftal* of the tenant is not the equivalent of the *doftal esiraado* or the *doftal giyiraabe*. The *doftal esiraado* is a labor contribution that a future son-in-law organizes with his age-grade (*fedde*) for his future father-in-law. The *doftal giyiraabe* is work that an entire *fedde* carries out for the family of one of its members. In the event, for example, that a family loses one of its children, the child's *fedde* responds with help. In other words, this type of *doftal* is a form of assistance, and expression of the peasant community's solidarity, which is manifested in other ways as well.

The *cootigu* is a kind of repurchase. It represents a right of transfer exercised by a child to claim the inheritance of his deceased father in order to continue cultivating the lands claimed by the *joom* through the *jambere* or the *jeyngol*. The *cootiigu* is sometimes quite large. Its value depends on the worth of the field and can range from a bolt of cloth to a horse, or something of even greater value.

In summary, the *joom* is a very important person, but his control over land is not absolute. Under no circumstances can he take away the lands of a legitimate tenant, whether it be a seasonal or permanent tenant. For new households, he utilizes seasonally rented plots of land. Once the field passes from the *joowre* to family use, it is exonerated from customary taxes with the exception of the *asakal*. A field of changed status is called *ngesa suudeewa*.

The regulation of jeeri land is generally more relaxed than that of waalo lands. Control of the waalo is virtually absolute, which is not the case for all of the jeeri. For those who do not fear the inconveniences posed by isolation, it is lawful to clear unclaimed lands, or claimed lands in the waalo that lie far from inhabited areas. Dissidents from a village community, or *Fulbe* migrants voluntarily looking for vaster tracts of land or for new lands far removed from village conflicts, often do this. But these new land clearers and village founders must first obtain authorization from the *saatigi* or the *aalmaami*. These new settlements that claim rights of ownership are called *lewre* or *sincu*. The new lands that are fertilized by the herds that graze on them after harvest are likely to produce high yields the following season. The presence of a water source favors a new establishment. Agriculture thus encourages herder sedentarization and land appropriation. In any case, suits concerning control and land boundaries are more frequent with waalo than with jeeri fields.

That this system has lasted intact until recently remains an obvious paradox. There does not seem to have been any major political or social crisis associated with the land to jeopardize the system. However, the substantial fees paid by tenants weighed heavily upon them, and during certain crises must have influenced events. This is probably the case in the abolition of the *muudo horma* by Sileyman Baal and the voluntary or forced relinquishment by the *joom* of their share of the harvest and their subsequent appropriation of the religious *asakal*.

The stability of this system is due to the fact that the Fuuta is based on a subsistence economy. Access to land is open to everyone either in the form of ownership or rent. The land use fees borne by tenants, although not merely symbolic, appear nonetheless to have been tolerable. No socioprofessional group, not even slaves, are prohibited from cultivating land at the individual level.

The caste system reflects the rational division of tasks in the community. Herders, fishermen, and farmers, who constitute the vast majority of the population, elicited the services of artisans called *nyeenybe*, who are gifted with creative technological ingenuity. They fashion tools essential to peasant life. Subspecialties developed for artisans using cloth, pottery, metals, leather, and wood. The system of inheritance among artisans is based on oral transmission of information or technique. This initiation always involves some kind of secret with which is associated a certain power. The transmission of these secrets passes from father to son or from father-in-law to son-in-law.

The emergence of a political power added military and political professionals, known respectively as *sebbe* and *lawakoobe*, to the traditional categories. The victory of Islam spawned a class of marabouts who ended up taking over at the end of the 18th century. These were the Toorobbe, among whom certain families emerged as a ruling class through the acquisition of land and the exercise of power, forming the *lawakoobe toorobbe*.

The Senegal River Valley is a melting pot where from the twelfth century on diverse ethnic groups converged, adopting much of the Fulani culture. None of the castes is ethnically pure. Each caste assimilates strangers who have lived in its midst and shared its craft and associated cultural values. There is no segregation of living quarters; the various castes mingle interdependently with the rest of society. Integration is reinforced by the system of age grades. The status of the individual is inherited from the father. Only marriage represents a form of rigorous social segregation. Parents are careful to investigate the background of prospective sons-in-law who wish to marry their daughters. For this reason praise singers are important. Associated with particular families, they are the keepers of oral tradition and genealogies.

2. Population Dynamics in the Middle Valley

According to the national census, in 1976 Senegal had a total population of 5,068,741, of whom 53.3 percent were under 20 years of age, and 50.5 percent were female.[35] The area that will be affected by the development structures on the Senegal river is composed of the entire region of Saint-Louis (departments of Dagana, Podor, and Matam), also known as the Fleuve, and the Bakel Department in the Sénégal Oriental. The Fleuve Region (the left bank of the Senegal River, up to Bakel), occupying 44,127 km^2 or 22.54 percent of the total surface area of Senegal, contained 514,735 inhabitants (10.15 percent of total population), and had a population density of 12 person per square kilometer.

On the basis of an annual population growth rate of 2.8 percent, ENDA estimates the 1984 left bank population to be affected by the development of the river at about 700,000 (698,000),[36] divided among the four departments as follows: Dagana 255,000 (132,000 rural, 123,000 urban), Podor 180,000 (170,000 rural, 10,000 urban), Matam 215,000 (203,000 rural, 12,000 urban), and Bakel 48,000 (40,000 rural, 8,000 urban). As shown, the population is largely rural (78.2 percent of total). The numbers reflect an even greater rural bias if we exclude the town of Saint-Louis, with a 1984 estimated population of 110,000. This gives us a total population of 588,000 of whom 43,000 or only 7.31 percent are urban, raising the percentage of the rural population to a very high 92.69 percent.

2.1 Ethnic Structure

Rural population density varies from one zone to another (waalo or jeeri), with higher population concentrations near the waalo. Engelhard (1986) estimates densities in the delta area and between Cascas and Thilogne at 20/km^2 and 50/km^2, respectively. Ethnically, the Fleuve Region is composed of Wolof (25 percent), Toucouleur (62 percent), Fulbe (4 percent), Maure (2 percent), Soninké (5 percent), and others (2 percent) (SCET International 1975; cited in Engelhard [1986:97]). The HaalPulaar, composed of Toucouleur and Fulbe, are the most numerous and are concentrated, along with the Maure, in the middle valley where waalo

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[35] This section is derived primarily from the following documents: P. Engelhard, Enjeux de l'après-barrage, Vallée du Sénégal, 1986; A. Lericollais, Peuplement et migrations dans la vallée du Sénégal, Cahiers ORSTOM: Séries Sciences Humaines, 1975, vol. 12, no. 2, pp. 123-135; and A. Lericollais and Y. Diallo, Peuplement et cultures de saison sèche dans la vallée du Sénégal, ORSTOM, 1980. The reader will notice some inconsistency in the population figures that are cited. This can be explained partially by the various sources utilized and partially by the levels at which the figures were gathered: national, the entire Senegal side of the valley, waalo cultivation figures for the entire valley (including Senegal and Mauritania), and specific departments on the Senegal side of the valley.

[36] Using the same rate of annual increase we can estimate the 1990 population size of the left bank of the Senegal River at 826,146.

cultivation is dominant; the Wolof are found largely in the delta and the Soninké in the upper valley area, upstream from Bakel (Lericollais and Diallo 1980:5).

2.2 Demographics of Waalo Cultivation

On the basis of a survey of peoples and cultures of the Senegal Valley including Mauritania (conducted by ORSTOM during four consecutive dry seasons beginning in 1970),[37] Lericollais concludes that, of the 289,000 km^2 area of the entire valley, waalo occupies about 10,000 km^2. In a year of average flooding, about 10 percent or 100,000 ha of this waalo is cultivated (Lericollais and Diallo 1980:5). Lericollais estimates the number of persons practicing waalo cultivation on both sides of the river at about half a million, divided among five major ethnic groups: the Wolof in the lower valley, the Toucouleur, the Fulbe, and the Maure in the middle valley, and the Soninké near Bakel (ibid.).[38]

In addition to some larger towns, these populations live in various other locations: villages, situated on the border of the jeeri or on higher elevations of water courses; semi-permanent jeeri camps and hamlets where people live only part of a year; temporary thatch huts at the periphery of waalo fields; and seasonal Maure tent camps, located near water points, pastures, or waalo fields (ibid.:10).

Tables 2.1, 2.2, and 2.3 and figures 2.1, 2.2, and 2.3, compiled from Lericollais and Diallo (1980), show the total number of Senegal Valley people practicing waalo by ethnicity, country of residence (Senegal or Mauritania), and arrondissement. The cited figures refer only to those active in waalo cultivation and not to total populations. For example in the arrondissement of Rao (Senegal), where the total number of people is calculated at 19,698, the number of those involved in waalo cultivation is zero.[39] In the arrondissement of Olodou and the town of Bakel, 8,715 cultivators were identified out of a total population of 23,723, while

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[37] The survey was based on population lists gathered and updated yearly by the *chefs* of the arrondissement and the *sous-préfets* (Lericollais and Diallo 1980:9). The survey covered 24 riverine administrative divisions or a total of 69,702 *carrés* or tents. Three lists of data were created that differentiated the populations active in waalo cultivation by ethnicity/area of cultivation, ethnicity/dry season habitation, and by administrative division/residence/ethnicity (ibid:14).

[38] It is not clear whether the estimation was for 1980 (publication year) or for 1970-1973 (survey years). Based on Lericollais and Diallo's population figures as they appear in the seven "map" reports (Cartes A to G), we come up with an entirely different number for those practicing waalo: 364,132.

[39] For the arrondissements of Ross-Bethio (Senegal), Keur-Massène (Mauritania), and Rosso-Ouest (Mauritania), people cultivating the waalo include rice cultivators on perimeters active since 1964. For the other arrondissements included in the survey, only those growing waalo sorghum or cultivating falo were included.

on the right bank, in the department of Sélibabi (1973), 7,399 out of 45,368 inhabitants were identified as waalo cultivators.

Table 2.1 Persons Dependent on Waalo Agriculture by Ethnicity and Place of Residence: Senegal (S) and Mauritania (M) (1970-73)

Arrondissement	Ethnic Group						
	Maure	Peul (Fulbe)	Soninke (Sarakole)	Pulaar	Wolof	Autre	Total
A) Rao (S)	0	0	0	0	0	0	0
B) Ross-Bethio (S)	553	2,083	53	1,041	6,137	323	10,190
C) Keur-Massène (M)	525	0	0	0	290	2	817
D) Rosso-Ouest (M)	309	0	0	27	1,187	0	1,523
E) Jedril-Mohageune (M)	2,506	1,196	5	15	4,435	196	8,353
F) Rkiz (M)	25,057	1,060	0	4,281	2,253	129	32,780
G) Mbane (S)	1,558	1,140	24	239	4,063	49	7,073
H) Tyile-Boubaker (S)	636	4,912	11	4,619	1,360	16	11,554
I) Bouge-Ouest (M)	11,001	1,440	9	18,791	871	155	32,267
J) Ndioum (S)	806	5,677	226	14,753	1,550	195	23,207
K) Bababe (M)	5,154	1,290	0	13,861	25	16	20,346
L) Mbagne (M)	1,631	1,107	0	11,405	14	52	14,209
M) Kaskas (S)	245	10,465	253	14,920	0	43	25,926
N) Salde (S)	163	6,575	3	10,082	16	8	16,847
O) Kaedi (M)	13,546	3,621	2,198	19,304	0	79	38,748
P) Thilogne (S)	638	7,527	3	15,805	0	[illegible]	23,981
Q) Ourossogui (S)	226	4,541	774	21,622	38	36	27,237
R) Magama (M)	1,581	3,264	5,713	19,494	6	0	30,058
S) Kanel (S)	116	1,261	897	12,070	0	11	14,355
T) Seme (S)	0	390	3,705	4,452	0	0	8,547
U) Sélibabi (M)	0	107	7,024	268	0	0	7,399
V) Olodou (S)	42	767	7,169	655	9	73	8,715
Total	66,293	58,423	28,067	187,704	22,254	1,391	364,132

Figure 2.1 Persons Dependent on Waalo by Ethnicity/Place of Residence: Both Banks 1970-1973

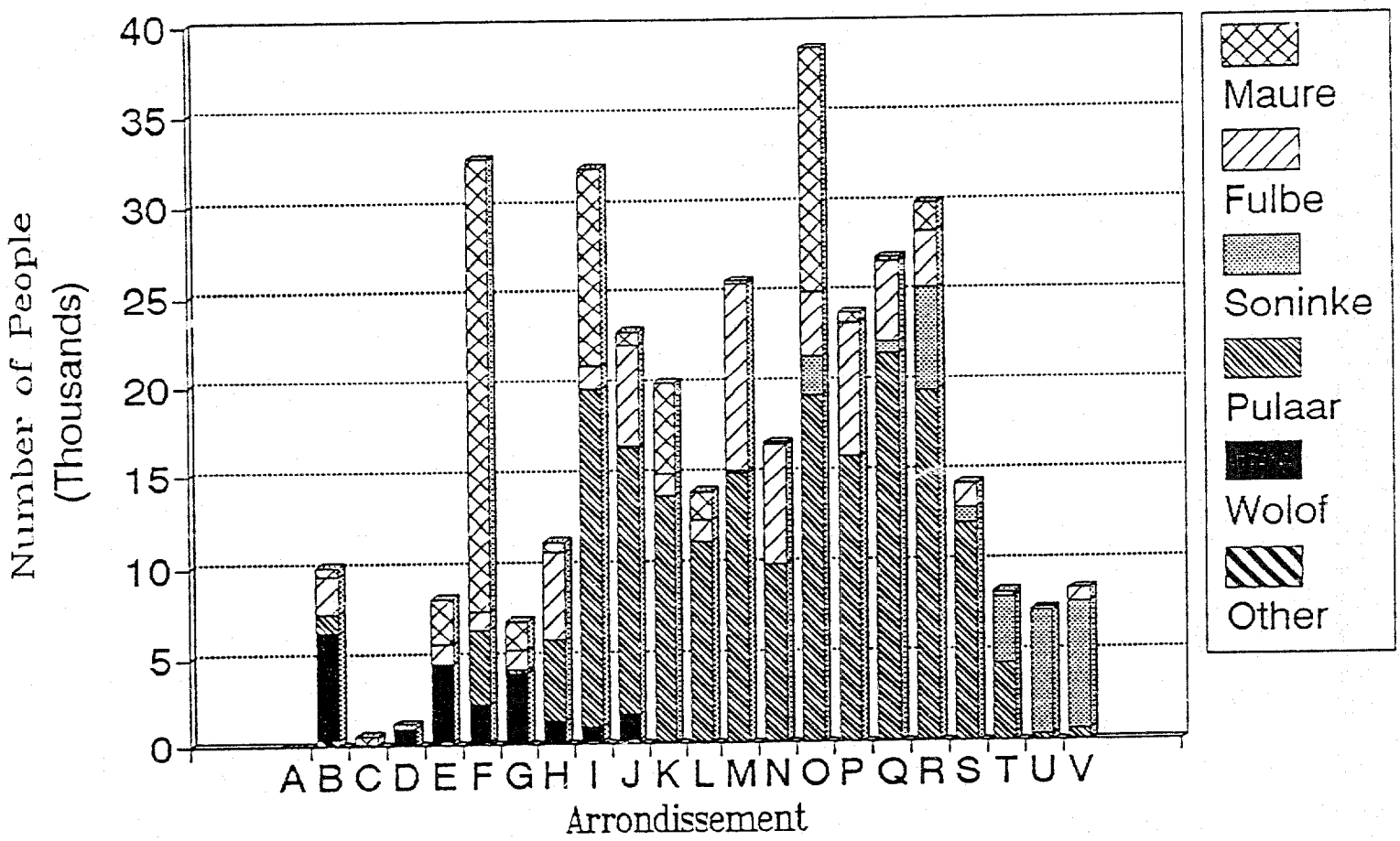

Table 2.2 Persons Dependent on Waalo Agriculture by Ethnicity and Place of Residence: Senegal (1970-73)

Arrondissement	Ethnic Group						
	Maure	Peul (Fulbe)	Soninke (Sarakole)	Pulaar	Wolof	Autre	Total
A) Rao	0	0	0	0	0	0	0
B) Ross-Bethio	553	2,083	53	1,041	6,137	323	10,190
G) Mbane	1,558	1,140	24	239	4,063	49	7,073
H) Tyile-Boubaker	636	4,912	11	4,619	1,360	16	11,554
J) Ndioum	806	5,677	226	14,753	1,550	195	23,207
M) Kaskas	245	10,465	253	14,920	0	43	25,926
N) Salde	163	6,575	3	10,082	16	8	16,847
P) Thilogne	638	7,527	3	15,805	0	8	23,981
Q) Ourossogui	226	4,541	774	21,622	38	36	27,237
S) Kanel	116	1,261	897	12,070	0	11	14,355
T) Seme	0	390	3,705	4,452	0	0	8,547
V) Olodou	42	767	7,169	655	9	73	8,715
Total	4,983	45,338	13,118	100,258	13,173	762	177,632

According to these figures, 364,132 people practiced recession cultivation in the period between 1970 and 1973. Assuming that this figure is applicable to the year 1971, and using Engelhard's (1986) estimated annual growth rate of 2.8 percent, one arrives at a total 1990 population of 615,358 inhabitants deriving at least part of their income from recession cultivation.[40] The number of people to be impacted by the loss of recession cultivation increases if we base our calculations on the annual growth rate of 3.4 percent cited for Matam in the Plan Directeur de Développement Intégré pour la Rive Gauche (Gersar/CACG et al. August 1988).[41] Moreover, if we assume that there was a similar rate of population growth in the rest of the valley including the right bank, the 1990 figure of people dependent on the flood increases to 687,304.

[40] This calculation assumes that valley populations who are dependent on recession cultivation have increased at the same rate as the overall population of the left bank of the Senegal Valley.

[41] The study contends that the Matam Department population grew from 159,260 in 1976 to 238,260 in 1988.

Figure 2.2 Persons Dependent on Waalo by Ethnicity/Place of Residence: Senegal 1970-1973

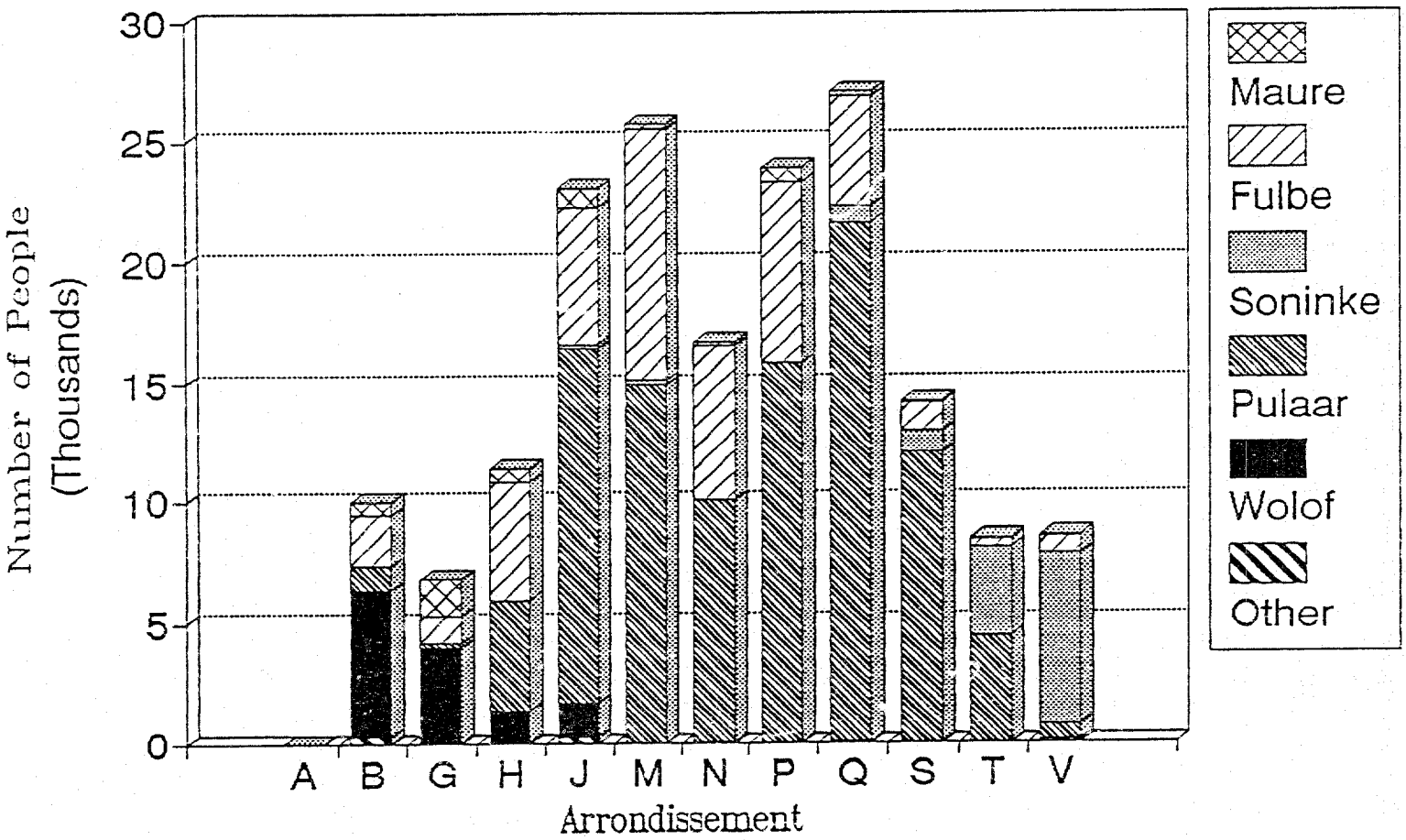

Table 2.3 Persons Dependent on Waalo Agriculture by Ethnicity and Place of Residence: Mauritania (1970-73)

Arrondissement	Ethnic Group						
	Maure	Peul (Fulbe)	Soninke (Sarakole)	Pulaar	Wolof	Autre	Total
C) Keur-Massène	525	0	0	0	290	2	817
D) Rosso-Ouest	309	0	0	27	1,187	0	1,523
E) Jedril-Mohageune	2,506	1,196	5	15	4,435	196	8,353
F) Rkiz	25,057	1,060	0	4,281	2,253	129	32,780
I) Bouge-Ouest	11,001	1,440	9	18,791	871	155	32,267
K) Bababe	5,154	1,290	0	13,861	25	16	20,346
L) Mbagne	1,631	1,107	0	11,405	14	52	14,209
O) Kaedi	13,546	3,621	2,198	19,304	0	79	38,748
R) Magama	1,581	3,264	5,713	19,494	6	0	30,058
U) Sélibabi	0	107	7,024	268	0	0	7,399
Total	61,310	13,085	14,949	87,446	9,081	629	186,500

Adapted from Lericollais, A. and Y. Diallo, "Peuplement et cultures de saison sèche dans la Vallée du Senegal, Cartes A-G. ORSTOM, 1980.

2.3 Migration

According to Engelhard,[42] in 1970-1971 49.4 percent of the total male population were under 15 years of age. Those between 15 and 44 represented 33.8 percent. Among women, the proportion in these same age groups was slightly inverted: only 38.6 percent of all women were under 15; women between 15 and 44 represented 43.7 percent. The larger proportion of women to men in the 15-44 age group is attributable mostly to the active engagement of men in labor migration.

Although recent demographic growth and the Sahelian drought of the 1970s has intensified the rate of labor migration out of the Senegal Valley, migration in the Valley can be traced back to the arrival of early Europeans in the 17th century. Six general reasons for migration can be discerned:

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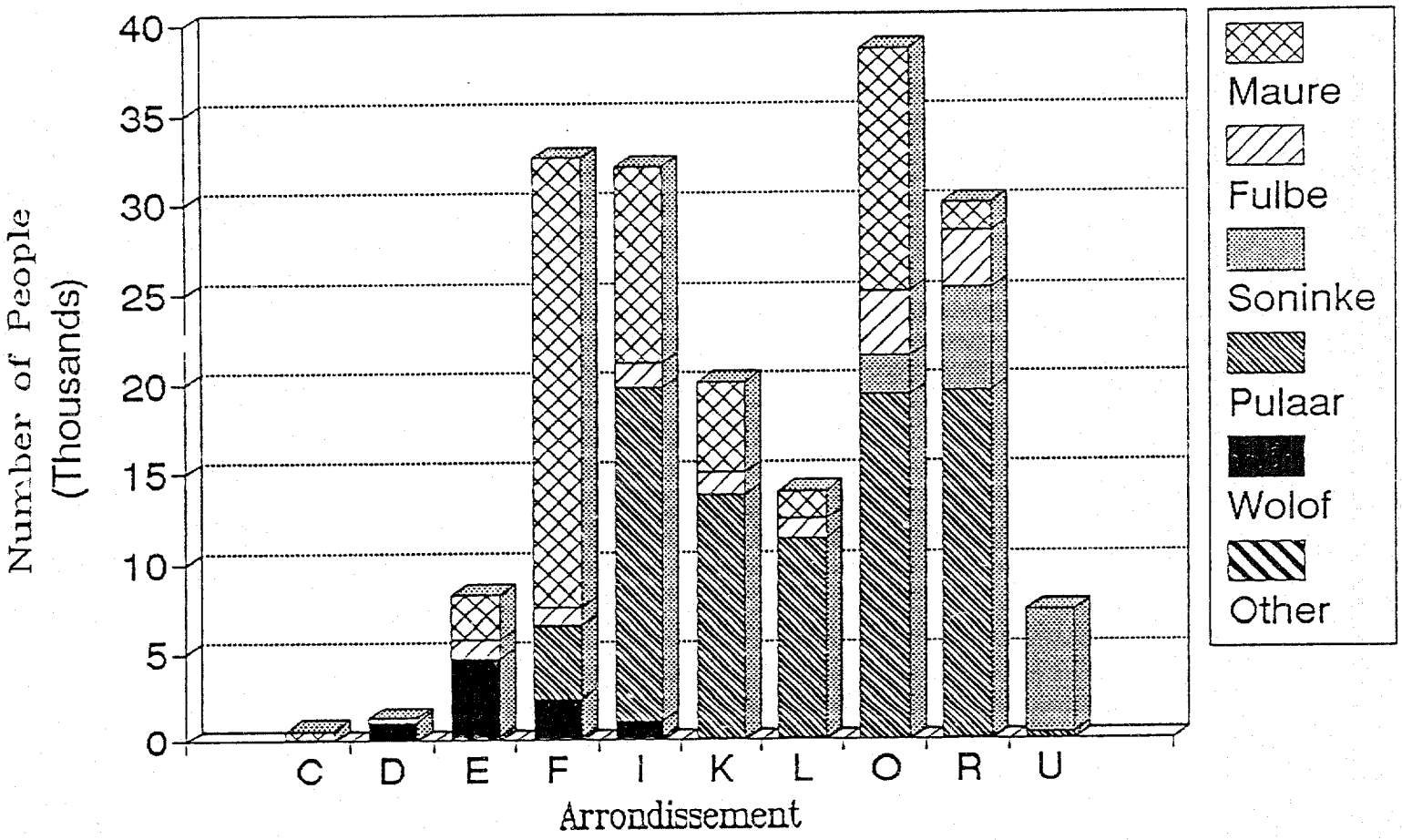
[42] The studies undertaken on mortality rates in Senegal are based on the following surveys:
1) the 1960-1961 retrospective survey;
2) the 1970-1971 survey with repeated interviews;
3) the 1978 Senegalese fertility survey.

Information also came from state records in Dakar, the MISOES survey, and ORSTOM's survey of rural areas (Engelhard 1984:84).

Figure 2.3 Persons Dependent on Waalo by Ethnicity/Place of Residence: Mauritania 1970-1973



(1) the establishment by the colonial administration of a head tax, the forced enlistment of men to construct the railway from Thiès to Kayes, and the enlistment of men to participate in World War I;

(2) the creation since the 1950s of various informal sector establishments in the cities and towns of Senegal, especially hotels and restaurants, which attracted a large number of young men from the Valley;

(3) the inability of many Valley households to support themselves in the area because of a combination of demographic growth, a severe drought, and perhaps various development interventions that changed the nature of the production system in the area;

(4) the establishment of labor intensive agricultural development schemes in other regions of Senegal, especially the peanut basin;

(5) the construction of the *route nationale* which facilitated longer-distance movement;

(6) the emergence of relatively attractive labor opportunities in various African and European cities and a certain receptivity to migrant foreign labor.

The reasons behind migration today are more complex than those cited above. For example, migration is more important in the Upper and Middle Valleys with more favorable environmental conditions especially in terms of rainfall than in the lower valley and delta areas.

Migration has taken various forms and directions and involves all ethnic and occupational groups; it occurs internally within the Valley itself, from the Valley to other towns and regions of Senegal, and outside of Senegal to other African countries and to Europe, especially France. In the early 1960s, 25 percent of all active men in the Valley participated in migration (Boutillier et al. 1962). This number rose slightly to 25.5 percent in 1972 (Lericollais 1972). In 1988 in the arrondissement of Ourossoggui, 71.5 percent of active men were involved in labor migration (Nuttall 1989). Of those, 39 percent were in urban areas in Senegal, 33 percent were in other African countries (mostly French speaking), and 28 percent in France (ibid.).

3. The Development of the Senegal Valley: Background

3.1 Irrigation in the Senegal Valley: An Overview

Although large-scale attempts to regulate the flow of the Senegal River started in this century, some efforts were made as early as 1822 when the French experimented with irrigated cotton, sugarcane, tobacco, indigo, rice, and vegetables at Richard Toll in the Delta. Irrigation at Richard Toll was conducted through a combination of controlled flooding of the basins intended for cultivation and the use of small dikes. Because of poor performance (attributed to soil salinity, ineffective irrigation techniques, poor choice of crops, and an inhospitable climate that the new European settlers could not adjust to easily, not to mention land tenure and labor availability problems), this early effort at irrigation by submersion was abandoned in 1831 (Miller 1984:21; Morris 1986:18; Ndiame 1985:21; Patterson 1984:20).

Interest in the irrigation of export crops through controlled flooding and cultivation of dike-protected basins reemerged in the twentieth century. Because of the major food deficits the country was facing, this narrow focus on export crops was revised in the 1930s. A Mission d'Aménagement du fleuve Sénégal (MAS) was charged with agricultural research and the development of irrigation schemes, mainly to increase domestic food production.

In 1945, irrigated rice cultivation was relaunched at Richard Toll. Although the mechanisms for irrigation and water control in the Delta and the rest of the Valley would change over the years, irrigation at Richard Toll was accomplished with controlled submersion, ensured by the installation of a powerful pumping station. Richard Toll was created to develop 50,000 hectares over a 10 year period; by 1957, however, only 6,000 had been developed (Patterson 1984:44).

As late as 1957, irrigation was developed without reference to local farmers. In 1960 and 1961 two organizations, one charged with the development of the delta (Organisation Autonome du Delta, OAD) and the other with the rest of the Valley (Organisation Autonome de la Vallée, OAV) were created by the Ministry of Agriculture to develop "irrigation systems by the controlled submersion technique, [to form] a peasantry skilled in irrigated agricultural practices, and [to produce] enough rice sufficient for reducing imports" (ibid.). This was the first large-scale attempt to involve the local peasantry in irrigation using controlled submersion (Seck and Lericollais 1986/87:4). In January 1965, OAD was replaced by the Societé d'Aménagement et Exploitation des Terres du Delta (SAED), whose function was seen as producing to reduce the food deficit in Senegal and to encourage development in the Delta by increasing the standard of living of farmers there (ibid.). Eventually SAED took responsibility for OAV projects as well.

Because of SAED's inadequate performance (for example, only 8,000 hectares, mostly in the Upper and Middle Delta, were developed out of an envisaged area of 30,000 hectares) and the Sahelian drought of 1967-1974, an interest in village-level irrigation perimeters for food production, initially sponsored by FAO, emerged in Mauritania in 1973 and in Senegal in 1974,

first in the region of Matam and later in Aere-Lao and Bakel (Gersar/CACG et al. 1980). By 1985, 522 small perimeters on both sides of the river, extended over an area of 10,000 hectares, and involved about 35,000 households (Diemer and Van der Laan 1987:47).[43]

The desire to focus on irrigation was highlighted in 1977/78, the year Senegal imported more than 600,000 tons of cereal (57 percent of the country's need) (Club du Sahel 1979:vii). To reduce dependence on imports, the government in its Fifth Plan (1977-1981) allocated half of the total agriculture budget (50.8 billion FCFA) to irrigation. The transition to irrigation was to be accelerated by installing large dams to regulate the Senegal River. The World Bank's review of its own involvement in Senegal from 1960 to 1987 sums up this period:

> Emphasis on import-substituting rice production had emerged as a key feature of government policy by the end of the 1960s, largely in response to the growing food import bill. By 1970 there was a shelf of a dozen rice projects. Production costs in the proposed large-scale irrigation schemes in the Fleuve region were estimated to exceed the landed cost of imported rice by some 30%, however, and the Bank consequently favored and supported the development of rice in the Casamance region. Yet, by the mid-1970s, the Bank's approach changed. The government was now urged to invest in rice schemes in the Fleuve, because it was now estimated that the projected barrage at Diama and the dam at Manantali would make economic rice production possible: there was little indication, however, that these estimates were based on detailed studies. Furthermore, this apparent shift in Bank emphasis had limited translation into resource allocation by the Bank, largely because of continuing doubts about the economic viability of rice production (The World Bank 1989:vi).

3.2 OMVS and the Development of the Senegal Valley

The Organisation pour la Mise en Valeur du Fleuve Sénégal (OMVS), founded in March 1972, represents a third attempt by Senegal basin states to create an organization capable of overseeing the development of the region. Its two predecessors, in both of which Guinea was a member, are the Inter-State Committee, founded in 1963, succeeded by the Organisation des Etats Riverains du Sénégal (OERS) in 1968. "The Constitution of the OERS was in fact meant to be a step towards pan-African unity with the goal of regulating all economic, social, cultural and even military activities of the four states" (Godana 1985:220).

A major goal of OMVS was the stabilization of the Senegal River flow at 300m^3/sec. at Bakel, to allow for irrigation, navigation, and power generation. OMVS's desire to attain this

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[43] Boutilier and Schmitz (1987:534) note more than 750 perimeters, on both sides of the river, occupying about 40,000 hectares by the end of 1985, while Belloncle (1985:60) observes that when he undertook his study in 1982 SAED was in charge of managing about 14,000 hectares of which 10,000 were occupied by large-scale perimeters and the rest by about 250 PIVs of 10 to 25 hectares each.

three-tiered goal coincided with the Sahelian drought and the severe food shortages of the early 1970s. Consequently, the Senegal River Valley and other areas of the Sahel attracted intensive donor attention and prompted massive economic assistance. In the Senegal Valley this expressed itself in the construction of two dams that were to facilitate the development of irrigation and thus transform the region into a major rice producing area by the 1990s.

The Diama dam, near the mouth of the river in the lower valley, was budgeted at $US 93 million and aimed at the prevention of salt intrusion from the sea, as well as the development of irrigation and navigation. The Manantali dam, in the southwestern region of Mali on the Bafing tributary of the Senegal river, was budgeted at $US 370 million and had as its objectives:

- to regulate the flow of the river and guarantee a minimum flow at Bakel of 300 m^3/sec throughout the year (the annual average flow at Bakel is 750 m^3/sec);
- to permit irrigation year round (dual season) on 375,000 ha.;
- to permit navigation year round upstream of Kayes;
- to generate electricity (800 Gwh/year) (van Lavieren, B. (Euroconsult-Arnhem) and J. C. J. van Wetten (RIN-Texel), Profil de l'environnement de la vallée du fleuve Sénégal, partie 2, n.d.:7).

Navigation was allotted $US 280 million for ports and landing channels, but never financed. Power transmission was allocated $US 190 million and another $US 80 million for the construction of a power plant at Manantali. This brought the overall cost to $US 753 million (Anderson 1987:1). Diama was completed in 1985 and Manantali in 1988.

As of September 1990, none of the three long-term goals of the Manantali Dam has been met. Only a minute fraction of the area intended for irrigation is currently being irrigated. No electricity is likely to be generated for at least five years because of the absence of turbines and power lines, and navigation shows little prospect of being justifiable economically, even in the long run.

3.3 Controlled Flood/No Flood Scenarios

As contemplated by OMVS, stabilization of the Senegal River regime will require the termination of the portion of the annual natural flood controlled by the Bafing tributary of the Senegal that has allowed the inhabitants of the area to practice recession cultivation. Three causes prompted a decision to allow a transitional period in which an annual controlled release from the Manantali Dam would simulate the natural flood to allow for recession cultivation. These were the delay in turbine installation, the anticipation that "it will probably be 10 to 20 years before irrigation can provide self-sufficiency in food in the valley,"(Sir Alexander Gibb and Partners 1987:1-2) and the desire of the three States to allow the people to be "weaned" from recession cultivation and to bring them more gradually towards full-scale irrigation.

> The decision to control the flow of water in the Senegal river was taken by the riverine states largely because of a desire to develop irrigated agriculture. To date, however, only 40,000 ha of the possible 375,000 ha have been prepared for irrigation, and the rate of increase in irrigated areas does not exceed 5,000 ha per year. Thus, it will not be possible in the foreseeable future to provide access to irrigated perimeters to all farmers in the valley (approximately 365,000 working age adults in 1990). These farmers will therefor continue to depend on flood recession farming. During this "transition" period, then, there will be an annual controlled release from the reservoir at Manantali (IDA translation) (Guerber 1985:1).

As of the 21st meeting of the OMVS Consultative Committee, held in Bamako, Mali, in December 1989, OMVS still plans to terminate the artificial flood by the year 2000.

> The High Commissioner presented a multi-year (1989-2000) program for irrigated perimeter development and the elimination of the artificial flood. . . . He insisted on the importance of establishing new irrigated perimeters in areas currently under recession cultivation prior to the completion of the power generating plant to avoid water use competition (USAID 1989).

The Commissioner's remarks are based on the assumption of an incompatibility between a controlled flood on the one hand, and power generation and irrigation on the other. In other words, the controlled flood is thought of as an option that allows the escape of waters that are no longer available either for irrigation or for electricity. Furthermore, the demand for labor in recession cultivation is seen to compete with labor needed for a second dry season irrigation cropping.

In fact, as this report will attempt to demonstrate, the incompatibility may have been seriously overstated. Hydrological data for the period 1904 to 1984 indicate that in most years both a controlled flood release and the generation of 86 megawatts of power would have been possible. To date, moreover, calculations comparing the costs of continuing recession cultivation and those associated with the maximum generation of power have been too simplistic. The benefits from flood recession cultivation in terms of net yields per unit of land have been set against the loss in power that would have been generated with the same amount of water.

> The establishment of a guaranteed artificial flood is an additional service rendered to farmers whose traditional form of agriculture has been extremely unreliable since the onset of the drought fifteen years ago. On the other hand, should the artificial release need to be maintained over a long period, and notably beyond the installment of the power generators at Manantali, there will be conflict with the production of electricity. Foregone power could encourage the construction of hydropower projects elsewhere (IDA translation) (Félou et Gouina) (Sir Alexander Gibb and Partners, et al. Septembre 1986:7/1).

> Net benefits accruing from flood regression cropping is approximately 34,000 FCFA/ha for a yield of 600 kg/ha (unit price of sorghum of 95 FCFA/kg less the cost of inputs at 22,600 FCFA/ha), that is slightly less than the expenditure incurred (Sir Alexander Gibb and Partners, et al. August 1987:8).
>
> A study undertaken by A. Gibb/EDF/EC estimates that the opportunity cost, in terms of power foregone, of water used in recession agriculture would be on the order of 50,000 FCFA/ha of recession land. The cost is extremely high as it is well above the gross value of production on the floodplain (400 kg/ha x 90 FCFA/kg = 36,000 FCFA) (IDA translation) (LeBloas 1986:3).

The calculations do not take into account built-in costs of generating electricity, nor, for that matter, the numerous benefits of the flood over and above crop production: provision of crop residues for sale, livestock grazing of harvested fields with the added advantage of fertilization, reproduction of the fish population, reforestation, and recharge of the aquifers.[44]

Individual member states do not necessarily continue to share in full the Commissioner's views vis à vis recession cultivation and irrigation. In January 1989, for example, the government of Senegal adopted a more experimental posture towards the continuation of recession cultivation, showing a readiness in testing the hypothesis that a controlled release

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[44] Interestingly, when developers wail the high costs and poor returns of recession cultivation they seem to forget that irrigated production is far more costly in both capital and labor requirements. This is true whether we are considering large-scale or village-level perimeters. Discussing the rice production on PIVs Seck and Lericollais note:

> Production of rice in the valley is very costly; this is all the more shocking when one compares the cost of domestic rice with that imported. Rice is subsidized at all stages of production:
>
> - the amortization of investments in rice production are not factored in;
> - the prices of water, fertilizer, and other inputs do not reflect real costs;
> - the costs of processing are covered in part by the state (IDA translation) (1986:6).

On large-scale perimeters the situation is much worse. Diemer and van der Laan list five negative impacts of large-scale perimeters: very high cost, high governmental subsidies, high rehabilitation costs which average half of initial construction costs, rapid multiplication of water-related diseases such as bilharzia and malaria, and environmental degradation. "It has been calculated that in the Sahel for each hectare that is prepared for irrigation, there is one that is forced out of production because of salinization (IDA translation) (Earthscan 1984)" (Diemer and Van der Laan 1987:13-15).

allowing for recession cultivation, aquifer recharge, reforestation, and other environmental enhancements might be made permanent, even after the installation of turbines at Manantali: "Monitoring the impact of the artificial flood constitutes a critical activity in the sense that it will permit an understanding of whether to terminate it because of its eventual competition with hydropower generation or to continue it to some as yet undetermined date" (Ka 1989:16).

3.4 Floodplain Productivity during the Transitional Period

When evaluating the importance of the annual flood to regional and household economy and ecology, it is crucial that all its functions be recognized. Viewed only in terms of its contribution to recession cultivation (despite the importance of this farming system in the maintenance of peasant households), the flood may seem a tremendous waste of valuable potential energy. However, once recession cultivation is seen as one element in an integrated production system all of which is dependent on the flood, maintaining the flood is no longer so bleak a proposition. Not only does it allow hundreds of thousands of smallholders to practice recession cultivation, it also facilitates the pursuit of other strategies such as agropastoralism and fisheries, and it contributes importantly to reforestation and ground water recharge.

> It has been reported that dam construction on rivers reduces downstream floodplain fisheries. For example, inundation of the lower Volta River floodplains has stopped completely, following the construction of the Akosombo dam (Hall and Pople 1968). Considerable portions of the Niger River floodplain downstream from the Kainji dam are no longer inundated. As a result, fish catches have diminished by more than 50 percent during some years (FAO/UN 1972).
>
> For the Senegal River, Reizer et al. (1972) estimate a maximum surface inundation of approximately 500,000 hectares during exceptional floods. Based upon an average annual fish productivity of 70 kilograms per hectare, it can be estimated that 35,000 tons of fish are produced during an exceptional year. Reizer et al. predict a loss of 100,000 hectares of inundated floodplain after dam construction. This loss in inundated floodplain would therefore result in a loss of 7,000 metric tons of fish (Gannett Fleming, Corddry, and Carpenter, Inc. 1978, Assessment of Environmental Effects of Proposed Developments in the Senegal River Basin: Partial Report for Fisheries, p. 72).

Despite the perceived conflict of interests, the OMVS has conceded the need to monitor productivity of the floodplain during the transitional phase, and to test hypotheses concerning the gains and losses that can be anticipated among the competing production systems under both flood and no flood scenarios. In order to measure the tradeoffs that can be expected by maintaining or eliminating one production system over another, costs and benefits should accurately reflect the true productive potential of the system, in both economic and environmental terms. Placing a numerical value on the latter is extremely difficult, and qualitative estimations of the economic value of an ecosystem can never fully capture the intangible benefits to be found in nature.

4. Research Context

4.1 Research Objectives

This study seeks to identify the many factors that shape and orient peasant responses to the controlled flooding of the Middle Valley of the Senegal River Basin provided by the Manantali Dam. The most important sources of information on this subject provide only limited insights to current problems, for the valley has undergone rapid changes.[45] This study investigated the productive potential of traditional and modern agriculture in terms of the three factors of production: land, labor, and capital. We compared indigenous and modern systems in their capacity to:

- provide income per unit of land area, labor, and production costs
- allow equitable access to the factors of production, and
- increase household revenue through higher yields.

Data were collected in the three following categories:

- agropastoral production,
- the domestic economy,
- socioeconomic stratification in *haal pulaar* society.

In addition to the specific problems addressed by the study, it is hoped that the research will also have contributed to a better understanding of the *Fuuta Tooro* and of the changes that its populations are facing.

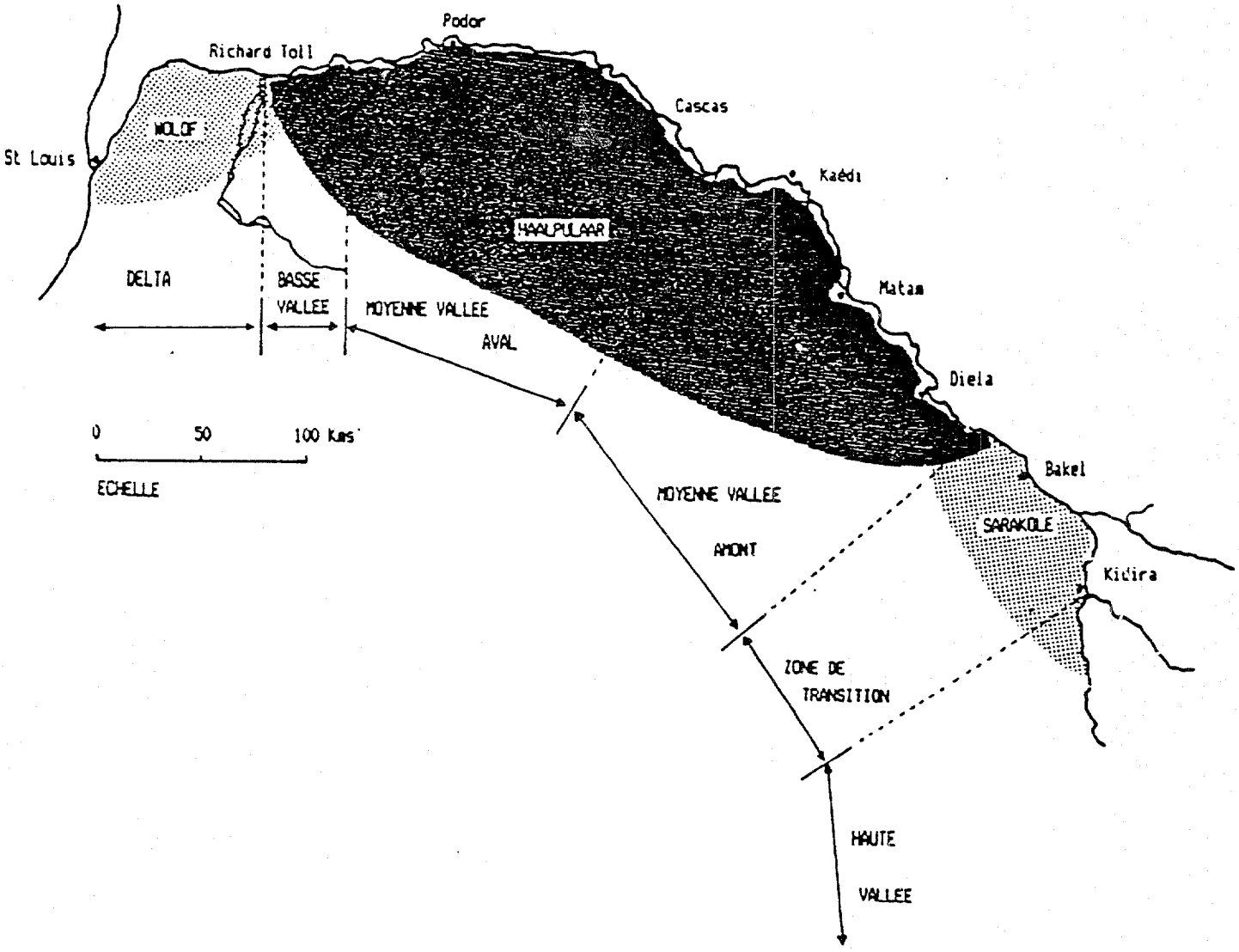
4.2 Geographic Context

4.2.1 The Middle Valley of the Senegal River

Travel downstream in the Senegal Valley (see Figure 4.1) follows the Upper, Middle, and Lower Valleys, to the Delta. The Middle Valley's relatively wide floodplain (8 to 15 km), called the *waalo*, supports recession agriculture. The Middle Valley can be subdivided into a downstream and an upstream portion. What distinguishes them, aside from the height of the

[45] The principal reference works concerning the socioeconomic problems of the valley at the household level are those of Boutillier et al. (1962) undertaken in the late 1950s, Minvielle's monograph (1985) based on work conducted in 1975, and OMVS reports (1980).

Figure 4.1 Geographic Representation of the Dominant Ethnic Groups in the Senegal River Valley



banks along the river and the characteristics of the flood (flow rate, calendar), is their rainfall. The downstream area, represented by the department of Podor, receives less than 300 mm of water per year, and can barely support rainfed agriculture. In contrast, the upstream Middle Valley, falling between the 300 mm and 600 mm isohyets, is more conducive to this production system.

The upstream Middle Valley is a valuable region for fishing and animal husbandry, and, most importantly, for a dual agricultural season: a flood recession and rainfed season that do not overlap spatially or temporally. Throughout the course of history, this agro-halio-pastoral potential has encouraged human settlement in this area. Even today, the whole Middle Valley appears to be one of the preferred zones for future large hydroagricultural schemes, despite its lag behind the Lower Valley. The three research sites, Boyenadji Roumde, Doumga Rindiaw, and Thiemping, in the departments of Ourossogui and Kanel, are situated in the heart of the upstream Middle Valley.

4.2.2 Ecological Diversity

The area inhabited by valley residents is defined by a complementary set of agro-halio-pastoral activities contained within a well-delineated territory that runs perpendicular to the river in a river-*falo-foonde-waalo-jeejegol-jeeri* transect (see Figure 4.2). Each of these different geomorphological units is a specific land type (Michel 1987).

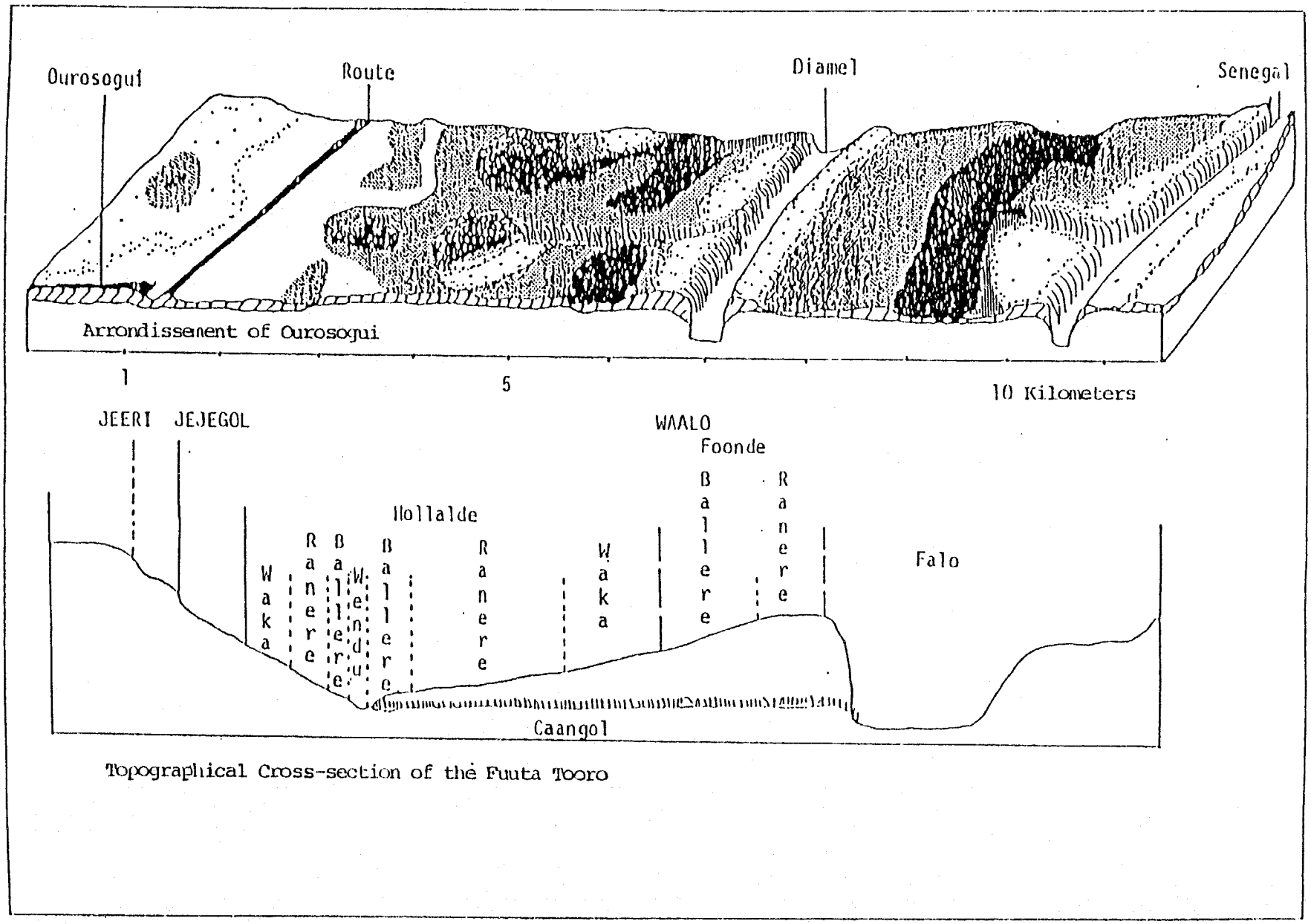
- The *falo,* located on drainage slopes on the banks of the river, is devoted to recession agriculture, where traditional garden crops are grown.

- On the *poode* (sing. *foonde*), infrequently inundated elevated areas of the river banks, rainfed agriculture is practiced. Yields are quite variable. Rice fields are located on the *poode* in Village Irrigated Perimeters established during the last fifteen years. Today, little of this area remains unoccupied.

- The *waalo*, made up of shallow depressions more or less regularly flooded, is the crucial strategic productive area for *haal pulaar* society. Here, recession grain crops requiring little preparation and maintenance are cultivated. The depressions provide an ideal habitat for the reproduction of fish during the flood. *Subalbe* (fishermen) also maintain rights and an interest in this area. And *Fulbe* (herders) bring their herds here after the harvest, thus fertilizing the fields. They too have a vested interest in the management of these lands. For all these reasons, this productive area has for a long time been coveted and is subject to specific land tenure regulations.

- Finally, the *jeejegol*, transition area between the *waalo* and the *jeeri*, as well as the *jeeri* itself, are devoted to rainfed agriculture. These larger regions where fallow is practiced are not subject to as strong land tenure pressures.

Figure 4.2 Morphology of the Senegal River Valley



Topographical Cross-section of the Fuuta Tooro

4.2.3 Uncertain Impacts of Climate: The Drought

Haal Pulaar society is doubly dependent on the level of precipitation. Rainy season agriculture on *jeeri* fields, and animal husbandry depend on the condition of pastures and water holes. Off-season agriculture and the height of the floods are tied to rates of precipitation in the whole of the upper basin of the Fuuta-Jallon.

During the last two decades, this society has been severely affected by significant ecological changes. The following two indicators reveal the amplitude of these changes:

1) Interannual and multiannual variations in amounts of precipitation between 1949 and 1988 at the Matam station. Rainfall, between 1949 and 1966, averaged 537.5 mm. The average dropped to 335.9 mm between 1967 and 1988. This reduction in precipitation is very marked. The reduction in terms of the amount of water fallen coincided with a drop in the number of rainy days (41.3 days per year for the period 1949-1965, in contrast to 33.5 for the period 1966-1988) and with a much less regular spatio-temporal distribution of rains (see Figure 4.3).

2) The development of the vegetative cover from 1960 to 1980 in the region of Boyenadji Roumde. Using two sets of aerial photos taken in 1950 and 1980, we calculated the reduction in tree cover, in particular for the dense forests of gonakié, at more than 30 percent. In addition, much of the area covered in dense forest in the 1950s has been replaced by thinly scattered copses today.

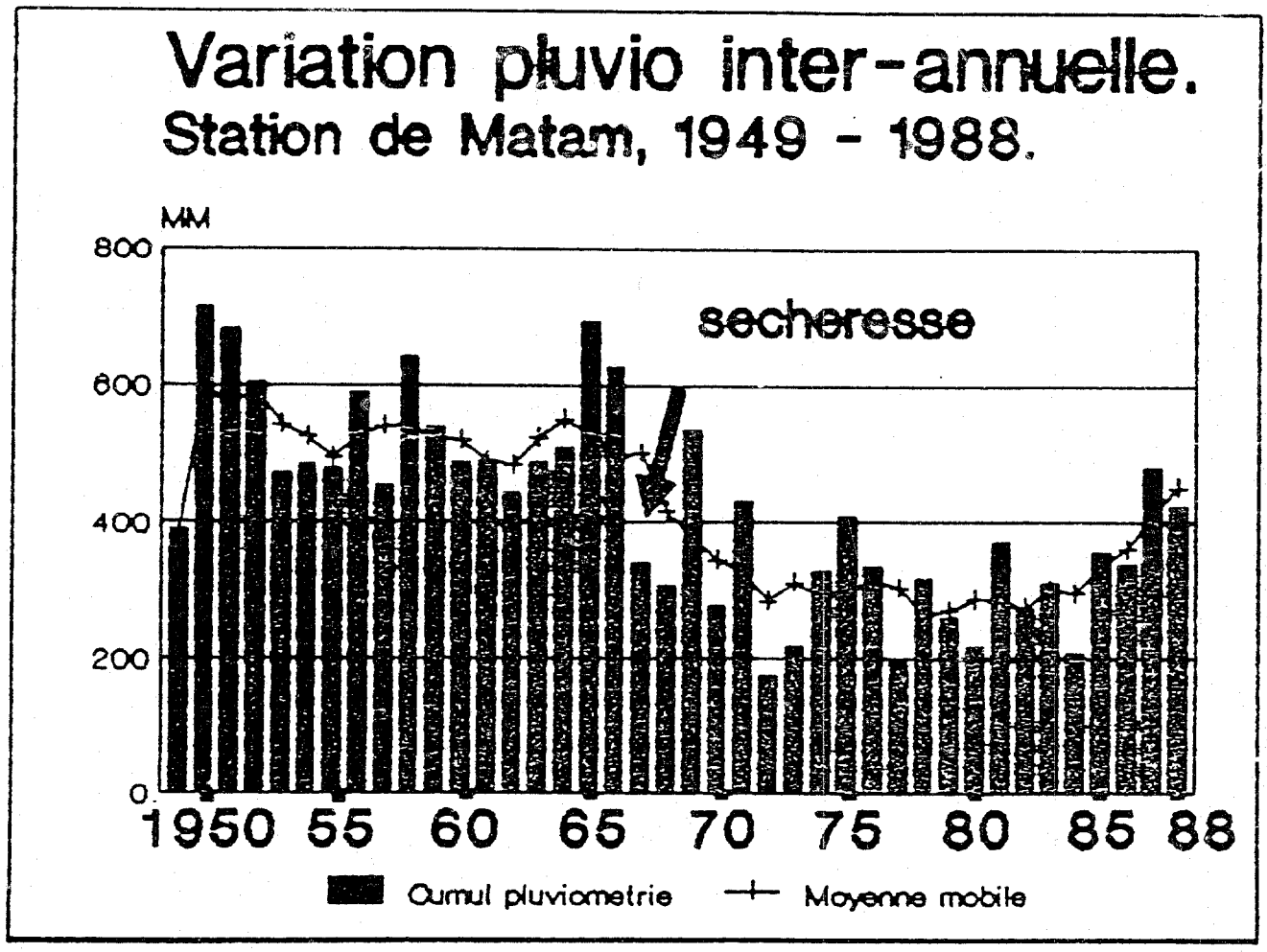
It would not be accurate to formulate a cause and effect relationship between the drought of the last twenty years and the noted degradation of the vegetative cover. This degradation is also due to human activity. Needs for energy in the form of ligneous combustibles have grown proportionally with increases in the local population. In part thanks to the poor management of forestry resources, the region today is severely degraded. The ecological damage is not irreversible, however; dense woodlands found in cemeteries and other protected areas attest to the biological potential of this artificially "desertified" ecozone.

The present climatic trend seems to be swinging back to normal, as witnessed by the appearance of new shoots springing from gonakiés previously believed dead.

4.3 The Sociocultural Context: Traditional Social Hierarchies (See Table 4.1)

Haal Pulaar society is pyramidal and inegalitarian and believed to be immutable. Inequality is based on caste divisions, on seniority rights, and on a strict gender division of prerogatives. Endogamy, the strict demarcation of castes, and the maintenance of hierarchy

Figure 4.3 Rainfall Data. Matam, 1949-1988.



provide the foundation for the social organization of this society (De Chassey 1977:210). While endogamy and the castes are clearly adhered to, the system of hierarchy is somewhat nuanced. In terms of the hierarchy of values reflecting the prestige accorded to each caste, the pyramidic arrangement has remained virtually unchanged since the Islamic revolution of the 18th century. At the same time, conditions and practices in the society are undergoing constant change. Society thus seems to be functioning at two speeds.

Table 4.1 Caste Stratification of *Haal Pulaar* Society

Social Categories	Statutory Groups	Traditional Prerogatives and Occupations
Rimbe (ardibe)	Fulbe	Former landed aristocracy; herders
	Toorobbe	Temporal or spiritual heads; farmers
Rimbe (hunibe)	Sebbe	Former warriors; farmers
	Subalbe	Fishers
	Jaawambe	Courtiers
Nyeenybe	Maabube	Weavers
(fetyiram golle)	Wayilbe	Blacksmiths, jewelers
	Lawbe	Woodworkers
	Burnaabe	Potters, ceramists
Nyeenybe		
Nyeenybe (nyagatobe)	Awlube	Praise singers, genealogists (for everyone)
	Wammbaabe	Guitarists, singers (for the Fulbe)
(Jyabe)	Maccube (sotibe)	Freed slaves
	Maccube (halfabe)	Dependent slaves

Adapted from Lericollais et al., 1990.

Though the two levels do not change at the same rate, they do influence each other. Major phenomena such as emigration, modern education, and irrigated agriculture have affected the traditional conception of hierarchy. Moreover, the dominant groups and ideologies have left a strong mark on these phenomena, a fact that is often wrongly perceived to be an attempt on the part of these groups to maintain control over these phenomena.

The traditional social hierarchy defines groups according to two sets of criteria: the degree of freedom or nobility, and productive activities specific to the group.

4.3.1 Nobility

The *Haal Pulaar* vertical hierarchy is defined by levels of "nobility" and of specific historic origins. The following description of this hierarchy is taken from the works of Yaya Wane (1969).

The first major category, that of free men or *rimbe*, is composed of four groups:

1) The *Fulbe* (sing. Pullo) are descendents of the first principalities in the Fuuta Tooro. The distinctive titles of nobility are *saatigi, ardo*, and *joom*. These are found in civil society.

2) The *Toorobbe* (sing. *Tooroodo*) are free men, marabouts of diverse origin who brought an end to the political supremacy of the *Fulbe* at the end of the 18th century. The foundation of society rests on Islamic religious criteria. Spiritual leaders, or *aalmaami*, appropriated land for redistribution. The distinguished titles of nobility, of religious connotation, are *elimaan* and *ceerno*. With the incorporation of the market economy during the last twenty years, both the foundation of the traditional economy and its leaders, the *Toorobbe*, have been undermined.

3) The *Sebbe* (sing. *Ceddo*) are descendents of former warriors whom the *Deniyankoobe* monarchs, and above all the *Toorobbe*, had situated at fords, or *juude*, on the river to guard these strategic points against Moorish invasions.

4) The *Subalbe* (sing. *Cuballo*) are fishermen. The highest title in this category is *jaaltabe*, master of the water spirits.

The second and inferior category is made up of the *Nyeenybe* (sing. *Nyeenyo*) or caste groups. They include the artisanal castes and the praise singers. These groups occupy a position subordinate to that of the *Rimbe* with whom they share patron-client relationships that are passed on from family to family.

At the bottom of the ladder are the servile castes or *Maccube* (sing. *Maccudo*). These are for the most part descendants of former prisoners of diverse origins and considered as property.

4.3.2 Group-Specific Productive Activities

In contrast to the vertical stratification of *Haal pulaar* society based on criteria of nobility, horizontal stratification rests on historically defined and distinct, but not exclusive, productive activities.

The *Fulbe* are seminomadic pastoralists who move between the *waalo* and the *jeeri*. Considering it dishonorable to work the earth, they undertake little agriculture, but base their economy on the production of livestock and its derivatives. They are a proud people, known for their courage, and were the first recent occupants of the valley, for the most part coming from Maasina in the interior delta of the Niger.

The *Toorobbe* and the *Sebbe* practice rainfed agriculture in the *jeeri* zone during the rainy season and recession agriculture on the waalo during the dry, cold season.

The *Subalbe* are fresh water fishermen. Through their close relationship with the water spirits, they monopolize transport on the *waalo* during the flood season, and on the river and the *caalli* (sing. *caangol: thalweg)* during low water season. They were among the first occupants of the valley.

The *Nyeenybe*, or artisans, contribute their creative and productive activities in traditional society. They include the *Maabube* (weavers), the *Sakkeebe* (leatherworkers), the *Lawbe* (wood workers), the *Wayilbe* (blacksmiths and/or jewelers), and the *Wammbaabe* and *Awlube* (praise singers and storytellers). They settled over time in the valley under the auspices of noble families who provided them both security and patronage.

4.3.3 Social Transformation and Caste Affiliation

The inherited division does not appear to be completely static. In fact, many factors can lead to a change in the social status of an individual or a group of individuals. This can happen to a family newly arrived in the valley from the outside. For example, in a fishing village, by making fishing its main activity, this family could become members of the fisherman caste. It could also hold for the *Nyeenybe*, who, preferring a particular craft, may change titles. In contrast, it occurs less often among free noble *Toorobbe* and *Sebbe* who keep their status from father to son.

Whole villages may change their social "class." This happened to the village of Diandiouli Bambara, whose Bambara origins are not contested, but which claims *Maccudo* affiliation. This represents a strategy of integration into *Haal pulaar* society. Apparently, social identification with the *Maccube* allows for better assimilation into *Fuutanke* society than simply remaining Bambara. In the same manner, the inhabitants of Hombo Fresbe, a village created during French colonization when slavery was abolished, and settled by former slaves owned by *Fulbe*, seek freedom and a new image today by laying claim to *Fulbe* status based on their livestock raising activities.

Few such social transformations occur, however, and they are subject to the control of village leaders, guarantors of the established order. The rules of endogamy, still strictly respected even by intellectuals and city dwellers, remain without a doubt the best protection against changes related to social status.

The most recent changes are also the most interesting because they can challenge the very foundations of traditional hierarchy. Indeed, given the hypothesis that hierarchical social organization is a product of the ecosystem in which it develops, one may wonder whether the destruction of the ecosystem will disturb the social structure. A partial answer may be found in the effects of the severe drought of the 1970s. The value of land—primarily agricultural—was greatly reduced with the drop in productivity during the ecological crisis. The local landholding

aristocracy thus lost a great deal of its power, prestige, and means of supporting its followers (the *Nyeenybe* and the *Maccube*) and dependents, in other words, the means to uphold its status.

Faced with repeated failures in rainfed agriculture, and a large reduction in arable recession land, which made it impossible for landholders to produce what they needed, most of the adult men of the *Fuuta* migrated. This brought on the economic rise of people belonging to social categories situated at the bottom of the local hierarchy.

Similarly, the evolution of the role of the village chief, the rise of the presidents of the PIVs, and the disturbances resulting from political cleavages had already seriously shaken the organization of traditional power at the village level. A veritable redistribution of roles and a new conception of authority in the villages was to be expected.

4.4 The *Leydi*: At the Crossroads of Society and Ecology

This structured society functions within a single territorial unit by way of agro-halio-pastoral activities that complement each other in time.

4.4.1 The Spatio-Temporal Dynamic of Environmental Management

When the waters of the Senegal River recede, and the soaked clay soils of the *kolaade* (sing. *kolangal*; depressions/cuvettes in the floodplains) of the *waalo* become workable (October-November), agriculturalists plant sorghum and cowpeas in their fields (*ngesa*), and sometimes feed corn in the low lands. After the harvest, at the beginning of the dry, hot, off-season, (March-April), when *jeeri* pastures and water are hard to find, herders follow well-known transhumant routes (*boowol* in the open space; *lappol* along cultivated areas; *jolirde* on the *foonde* and *tufnde* are access paths to the river) and bring their animals to graze on unoccupied *waalo* fields near marshes and running water (Schmitz 1986:363-367).

The arrival of the rainy season (June-July) draws the cultivator to the *lower jeeri* to plant *suuna*, *fela*, or *nyendiko* millet, or peanuts and cowpeas, and the herder to the upper jeeri, or in the *ferlo* where the grass is springing up, to pasture his herds of cattle, goats, and sheep. These comings and goings over distinct but complementary ecological and geographical spaces define networks of transhumance described by Bonnet-Dupeyron in a mapping study of the principal itineraries of transhumance (Bonnet-Dupeyron 1951). With the arrival of the drought, the routes to the south were extended to regions with better rainfall. The mobility of the herds had to adapt to the spatial distribution of the fodder resources. According to Milleville and Blancpamard, the more or less pronounced rainfall deficits, and their effects on the local environment, directly influence decision-making concerning the movements of the herds. The combined search for water and pasture elicited diversified strategies based on an extensive movement and on an adaptation of daily and seasonal activities to the spatial distribution of food resources (1985).

The arrival of rain raises the level of the river (September). The flood inundates the *daande maayo* (the secondary bed of the river), an area ideal for fish reproduction. During the recession period, fishermen intercept fish in the flooded thalwegs or *caali*. As the water recedes from these swampy areas, farmers again plant sorghum on *kolangal* plots, leaving fishermen with the task of watching over *lugge* (sing. *luggere*), ponds reserved for catching fish. When protected, these ponds are very productive. The fishing villages bordering the river join in their fishing efforts to maximize catches. Essentially, each village is responsible for one or more *lugge*, but these do not necessarily yield sufficient fish. Fishing is therefore conducted collectively upstream to downstream, from *lugge* to *lugge*: this is known as the *coktal*. The collective catch is then distributed among the various groups of fishermen.

Ecological management of riverine areas in the Middle Valley has never been the target of activities designed to improve its productive potential, for example by controlling the water. Ecological management has been essentially passive, even if the ecosystem seems to be managed optimally and in a manner conducive to conservation and natural regeneration. It has only been recently, with the onset of the drought, that a few peasants have tried to make some rudimentary adjustments. For example, a farmer desperately wanting his field to be flooded despite a late and insufficient flood, lowered the threshold of the *caangol* feeding his *kolangal*. Another farmer, digging a three-hundred-meter canal by means of a succession of holes (*gaabi*), intercepted the meandering flow of receding water which supplied his field during the flood period, and blocked its path with a temporary dam when the waters began to recede.

4.5 Demographic Context

The demographic trend in the population of the Middle Valley has followed a course of rapid growth during the last two decades. The arrondissement of Ourossogui, which circumscribes two of the three research sites and where 104 villages are located, was home for 31,220 people in 1962, 35,738 in 1971, 45,280 in 1978, 57,989 in 1982, and 72,757 in 1988. With an annual population growth rate of 3.3 percent, in less than thirty years the population density went from barely 60 p/km2 to more than 120 p/km2. Such a growing population is exerting pressure on the carrying capacity of the area, and the people can no longer produce the grains they need.

The population is distributed geographically in the following manner: 32.4 percent in the *waalo*, 44.2 percent along the paved highway, and 23.4 percent in the *jeeri* (Nuttall 1989:82). Over the past thirty years there has been a clear increase in the concentration of people along the road, on which all goods from the outside arrive, to the detriment of the former transportation route, the Senegal River. This progressive movement towards the road has had negative results for the *jeeri* which, despite its vastness, is emptying out. The *waalo*, which had also been experiencing a certain exodus with the current establishment of small irrigated perimeters, is undergoing a stabilization of demographic growth similar to that associated with the region in proximity to the road.

At the village level, the recent conflict between Senegal and Mauritania has introduced a new demographic variable that must be managed over the medium and long term. The large-scale and uncontrolled movement of thousands of animals is creating new ecological threats. The closed border, if it remains so, will threaten fishing activities, which provide a livelihood for thousands of families.

Given the region's current farming practices and techniques, it is no longer possible to produce enough food for the village populations. Migration seems to be the local response to population growth and drought.

5. Methodology

5.1 Site Selection

Three primary village sites in the Matam Department were selected for intensive field investigation beginning in September 1988. The population size of the selected villages is representative of the mean number of inhabitants (approximately 1,000) for villages in the middle valley. On the basis of the geomorphological transect of river-*falo-foonde-waalo-jeejegol-jeeri* described in the preceding section, three principal zones were identified as representing the socioecological diversity in the region. These three zones also incorporate secondary village sites that were studied in order to provide a broader regional perspective of the dynamic interrelationships operating among diverse communities in the same geographical subregion.

5.1.1 Doumga Rindiaw: Intermediary Zone where Agropastoralism Predominates

Approximately 30 kilometers northwest of Ourossogui in the Department of Matam, just north of the national highway, Doumga Rindiaw is located in the *jeejegol*, the ecological zone halfway between the *waalo* and the *jeeri*.

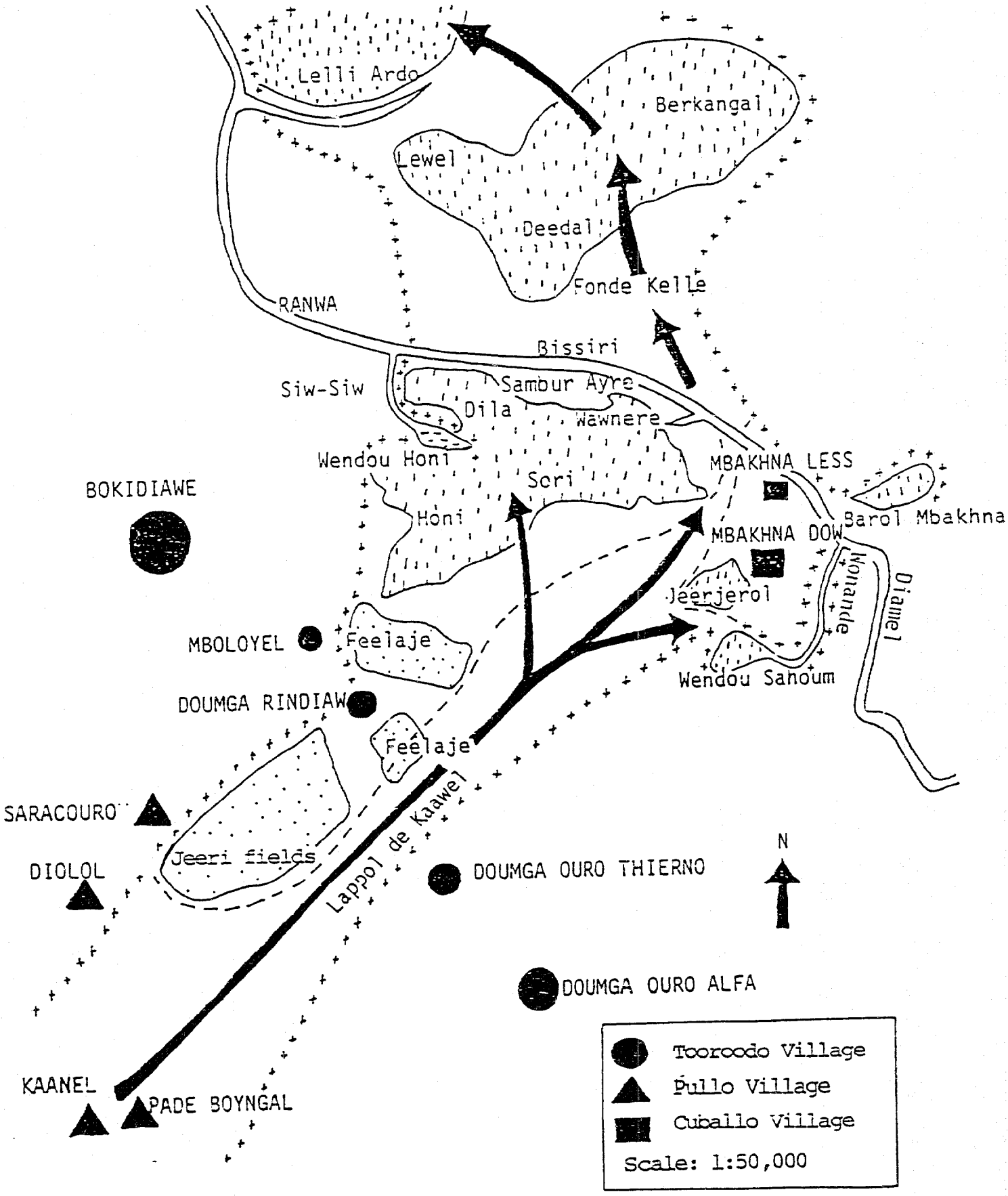
The village territory extends from the point of confluence of the Diamel into the area southwest of the national highway. It includes four very distinct zones: the sandy *jeeri* to the southwest of the national highway; the *foonde* (embankments of sandy clay) stretching southeast and northwest; the *waalo* to the north near the Diamel; and the *jeejegol* on which the village itself is located.

A cross-section of this area, at the heart of which lie ares of recession cultivation, fishing, rainfed agriculture, and pasture land, in its idealized form brings to mind the *leyde* described by Jean Schmitz (1986:363): the *Fulbe* villages of Sarakoura, Diolol, Kaawel, and Pade bordering fields of *gawri ndiyamiri* (finger millet); the Toucouleur village of Doumga Rindiaw, mostly inhabited by *Toorobbe* in the intermediate zone (*jeejegol*); and two Subalbe fishing villages, Mbakhna Dow and Mbakhna Less, on the banks of the river's tributary. In attempting to define the complex notion of *leydi*, we laid the framework of our study: the village of Kaawel became the secondary research site while the village of Mbakhna Less became the subject of more detailed studies. (See Figure 5.1.)

5.1.2 Boyenadji Roumde: Intermediate Zone where Agricultural Production Predominates

Boyenadji Roumde is situated near the national highway five kilometers from Ourossogui, a town at the crossroads between Matam-Linguere and Bakel-Saint Louis. Like Doumga Rindiaw, Boyenadji Roumde is in the *jeejegol*. Because of its intermediate position between the *waalo* and the *jeeri*, this village has control over diversified land holdings and offers access to the whole range of crops cultivated in the area. The villagers are involved primarily in:

Figure 5.1 The *Leydi*: Socioecological Relationships in the Region of Doumga Rindiaw



1) Rainfed agriculture in the *jeeri* undertaken in numerous zones such as Tiama (57.5 percent of cultivated fields), Boki (11 percent), Wendou (12.5 percent), Bellel Gaoudy (10.5 percent), Belly Koly, Seno Mogo, and Niaoural.

2) Recession cultivation on the *waalo* in depressions called Noussoum Yirlabe (86.6 percent of cultivated fields), Dounguel, and Gadievol.

3) Irrigated agriculture on perimeters. Only one of the two perimeters is operational. The more recent one, built in 1985 on 34 hectares, is worked by 50 farmers, while the other, established in 1978, was abandoned because its soils were not fit for rice culture. (See Figure 5.2.)

Boyenadji Roumde, moreover, is located adjacent to one of the largest foreign donor projects in the river valley set up to develop several medium-sized rice perimeters (Casiers Intermédiaires) in the area. Also, the village was the site of a major socioeconomic study undertaken in 1974-1975 (Minvielle 1985). Thus, the selection of this site provides a longitudinal perspective of the evolution of the region during the past fifteen years.

Analysis of the zone was rounded out by a case study of Tiguere Cire, a fishing village on the banks of the Diamel, where *falo*, *foonde,* and PIV agriculture is practiced, and of *two Wolof* and *Fulbe* villages, where only *jeeri* agriculture or herding is practiced: Tiehel and Mogo Yalalbe. This approach to geographical complementarity shows again the relevance of analyzing the *leydi*, the wide area extending beyond a single village, which reveals the interwoven relationships at the heart of a socially, ecologically, and economically viable territorial unit. Within this framework, it was possible on the one hand to investigate certain concepts associated with ethnic and caste-based stratification of the society, and on the other hand to formulate a relevant typology of the units of production as a function of accessibility to certain lands, which necessarily influences specific peasant strategies.

5.1.3 Thiemping: Riverine Agrofisheries Zone

Thiemping, which is located seventeen kilometers upstream from Matam on the banks of the Senegal River, features a range of production activities that includes recession cultivation in the *waalo* and *falo* ecozones, rainfed *jeeri* agriculture, irrigated rice and vegetable gardens, fishing, and small-animal husbandry. (See Figure 5.3.) The boundaries of the riverine ecosystem extend slightly south into the floodplain and laterally toward other riverine villages. Recession agriculture in the floodplain plays a central role in the gamut of production activities of Thiemping farmers. In all, ten different *kolaade (basins)* are utilized by the village in the surrounding *waalo*, a large number uncharacteristic of other regional riverine villages. These villages generally have only modest landholdings in the floodplain and must rely more heavily on irrigation agriculture. Because flooding was adequate in both 1988 and 1989, the village's only rice perimeter, situated in a high floodplain area known as Lewol, was inundated and farmed as *waalo*. Another rice perimeter, Buldaka, is now farmed by a village women's cooperative in the cool dry season exclusively in irrigated vegetable crops.

Figure 5.2 The *Leydi*: Socioecological Relationships in the Region of Boyenadji Roumde

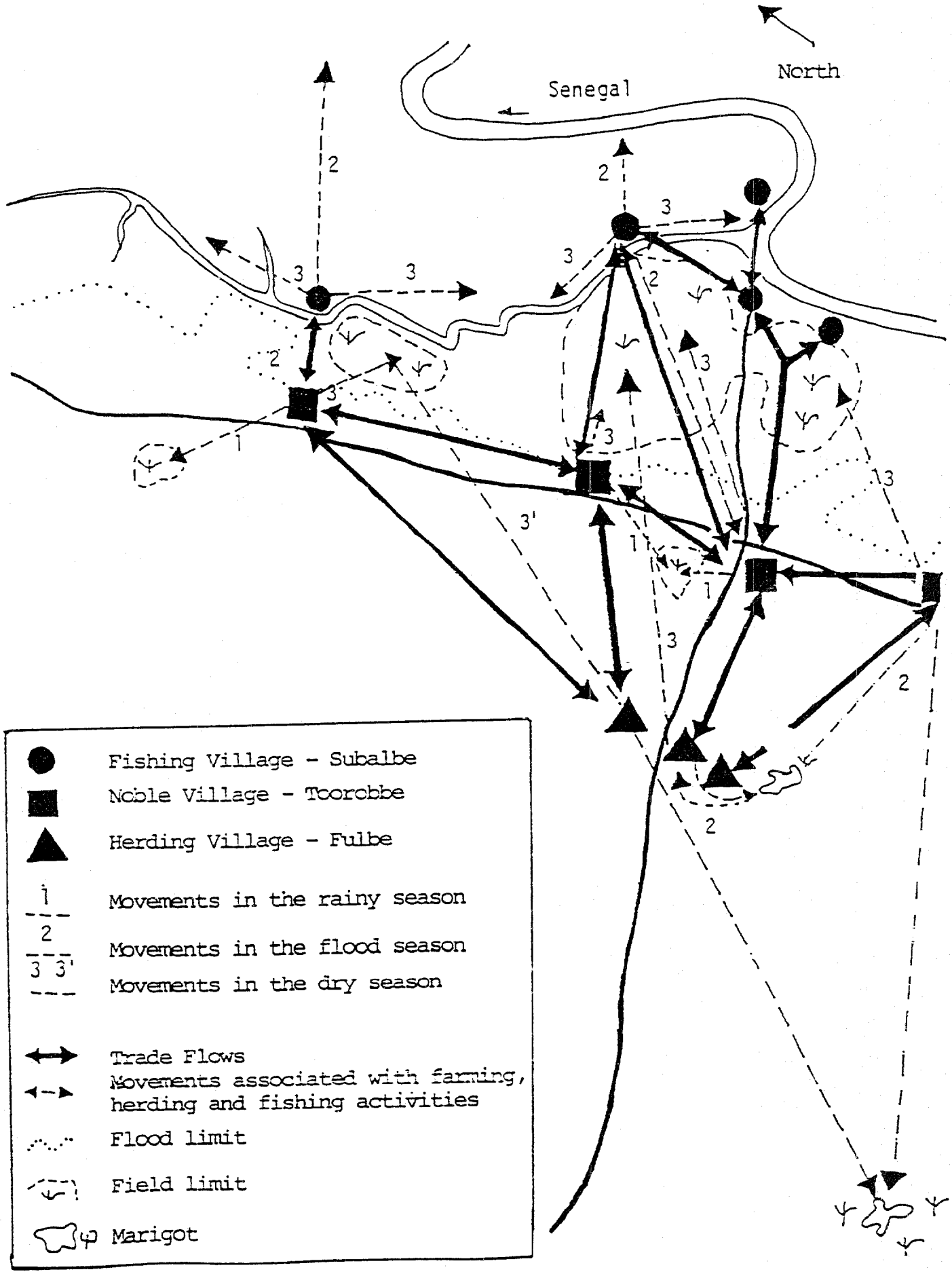
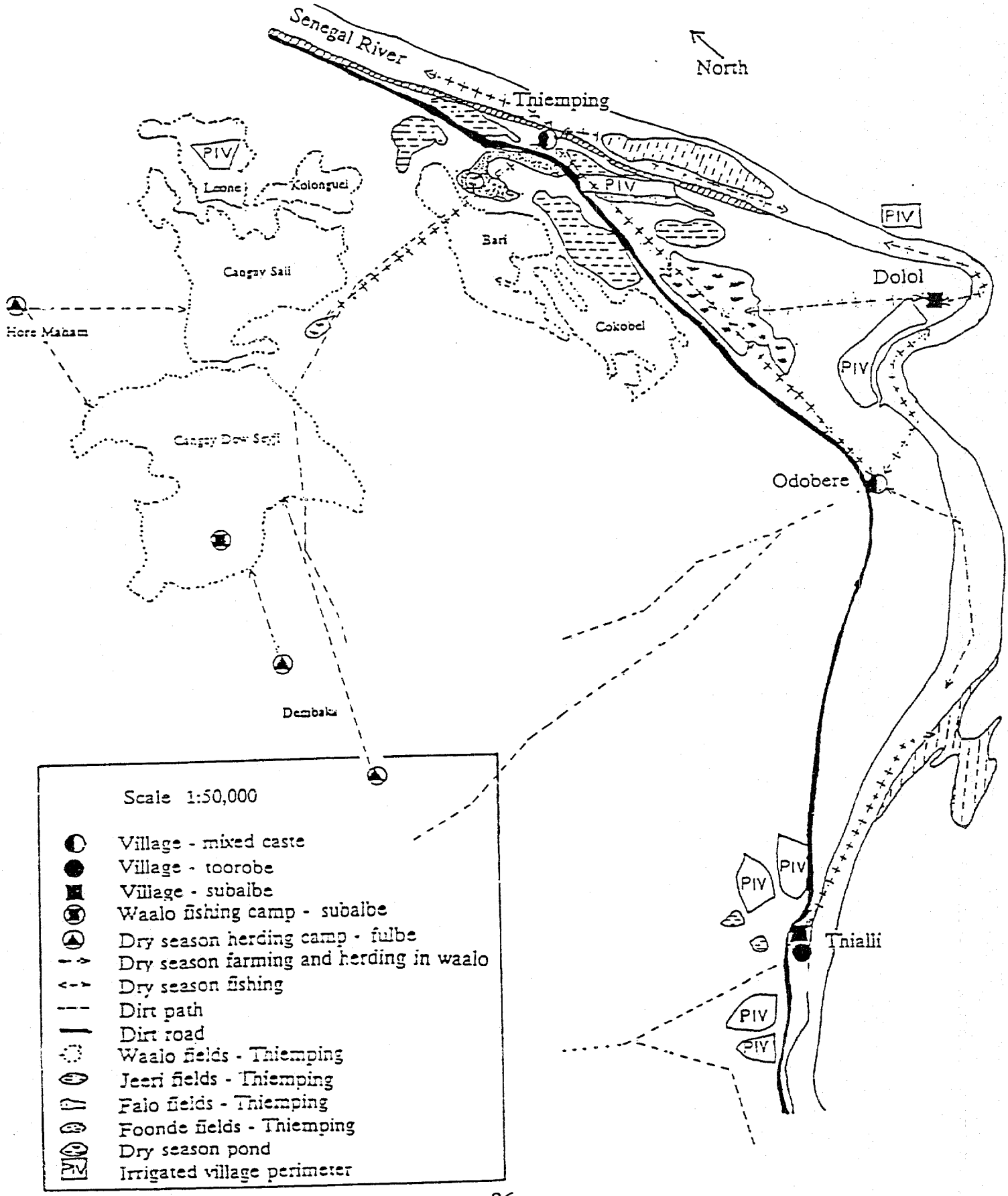


Figure 5.3 The *Leydi*: Socioecological Relationships in the Region of Thiemping



Several *kolaade* extend within a five-kilometer radius immediately to the south of the village. The largest of these include Cangay Dow Seyji and Cangay Sali, Thokobel, Bari Sali and Bari Paté. Two major *falo* areas extending several kilometers east and west of the village on the river include Buldaka and Goulmbol. A third area of recession cultivation occurs in the *foonde*, a higher elevation located at the periphery of the *waalo* and adjacent to the village. Here, a unique topographical depression is farmed in a fashion similar to that of the *falo* gardens involving a multiple intercropping system of maize, beans, melons, and tomatoes. This area, locally named Barol and Njakone, is similar to other microenvironments found uniquely in the riverine zone where this form of recession cultivation takes place. These low-lying areas are rapidly submerged by rainwater, and in years of heavy flooding, such as 1988, floodplain waters extend into this depression to provide excellent field conditions for recession cultivation.

The rainfed riverine area known as the "*jeeri*" is another unique microenvironment found exclusively in this zone. It is distinctly different from the geographical upland region termed the *jeeri* just south of the national highway. In riverine villages such as Thiemping, "*jeeri*" cultivation actually occurs in small depressions in the *foonde* at higher elevations than the *foonde* recession area described above. This "*jeeri*" consists of small fields dispersed over a wide area of the landscape in contrast to the upland *jeeri* where fields are much larger and generally found in broad contiguous areas. Several riverine "*jeeri*" areas near Thiemping are Goulmbol, Medina, Sawalelo, Foonde Dow, and Mboylel.

Because fishing activities in Thiemping among a small number of fishing caste households were limited, a second site was selected, Thially, located ten kilometers further downstream, and heavily dependent on both irrigation and fishing. In contrast to Thiemping, Thially's landholdings in the *waalo* and *falo* are located primarily across the river in Mauritania. Thially relies considerably less on these traditional production systems than does Thiemping, however.

A third research site, Dembaka, a small seasonal herding camp near the Thiemping floodplain, was incorporated into the study in order to monitor the farmer-herder dynamic of seasonal exploitation of the floodplain and the economic exchanges existing between the two groups. As a whole, the diverse array of productive activities found in the three sites and the different levels of interaction and exchange existing among farmers, herders, and fishermen provides a holistic view of the socioeconomy of the region.

5.2 Conceptualization of the Project

Any study of the production systems in the Senegal River Valley and elsewhere must center on an analysis of the economic strategies of its producers. These producers maintain a set of social relations founded on two types of inequalities:

- Inequality based on traditional hierarchies still valid from the perspective of the dominant ideology. This form of social organization continues to have political and territorial implications, albeit weakened.

- Economic inequality, accentuated in the past few years by the phenomenon of emigration, and today the most notable aspect of the Senegal River Valley in general, and of the Department of Matam in particular.

Almost all economic studies of the valley are based on the first form of inequality, thus depicting the society to be that which it claims to remain. The stated ideal and social reality must have coincided in the past, but discrepancies have rapidly become apparent over the last few decades.

The emergence of economic differentiation independent of traditional social, land tenure, or political categories can be explained by the fact that the "economic battle field" of the people in the Valley is presently situated outside of the territory, often thousands of kilometers away, where people are obligated to live according to the ideologies of their host societies. At the same time, the traditional political structures of the *Fuuta* since independence have been severely trivialized if not completely dismantled by the institutions of the modern state.

What approach would give us the best understanding of the environment under study? In the past, socioeconomic studies of the valley were based on traditional systems of inequality—notably the caste system. With the ideological reinforcement mentioned above, it was tempting here to adopt the same approach, given that the society claims not to have changed significantly. From a spatial perspective, such an approach exhibits the fault of tending to generalize from data specific to one zone: castes differ according to the region in the Valley, or, even if they are not different, their prerogatives and status can vary from one locality to another according to the historical role they played there. From a temporal perspective, stratification by caste implicitly denies all societal changes. Focusing on fixed categories within a changing environment, this approach provides no opportunity for reliable extrapolation, either in time or in space.

The approach adopted by this study questions the relevance of this perspective and attempts to see the society as it is—or as it has become—by determining the most appropriate variables that capture the Valley and its transformation. The study places emphasis on the second type of inequality, without denying the existence of the first. The question is whether relevant, objective, and measurable, or clearly identifiable criteria exist that will permit us to understand production systems, to formulate a typology of the units of production, and to establish a framework of analysis of the current social and economic situation at the local level.

The first expected result from this approach is that it will permit us to establish a sample of production units, stratified economically (first level) and then by status group (second level).

5.3 The Variation in Scale in the Collection and Analysis of Information

A microanalytical orientation was adopted in order to understand the units of production, consumption, and distribution among the *Pulaar* both at the inter- and intrahousehold levels. In this study "household" is synonymous with "*foyre*", defined below.

5.3.1 Intrahousehold Organization - The *Fooyre*

The *fooyre* (plur. *pooye*), *Pulaar* for "kitchen," is the smallest unit of a segmented patrilineage. It is at the level of the *fooyre* that the unit of consumption is conceptualized: a single kitchen shared by all. The *fooyre* also often represents the unit of production (commonly-held fields and tools) and accumulation (commonly-held fields and granaries). It is also in the *fooyre*, and for good reason, that peasant economic strategies can be best understood. This is why we have chosen it as our unit of analysis. But within *galleeji* comprised of numerous *pooye*, it is ill-advised to study a single *fooyre* to the exclusion of others. Some *galleeji*, because of much overlapping of *pooye*, will be pertinent units of analysis. Our principal interviewees for periodic interviews were the heads of the *fooyre* and/or the chiefs of the *galle*.

5.3.2 Interhousehold Organization - The *Galle*

The *galle* is a larger unit of a segmented patrilineage and includes one or more *pooye* living within the same compound. The *galle* provides the advantage of being clearly defined by a fence or hedgerow. It does not correspond to the "carré," a term utilized by the administration for tax purposes. The carré is not the geographic entity it seems at first glance. Rather it is a basic political structure and may be composed of several *galleeji* or households dispersed within the same village or in different villages. Thus, for example, it could include households established in the village and others that have left it several years ago, or for many generations. The notion of a carré depends on the recognition by its members of a chief in charge of the unit thus defined and all concerns associated with modern power—the State—and the organizations that depend directly or indirectly on it. Thus, collection of rural taxes, distribution of food provisions by aid organizations, and the allotment of irrigated land are carried out according to the carré. The *galle* can also represent a lineage segment, but often in an expanded form to include households and their dependents, such as those comprised of descendants of slaves who are still considered to be servants for certain families.

The compound, a term close in meaning to the *galle*, doesn't coincide with it either. It may be a gathering of *galleeji* that are not enclosed by a fence representing whole neighborhoods at the village level. In contrast to the compound, the *galle*, generally smaller in size, is a geographically and politically separate unit whose boundaries are often well-defined. It is therefore a residential unit. The *joom galle* (head of the *galle*) exercises power over it that stems from rights of seniority.

5.4 Sampling Methods

To situate our study at the household level, we started with an initial comprehensive demographic, economic, social, and land survey of the population. Through the resulting analysis of the population, we formulated a typology of households. Our concern was not to obtain a sample representative in terms of size, but to obtain a sample of the qualitative behavioral tendencies and circumstances of the population.

5.4.1 General Census of the Research Sites

A general census was undertaken in which data on demography and migration, agricultural production activities, herding and fishing, as well as on associated land tenure practices, artisanal and commercial activities, and capital inventories in livestock and agricultural equipment were obtained for each primary and secondary research site. From this census data, random stratified subsamples of at least 10 percent of each village population were chosen. The most pertinent census data concerning the demographic features of the primary village sites are summarized here:

- All three sites have total populations (present and absent) above 1,000 inhabitants. This was considered to be a reasonable population size for intensive study. The village populations include: Doumga Rindiaw, 1,411 inhabitants; Boyenadji Roumde, 1,158 inhabitants; Thiemping, 1,647 inhabitants.

- The age distribution of the population is highly concentrated among the lowest age group, 0 to 15 years. This is characteristic of high birth rates observed in the developing countries of the world.

- A marked absence of males between the ages of 15 and 55 is evident. This is due to the high rates of outmigration common to villages throughout much of the Senegal River Valley.

- Distinct patterns of seasonal migration, whereby mostly young males return to participate in rainfed and recession agriculture, are noted as well.

The common observations drawn here with respect to each site are more fully elaborated by examining in detail the demographic features of both primary and secondary village sites.

5.4.1.1 Demographic Profile

5.4.1.1.1 Doumga Rindiaw and Kaawel

Four ethnic groups live in the village of Doumga Rindiaw (*Haal Pulaaren, Fulbe, Safalbe*, and *Wolof*). Among them, the *Haal Pulaaren* represent 94 percent of the population. The village is also stratified by caste; *Toorobbe* dominate with 63 percent of the population (see Table 5.1).

The 1,411 inhabitants of Doumga Rindiaw are distributed among 98 *galleji* and 163 *pooye*, with an average of 14 people per *galle* and 9 people per *fooyre*. These figures refer to the gross population (both absent and present at the time of the survey). The collected information permits us to distinguish three demographic profiles: the whole population, including both absent and present members; the population present during the rainy season (largely, the

period of the survey); and the population expected in the village during the cultivation of waalo crops (November-February/March).

Table 5.1 Ethnic Groups and Castes in Doumga Rindiaw

Ethnic Groups	Castes	Pop. Total	Percent
Haal Pulaar	Toorobbe	892	63
	Jaawambe	69	5
	Sebbe	57	4
	Maabube	29	2
	Wayilbe	23	2
	Maccube	250	18
Fulbe		55	4
Safalbe		34	2
Wolof		2	0
Total		141	100

The population pyramid obtained from the age and sex structure of the whole population (including members both absent and present) of Doumga Rindiaw (see Figure 5.4) invites the following commentary:

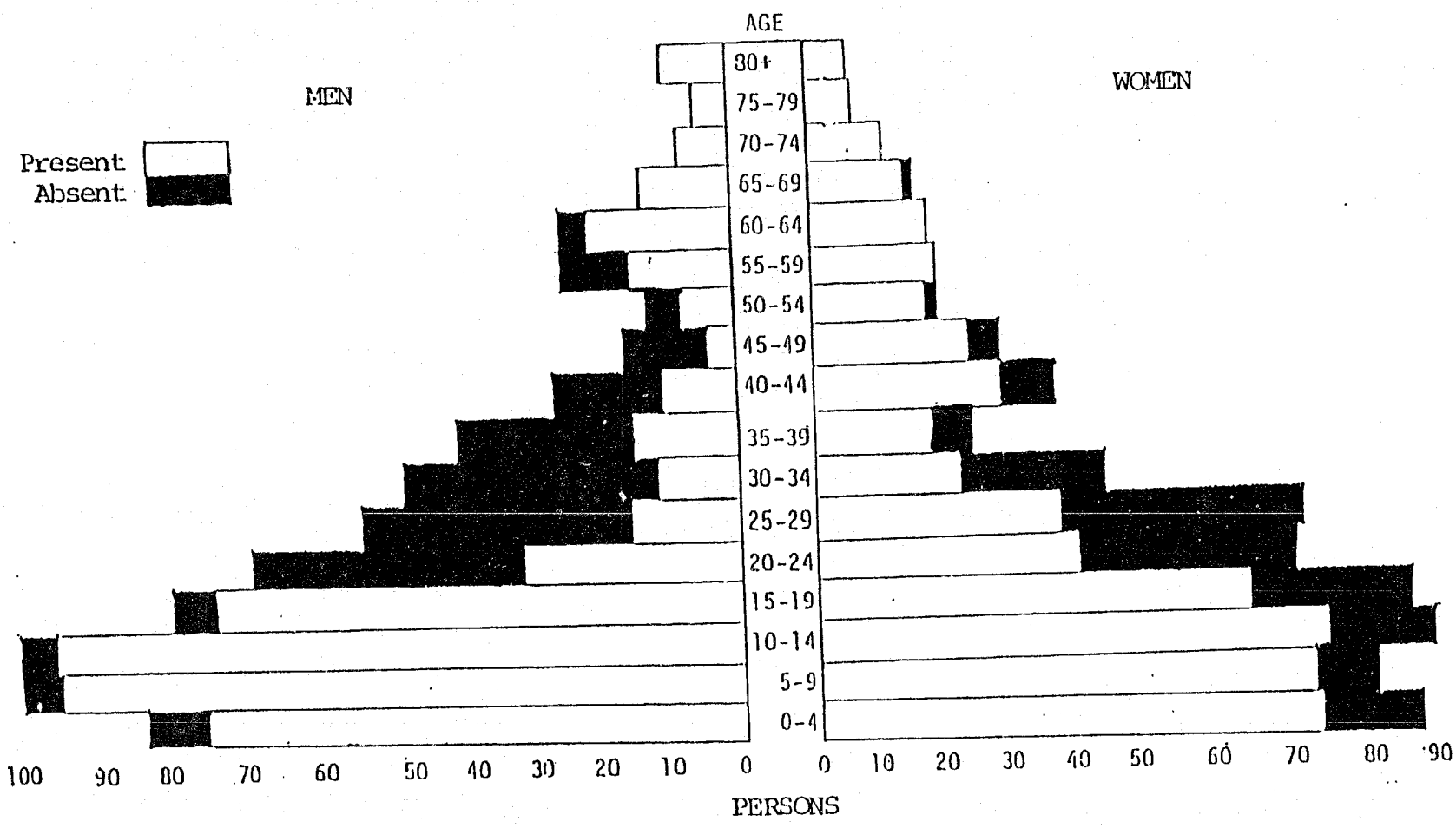
- In its general form, it parallels the demographic structure of many countries in the Third World: very large base (high proportion of young people), and tapering summit (low life expectancy). The division by sex is fairly balanced. A closer look reveals puzzling disparities: the population between the ages of 0 and 15 appears to be growing.

- The population of men between 15 and 55 years decreases steadily and then rebounds, resembling a bottleneck between the age groups of 45 and 55 years. The growth in the male population over 55 may be interpreted as the consequence of the return en masse of men of retirement age; whole *pooye* currently in absentia, and thus not included in the survey, may be returning to the village after the retirement of the chief.

- The same phenomenon, although less pronounced, can be noted for women between 35 and 40. If one defines the migration of women as accompanying migration, it is strongly dependent on labor migration; thus that of men. Taking into account the age difference between husbands and wives, women 30 to 40 years old would accompany their 55-year-old husbands (retirement age) back home to the village.

- The population pyramid shows that men and women of all age groups are affected by absenteeism. Only after the age of 55 (for women) and 65 (for men) does the percentage

Figure 5.4 Age Pyramid: Doumga Rindiaw



of individuals present approach or equal 100. The lowest percentages present are represented by men between 15 and 55 and women between 15 and 35.

The population census for the village of Kaawel denotes 1,992 individuals of whom 1,645 were present when the survey was conducted. Thus, the phenomenon of absenteeism is important but is less pronounced than in Doumga. The age and sex structure of the population is close to that in Doumga Rindiaw. Slight differences are to be noted, however, such as the low absenteeism of women and children in Kaawel. (See Figure 5.5.)

The degree of population mobility at this stage of the analysis (migration will be discussed in detail later) is especially important because it allows us to estimate, for each *fooyre*, the labor availability for agricultural production.

5.4.1.1.2 Boyenadji Roumde

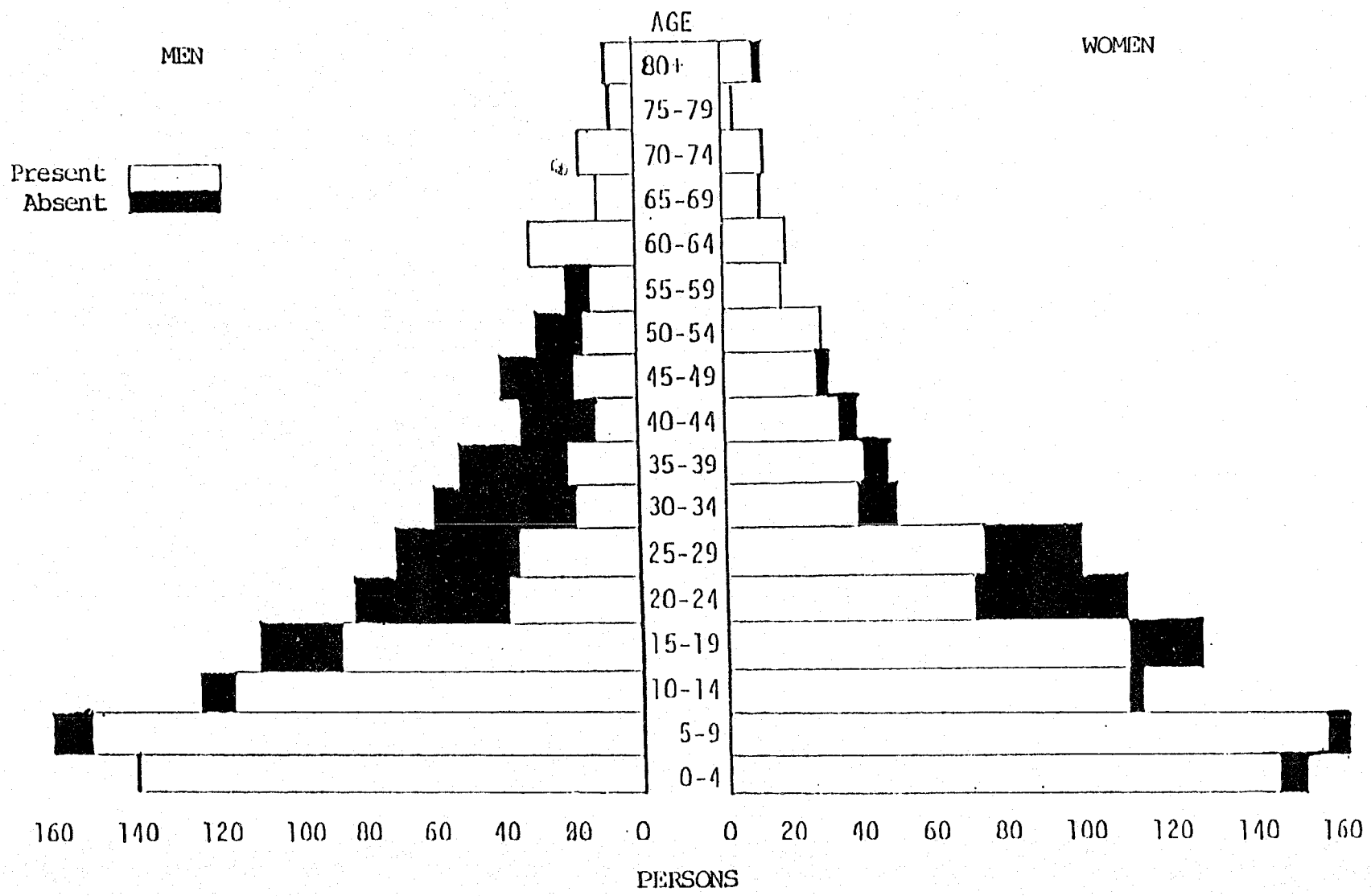
To the best of our knowledge, the first known census of Boyenadji Roumde in 1962 accounted for 642 people (Lericollais, personal communication). In 1971, Boyenadji Roumde had 726 inhabitants, as compared to 935 in 1978 and 1,013 in 1982 (Lericollais, ibid.). Our own census accounted for 1,158 people, whereas we had counted 1,120 in 1987.

These numbers suggest a strong demographic growth. From 1962 to 1971, the average annual rate of growth was 1.38 percent. From 1971 to 1978, it grew to 3.68 percent compared to a rate of 2.0 percent from 1978 to 1987. For certain villages in the arrondissement of Ourossogui, we were able to collect certain information concerning a census conducted in 1862 (Lericollais, ibid.). Keeping in mind the limited reliability of this early data, we nonetheless believe they provide an idea of the size of the population for the last century. From 1862 to 1962, we noticed a clear leveling off of population growth. The population boom during the 1960s can be attributed in large part to medical interventions resulting from primary health care and vaccination campaigns.

Population growth in the seventies is most likely due to the massive influx of refugee herders from the *ferlo*, who came to settle near the river, particularly along the axis of the Bakel-Saint Louis road, to escape a degraded environment and chronic drought conditions. This phenomenon is widespread within the arrondissement of Ourossogui.

Our age pyramid separates the population by age groups based on a census of the total population. Boyenadji Roumde has a total population of 1,158 — those present at the time of the census and those who were absent. The population at hand during the first half of September, the time at which we conducted our census, comprises the permanent population of the village, those on vacation (university and high school students, distant migrants) and those returning for rainfed

Figure 5.5 Age Pyramid: Kaawet



agriculture. The latter are called locally *nduumtaaji jeeri*. These three subcate figure in our age pyramid: absentee population (dark color), permanent population of lage (light color), and the population returning for *jeeri* agriculture, including students cation, and migrants (cross-hatching) (see Figure 5.6).

This pyramid is fairly characteristic of the pyramids regularly encountered in developing countries: more than 30 percent of the total population is under ten years of age, and 54.4 percent of the population is under twenty years of age. People over sixty years old represent only 4.4 percent of the total population. We noted a slightly higher number of females born than males, but the overall population contains more men: 592, compared to 566 women.

The following conclusions can be drawn from the analysis of the age pyramid:

- A large proportion in absolute terms are absentee individuals; among these, men figure more prominently than women.

- This rate of absence is highest, if one includes the *nduumtaaji jeeri* (those returning for *jeeri* agriculture), for the age group between 25-45 years. Nevertheless, these absences are significant in lower age groups as well.

We formulated a classification of castes and ethnic groups within the population. The *Tooroobe*, the noble caste, who control religious, political, and land tenure powers, represent 40.2 percent of the total population. The *Maccube*, the servant or former captive category, make up 23.8 percent of the Boyenadjibe, as compared to 15 percent for the *Fulbe* (herders), 5.5 percent for the *Sebbe* (former warriors), 5.5 percent for the *Wayilbe* (blacksmiths), 4 percent for the *Maabube* (weavers) and, finally, 2.5 percent for the *Safalbe*. This population profile is characteristic of the *jeejegol* population.

5.4.1.1.3 Thiemping

The population of Thiemping is 1,647 inhabitants, 1,214 of whom were present in the village at the time of the census. They comprise a total of 96 *galleeji* and 148 *pooye*. The total population present and absent is relatively equally distributed by gender (836 men, 811 women), but the marked absence of adult men is reflected in the population present (533 men, 681 women).

The age pyramid for Thiemping reveals the population composition by age and sex and indicates the proportion of inhabitants, both present and absent (see Figure 5.7). The absence of males is most evident in the age group between 20 and 50 years. Among males aged 31 to 35 and 36 to 40, only 23.9 percent and 23.4 percent, respectively, are present. The 20-40 year age group represents the bulk of the labor force. Of the men in the 26 to 30 year age group, 21.4 percent return seasonally. This labor pool is generally comprised of advanced secondary school students or young seasonal labor migrants returning from Dakar. The substantially high proportion of absent males in the 51 to 55 year-old age group may be explained by the fact that

Figure 5.6 Age Pyramid: Boyenadji Roumde

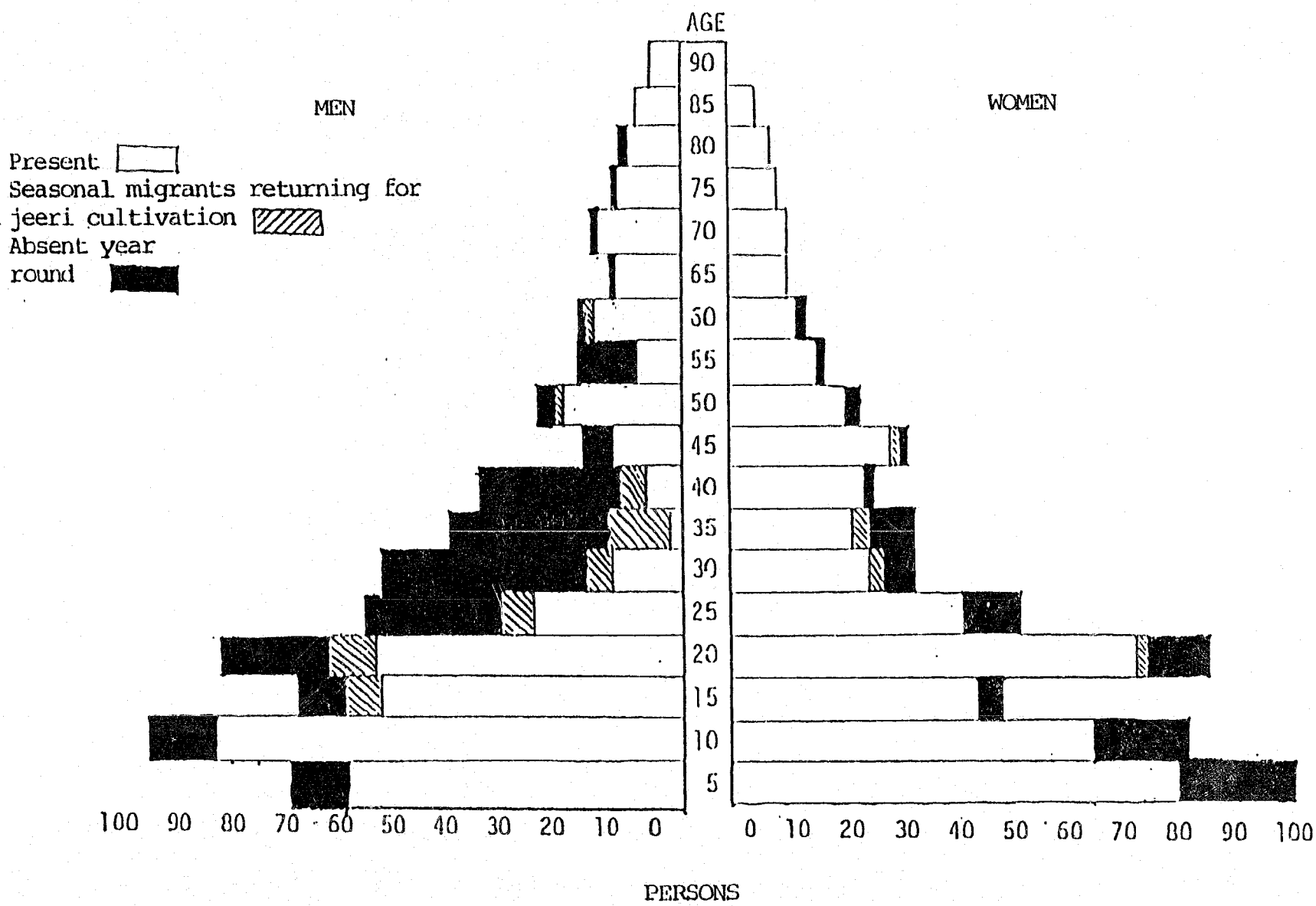
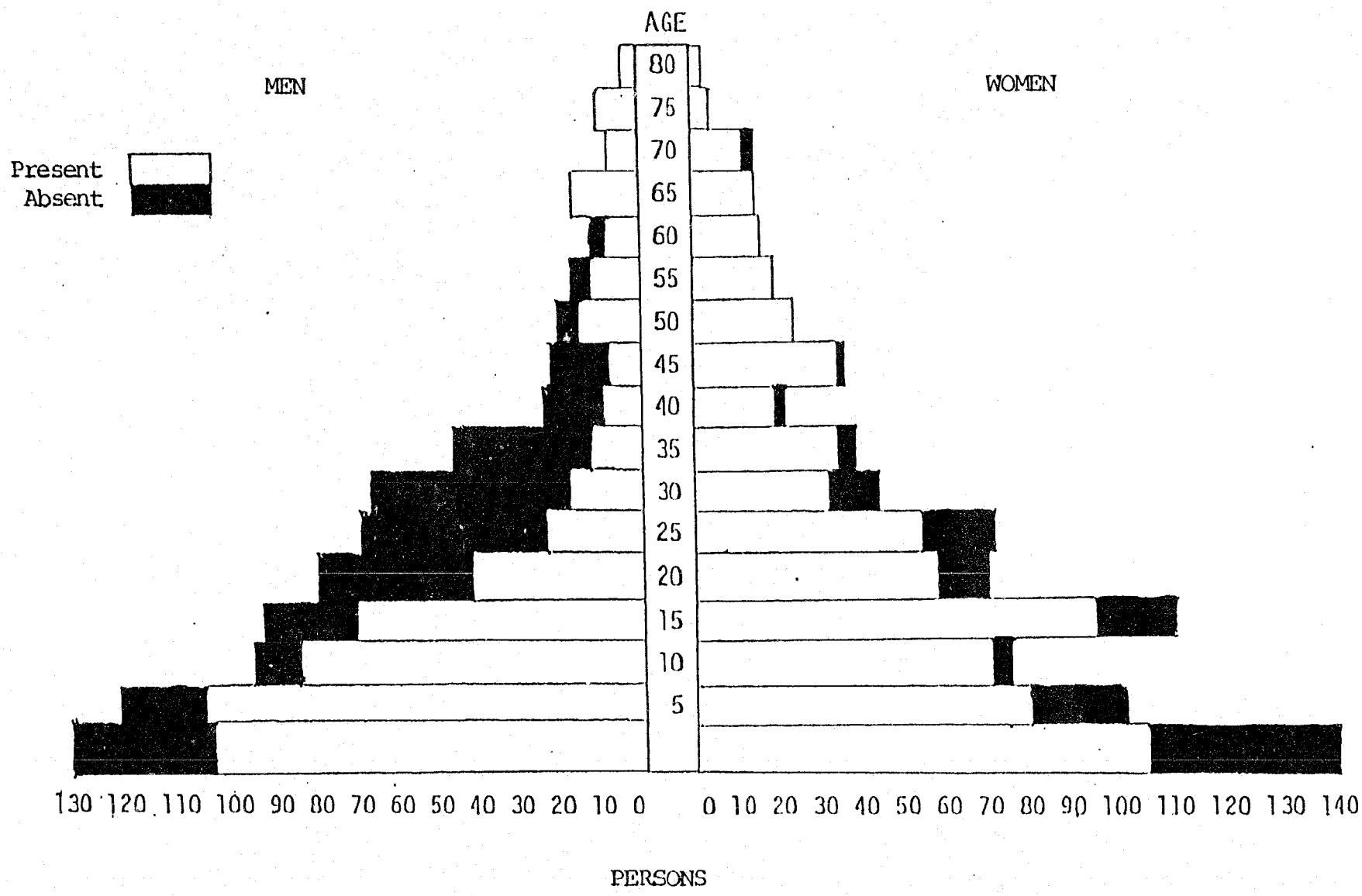


Figure 5.7 Age Pyramid: Thiemping



males of this age return seasonally to survey *jeeri* fields which belong to them but are being cultivated by other family members. Accurate census data regarding the labor force returning for the *waalo* season could not be obtained.

5.4.2 Methodology for Sample Stratification

5.4.2.1 Socioeconomic Variables and Household Typologies

A random stratified sample of households from each village was selected according to three socioeconomic criteria: access to land, labor, and capital; household types were identified according to different combinations of these features. Through a systematic analysis of each type, it is possible to identify whether households with specific endowments in land, labor, or capital occupy advantaged or disadvantaged positions in relation to development initiatives to be introduced in the Après-Barrages.

5.4.2.1.1 Labor

Members aged 10-64 within a household who were present at the time of the survey represent the total productive labor capacity. This capacity was quantified by adding together the total number of household members in this age group. Though variability in labor output due to differences in age and sex is recognized, assigning labor coefficients to individuals was highly problematic. Although individuals not included in this age group may be active household members in agricultural tasks (particularly children between 5 and 10, as well as individuals between 65 and 70 years), the age range 10 to 64 was chosen to be the most accurate representation of active household labor capacity available for agricultural production. Using this classification, a total labor value was then generated for each household and an overall village mean was calculated. For Doumga Rindiaw, the average was 4 people, for Thiemping, 5.4, and for Boyenadji Roumde, 4.5. All households above the mean were assigned to Group L+ (Labor +) to represent high labor capacity, while all households below the mean were assigned to Group L- (Labor -) to represent low labor capacity.

5.4.2.1.2 Agricultural Diversification

The second variable was established to represent the range of local agricultural production activities undertaken by each household. This measure was considered to be the best possible indicator of land use and access. Since field size and quality could not be quantified at the time of the village census, a representation of total productive agricultural capacity was not feasible. The capacity of households to diversify their agricultural repertoire and thus reduce the risk of production deficits may be seen as a crucial socioeconomic indicator that differentiates households in terms of their capacity to maintain successfully a reproductive cycle. Each household was assigned a value to represent the total number of agricultural production activities undertaken. Below is a list of agricultural activities practiced in the region:

- Rainfed cultivation - *jeeri*
- Recession cultivation - waalo
- Recession cultivation - *foonde*
- Recession cultivation - *falo*
- Irrigated cultivation
- Garden cultivation

The systems of cultivation listed above take into account both landholding as well as tenancy and sharecropping relationships. The sum of all these systems, then, provides a quantitative measure of the degree of land access available to each household. Two types associated with the village mean were identified: high diversification (AD+) and low diversification (AD-). In Doumga Rindiaw, (AD+) corresponds to at least three systems of production, and (AD-) to two systems of production or fewer. The average number of production systems per household in Thiemping is 4.4. In Boyenadji Roumde the average, 4, is based on cultivated plots, regardless of the system.

5.4.2.1.3 Nonagricultural Revenues

Household revenues derived from nonagricultural activities were one of the most important factors of socioeconomic differentiation in the village. During the course of the village census, it was determined that incomes generated from activities other than agricultural production were derived primarily from the following sources:

- Migration remittances
- Military and retirement pensions
- Local artisanry
- Local commerce

The amount of these revenues was unobtainable at the early stages of research, but the sum of these sources provides a quantitative measure of the revenues available to each household. Two categories were created to reflect values inferior or superior to the village mean: high (NAR+) and low (NAR-) sources of nonagricultural income. The village averages were computed as follows: for Doumga Rindiaw, the figure reflects the average number of individuals receiving nonagricultural revenue (1.4 individuals per household). In Thiemping, the figure reflects the average number of nonagricultural sources of revenue, with an average for the village of 1.9 different sources.

5.4.2.2 Stratification of Village Households

In place of an ordered matrix, the technique of "arborescence"[46] was utilized to group various *pooye* that seemed to fit the preceding criteria. Using classification through arborescence, households are grouped according to their responses (positive or negative) to the criteria and the ramifications stemming from these responses. Eight strata emerged from the manipulation of three variables: L (labor), NAR (nonagricultural revenue), and AD (agricultural diversification).

Despite the diversity among households, they were treated as autonomous units of production, consumption, and accumulation—a characterization not always in conformity with reality—making it possible to employ a method of stratification that favors certain parameters over others.

At the village level, household stratification according to available resources resulted in the inclusion of all units. Even if the method employed cannot claim to have taken all of the details associated with the *pooyre* into account, it reveals the main factors underlying the possible responses of the households to the essential economic options, which are agriculture and migration for the *Fuuta*, and herding for the Kaawel or Mogo Yalalbe.

The following analysis reveals that in the three research sites, higher castes do not necessarily have an economic advantage over lower castes. Thus, higher castes do not appear to be overrepresented within the more advantaged strata. The representation of various castes in the sample is presented in the following discussion and tables.

5.4.2.2.1 Doumga Rindiaw

Analysis of the data for Doumga Rindiaw according to this method gives the following results (see Table 5.2):

(i) In the first stratum are 14 *pooye* who have in common a large number of working members (L+); a large number of people with high nonagricultural income (NAR+); and who practice a diversified agriculture (AD).

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[46] This method, which is similar to Chomsky's "tree" (1968) in the field of linguistics, is useful for its simplicity. It seems most adapted to circumstances where there is a limited number of variables to manipulate. The technique of ordered matrices is especially useful when there are numerous individuals and variables. Through the permutation of columns (e.g., criteria) and rows (e.g., individuals), the technique allows us to group together similar responses to formulate a typology with a minimum number of categories.

Table 5.2 Classification of Households in Doumga Rindiaw

L+: 85 Households				L-: 78 Households			
NAR+: 36 Households		NAR-: 49 Households		NAR+: 27 Households		NAR-: 51 Households	
1) AD+: 14 Households	2) AD-: 22 Households	3) AD+: 21 Households	4) AD-: 28 Households	5) AD+: 6 Households	6) AD-: 21 Households	7) AD+: 4 Households	8) AD-: 47 Households

Note: L = Working age population (available labor)
NAR = Nonagricultural resources
AD = Agricultural diversification

Sample Chosen and Composition by Caste (16 Households)[47]

2 Toorobbe	2 Toorobbe	1 Tooroodo 1 Maccudo	1 Maccudo	1 Tooroodo	2 Toorobbe 1 Capaato		1 Tooroodo 1 Pullo 1 Ceddo 2 Maccube
St1	St2	St3	St4	St5	St6	St7	St8

(ii) In the second stratum are 22 *pooye* who have access to labor potential (L+) and nonagricultural income (NAR+); these households do not practice a diversified agriculture (AD-); and therefore are likely to depend heavily on nonagricultural income.

(iii) In the third stratum are 21 *pooye* with a large labor potential, who practice diversified agriculture (L+, AD+). Because theoretically they cannot count on substantial nonagricultural income (NAR-), these households became heavily involved in numerous forms of agriculture.

(iv) The fourth stratum comprises 28 *pooye* who, despite high local labor availability (L+) and a low number of individuals with nonagricultural income (NAR-) have not diversified their agricultural production activities (AD-).

(v) There are only six households in the fifth stratum. (See Table 5.2.) The small size of this group can be explained by the paradox that characterizes the group: though there are few people of working age (L-), these households practice diversified agriculture (AD+) which may be taking a human toll. These efforts are all the more difficult to understand given that these households have large nonagricultural incomes (NAR+).

(vi) The 21 households in the sixth stratum seem to be heavily involved in migration: the lack of available manpower (L-), which may explain the lack of diversified agriculture (AD-), could itself be a result of the high numbers of migrants of working age (NAR+). The relatively large size of this group (13 percent of the households in the village) certainly provides evidence

[47] The tooroodo household in the fifth stratum was eventually shifted to the first stratum and combined with another household to which it was closely linked.

for the hypothesis that agriculture is being abandoned somewhat in favor of migration in the *Fuuta*.

(vii) The seventh stratum is similar to the fifth in that it contains few households (4) and, paradoxically, has agricultural diversification (AD+) with reduced availability of labor (L-). Here, however, the paradox is lessened by a lack of alternatives to agriculture—nonagricultural resources being rare (NAR-). Extensive migration is not an option either because of the low number of individuals of working age, which is the same age group that migrates.

(viii) The eighth and last stratum is comprised of 47 *pooye* (nearly three out of every ten households at the village level). All of these households responded negatively to the three criteria: low number of individuals of working age (L-); few people with access to nonagricultural resources (NAR-), and little or no participation in diversified agriculture (AD-).

5.4.2.2.1.1 The Relationship Between Castes and Typologies in Doumga Rindiaw

Generally speaking, no ethnic group or caste identifies clearly with one or another of these groups, especially in the case of the most representative groups (those comprising more than ten households). But certain observations can be made (see Table 5.3).

Table 5.3 Castes and Household Typologies in Doumga Rindiaw (as a % of the total)

Castes	Village	St1	St2	St3	St4	St5	St6	St7	St8
Toorobbe	59.0	64	50.0	86	71	83	38	25	51
Maccube	19.0	22	23.0	14	7	0	38	25	19
Jaawambe	5.0	7	4.5	0	4	0	19	0	2
Sebbe	5.0	0	9.0	0	4	17	0	25	7
Fulbe	6.0	0	0.0	0	7	0	0	25	15
Maabube	2.5	0	0.0	0	7	0	5	0	2
Wayilbe	0.5	0	4.5	0	0	0	0	0	0
Safalbe	2.5	7	9.0	0	0	0	0	0	2
Wolof	0.5	0	0.0	0	0	0	0	0	2
Total	100.0	100	100.0	100	100	100	100	100	100

The *Tooroodo* caste, demographically and politically dominant in the village, is overrepresented in the third group, with 86 percent of all households in this category. This stratum, characterized by a large available work force, diversified agriculture, and few individuals with nonagricultural income, may represent the last bastion of resistance to migration. This resistance is manifested in heavy involvement in rainfed, irrigated, and recession agriculture. Easy access to land might explain this pattern of behavior, but the village census shows that, on the contrary, in this stratum more than in any other, producers pay rent

on land: 48 percent of the households in this group (10 out of 21) cultivated PIV plots as sharecroppers even though only 14 percent (23 out of 163 households) of the village as a whole cultivated as sharecroppers. Similarly, 57 percent—compared to 15 percent from the village overall—cultivated the *waalo* as sharecroppers in 1986.

In other words, the agricultural strategy of these households can only be explained at this time by the availability of a large work force that has remained uninvolved, for one reason or another, in the migratory process. This situation suggests that there isn't, or is no longer, a correlation between the traditional social hierarchies and the present economic hierarchies in the *Fuuta*.

The same *Tooroodo* caste occupies 71 percent of the households in the fourth stratum. Such a large presence of the traditional social elite in a group that, despite a large available labor force, is not heavily involved either in agriculture or in migration, might suggest that other sources of income are available, such as those associated with the control of land: "land use fees" on the *waalo* or the PIV. In fact, however, only five households in this stratum received fees from land in the *waalo* in 1986, and four in the PIV in 1988.

In the sixth stratum, which appears to represent households that live almost exclusively on nonagricultural income, the *Maccube* and the *Jaawambe* are overrepresented compared to their overall proportion in the village, while the situation is reversed with the *Tooroobe*. Is involvement in migration greater, all other things being equal, for traditionally disadvantaged social categories?

In the last stratum, which could be described as "deprived," the various social groups—with the exclusion of the *Fulbe*—have almost the same representation as they do at the village level. The disproportionate number of *Fulbe* might have suggested that the hidden resource of this stratum was cattle, but the average member of this stratum owns even fewer animals than the average villager: 3.4 goats/sheep and .15 cows as compared to 4.2 and .4, respectively, for the village overall.

5.4.2.2.2 Boyenadji Roumde

Table 5.4 presents the village and sample typologies for Boyenadji Roumde.

Table 5.4 Household Stratification in Boyenadji Roumde

	Number of Households (Village)	Percentage of Village Households	Number of Households (Sample)	Percentage of Sample Households
Group 1 L+ AD+ NAR+	20	16.2	2	13.3
Group 2 L+ AD- NAR+	10	8.2	1	6.6
Group 3 L+ AD+ NAR-	19	15.4	2	13.3
Group 4 L+ AD- NAR-	11	9.0	2	13.3
Group 5 L- AD+ NAR+	8	6.6	1	6.6
Group 6 L- AD- NAR+	12	9.8	2	13.3
Group 7 L- AD- NAR+	11	9.0	2	13.3
Group 8 L- AD- NAR-	32	25.8	3	20.0
Total	145	100.0	18	100.0

5.4.2.2.2.1 The Representation of Castes in the Typologies for Boyenadji Roumde

There are far greater numbers of *Toorobbe* in the village (40.2 percent), than *Maccube* (23.8 percent). Caste representation in the household typology indicates that *Toorobbe* are fairly well distributed along typological lines in proportion to their composition in the village (see Table 5.5). Indeed, they dominate the most privileged stratum, with available labor, access to nonagricultural income, and adequate land resources; but they are also well represented in the most disadvantaged strata: 7 and 8 (54.5 percent, and 40.6 percent, respectively). However, they are underrepresented in the fourth stratum, characterized by a large labor force, low nonagricultural income, and low accessibility to land. This is not surprising, considering that the *Toorobbe* are supposed to hold power in Boyenadji Roumde. What is surprising is their

presence in group 8 (characterized by a lack of labor, limited nonagricultural revenues, and restricted access to land).

It is also surprising that the *Maccube*, who have a low social status, are quite well distributed among the economic, demographic, and land tenure groupings. They seem as well situated as their former masters. In fact, a detailed analysis reveals that they have an agricultural labor potential higher than that of the *Toorobbe*. The *Maccube* can always be distinguished from the *Toorobbe* with regard to agricultural equipment[48]—they are the best equipped subgroup in the village. Thirty-nine and a half percent of the households who own agricultural equipment are *Maccube*, who represent only 23.8 percent of all village households. On the other hand, only 29.75 percent of *all Toorobbe* households, which make up 40.3 percent of households in the village, own agricultural equipment. Inversely, many more *Toorobbe* do not own agricultural equipment (49.5 percent) as compared to Maccube who do not (17.25 percent).

Table 5.5 Castes and Household Typologies in Boyenadji Roumde (as a % of the total)

Castes	St1	St2	St3	St4	St5	St6	St7	St8	Village
Toorobbe	54.0	20.0	42.0	9	37.5	25.0	54.5	40.6	40.2
Maccube	24.0	10.0	21.0	27.3	37.5	16.7	45.5	12.5	23.8
Fulbe	0.0	40.0	5.3	27.3	12.5	41.7	0.0	25.0	15.0
Wayilbe	9.0	20.0	0.0	27.3	12.5	0.0	0.0	9.4	5.5
Sebbe	4.0	10.0	10.5	0	0.0	8.3	0.0	3.1	5.4
Maabube	5.0	0.0	15.9	9	0.0	0.0	0.0	3.1	4.0
Safalbe	0.0	0,0	5.3	0	0.0	8.3	0.0	3.1	2.5
Subalbe	4.0	0.0	0.0	0	0.0	0.0	0.0	3.1	1.5

An interesting distribution appears among the *Fulbe*. They appear consistently in groups having little access to agricultural activities: groups 2, 4, and 6. However, a number of them own agricultural equipment (37.5 percent of owners of such equipment, even though the *Fulbe* represent only 15 percent of the population in the village). Most of them appear in disadvantaged categories; the *Fulbe* social caste seems to be endowed with the fewest resources, having suffered the most during the last two decades of drought. This trend, if care is not taken to reverse it, will worsen with the Après-Barrages if no measures are taken to integrate pastoral groups in programs operating in the Valley. This tendency is already manifested in the currently unfavorable position occupied by the *Fulbe* vis-à-vis land tenure (Nuttall 1989).

[48] Agricultural equipment is counted as part of nonagricultural income in Boyenadji Roumde.

5.4.2.2.3 Thiemping

In Thiemping, the typologies for the village and for the sample are shown in Table 5.6.

Table 5.6 Household Stratification in Thiemping

	Number of Households (Village)	Percentage of Village Households	Number of Households (Sample)	Percentage of Sample Households
Group 1 L+ AD+ NAR+	40	27.6	6	33.3
Group 2 L+ AD+ NAR-	7	4.8	2	11.0
Group 3 L+ AD- NAR+	8	5.5	1	5.5
Group 4 L+ AD- NAR-	6	4.1	0	0.0
Group 5 L- AD+ NAR+	17	11.7	4	22.0
Group 6 L- AD+ NAR-	13	9.0	3	16.5
Group 7 L- AD- NAR+	17	11.7	1	5.5
Group 8 L- AD- NAR-	37	25.5	1	5.5
Total	145	100.0	18	99.3

5.4.2.2.3.1 Relationship Between Castes and Typologies in Thiemping

The eight household group profiles are illustrated according to their caste composition in Table 5.7. The caste composition of these profiles is also compared to the overall composition of the village population, caste by caste.

A few general conclusions may be drawn from Table 5.7 concerning the correlation of caste with household stratum profiles. More than one-half (53 percent) of all village households

(77 out of 145 *pooyre*) are subsumed within two strata, 1 and 8. In these groups, two important distinctions concerning caste composition may be discerned. First, the *Sebbe* caste dominates the first group (approaching one-half or 48.3 percent of all group members). This suggests a slight overrepresentation of this caste in relation to its overall proportion within the village (38 percent). In contrast, the *Fulbe* caste is not represented (0 percent) in this group. In group 8, however, the *Fulbe* are represented quite strongly (24.4 percent) in comparison to their overall representation in the village (6.9 percent).

Table 5.7 Castes and Household Typologies in Thiemping (as a % of the total)[49]

Castes	Village	St1	St2	St3	St4	St5	St6	St7	St8
Toorobbe	15.8	22.9	7.9	27.4	0.0	3.5	24.0	0.0	7.4
Maccube	23.8	18.8	31.5	31.5	0.0	22.2	38.0	25.3	29.5
Sebbe	38.0	48.3	39.4	13.7	34.9	52.0	5.0	29.5	32.7
Fulbe	6.9	0.0	0.0	0.0	47.6	0.0	17.3	0.0	24.4
Nyeenybe	10.2	8.6	9.4	16.4	0.0	15.8	15.6	15.8	5.5
Subalbe	5.1	1.4	11.8	11.0	17.5	6.4	0.0	29.5	0.5
Total	100	100	100	100	100	100	100	100	100

A summary of general observations concerning caste composition in relation to the eight household resource profiles follows:

• *Sebbe* - The constitution of *Sebbe* households is oriented toward Group 1, in which 55.4 percent of all *Sebbe* households are found. In contrast, only 11.3 percent of *Sebbe* households are found in Group 8. This incongruence suggests that a majority of *Sebbe* households enjoy a favorable socioeconomic position in terms of labor capacity, agricultural diversification and potential nonagricultural income-generating resources.

• *Toorobbe* - The *Toorobbe* have a socioeconomic profile similar to that of the *Sebbe*. The majority of *Toorobbe* households (63.5 percent) are situated in group 1, while only 6.2 percent are found in group 8. This again suggests a relatively privileged position held by the *Toorobbe* in terms of resource capacity and access.

• *Fulbe* - The *Fulbe* are completely absent from groups 1, 2 and 3, and well represented in groups 4, 6 and 8. This implies that the *Fulbe* are relatively deficient in labor capacity, diversified agricultural strategies, and nonagricultural revenues. This data may be consistent with the basic belief that sedentarized *Fulbe* populations in villages along the Senegal River

[49] It should be noted that three non-haalpulaar households (2 wolof, 1 maure), which constitute part of the village population (33 people), were not included in the analysis of the strata according to caste.

Valley are generally impoverished as a result of severe herd losses during the Sahelian drought of the early 1970s.

• *Subalbe* - The *Subalbe* caste is fairly equally distributed in all groups except 1, 6, and 8, in which they are underrepresented. One-third (33.3 percent) of all *Subalbe* households are found within group 7. This suggests that a high number of *Subalbe* households display a proclivity toward diversified agricultural production despite their inferior labor resource capacity.

• *Nyeenybe* - A fairly equal distribution of *Nyeenybe* are found in all groups with the exception of group 4 (0 percent). A high number of *Nyeenybe* (36.9 percent) are situated in group 1. Thus, the *Nyeenybe* may represent a relatively heterogeneous village population similar to the *Subalbe* in terms of their resource profile.

• *Maccube* - The *Maccube* reveal a slightly bimodal distribution within groups 1, 6, and 8. While fairly well represented in all groups except group 4 (0 percent), a mild dichotomy exists between group 1 (34.4 percent of all *Maccube*), and groups 6 and 8 (33 percent). This suggests that a polarization may exist among the majority of *Maccube* households in terms of an advantaged or disadvantaged resource status.

5.4.2.3 Sample Representativeness

An important question remains as to whether the very small population sample chosen to be the subject of detailed studies is representative of the study villages on the one hand, and of the entire Department of Matam or of the Valley on the other.

In Thiemping, the sample includes 222 inhabitants (161 present, 61 absent) or 13.5 percent of the total village population (1,647 inhabitants). The caste groups in the sample reflect closely their degree of representation in the overall village population (see Table 5.8).

Table 5.8 Sample Size and Percentage by Caste in Relation to Total Village Population at Thiemping

Caste	Number of Sample Households	Percentage of Sample	Percentage of Village Population
Fulbe	1	5.6	6.9
Maccube	5	27.8	23.8
Nyeenybe	2	11.1	10.2
Sebbe	6	33.3	38.0
Subalbe	1	5.6	5.1
Toorobbe	3	16.7	15.8
Total	18	100.0	100.0

The sample for Boyenadji Roumde is representative of all castes in the village, excepting the *Safalbe* of Mauritanian origin, and the fishermen caste (*Subalbe*), who represent 4 percent of the total population (See Table 5.9).

Table 5.9 Sample Size and Percentage by Caste in Relation to Total Village Population at Boyenadji Roumde

Caste	Number of Sample Households	Percentage of Sample	Percentage of Village Population
Fulbe	3	20.0	15.0
Maccube	4	27.0	23.8
Nyeenybe	2	13.0	9.5
Sebbe	1	7.0	5.5
Safalbe	0	.0	2.5
Subalbe	0	.0	4.0
Toorobbe	5	33.0	40.2
Total	15	100.0	97.9

5.5 Household Monitoring

Both formal survey questionnaires and structured interviews were used to monitor all on-farm household production activities, family revenue, expenditure, and food consumption patterns. Data were collected to identify the following relationships:

- the nature of agricultural revenues in comparison to nonagricultural revenues in terms of their capacity to meet basic household maintenance needs.
- the role of agricultural production activities in meeting basic subsistence needs.
- the periodicity of fluctuation in household assets in cash and kind.
- the degree of intra- and interhousehold exchange of land, labor and capital.

Household visits were conducted every two weeks using the following sampling instruments:

5.5.1 Production Systems Survey

Questionnaires were used to monitor the following production activities: rainfed *jeeri* cultivation, recession cultivation (*waalo, falo, foonde*), irrigated agriculture (rice and women's

gardens), herding, and fishing. Data were obtained in the following areas: (1) household gender divisions of labor; (2) labor networks—reciprocal and nonreciprocal labor allocation, and wage labor; (3) land tenure practice—labor rents and prestations; (4) labor time allocation; (5) crop yields and harvest distribution; and (6) intercropping patterns and crop varieties. These quantitative data were supplemented by regular household visits to obtain qualitative information such as land tenure history and decision-making strategies in the allocation of land and labor.

5.5.2 Household Budget Survey

A questionnaire was used to follow flows of cash and goods in and out of households on a monthly basis. Periods of accumulation and drawdown in household subsistence stocks of locally produced grain, livestock, fish, etc., were monitored in relation to off-farm revenues to understand the role of each in meeting the households' needs.

5.5.3 Household Food Consumption Survey

Every two weeks, food consumption data were gathered on each household. Interviews were based on twenty-four hour recall and records were kept of the range of food items consumed and their seasonal availability, origin of the item (locally produced or imported), food expenditures (in cash, kind, or barter), location of transaction (local or external markets) and the number of members consuming each meal. Consumption patterns were monitored to ascertain the extent to which agricultural and/or nonagricultural revenues are used to fulfill household food requirements.

5.5.4 Land Surveys and Field Mapping

The surface area of all fields cultivated by households in the three research sites was measured. In addition, all fields were measured for three monograph studies of *waalo, falo*, and irrigated rice. Using the field surveys, maps were designed for monograph studies.

5.5.5 Production Systems Monographs

A monograph was produced for each of the major production systems (*waalo, falo, jeeri*, and irrigation). This type of analysis complements household analyses conducted at the level of the sample. To study an entire agricultural system contributes to a better understanding of the complexity both of land tenure strategies adopted by smallholder producers and their responses in various flooding scenarios.

6. Social Organization and Elements of Transition in *Haal Pulaar* Society in the Middle Valley

6.1 Hierarchization of Society

The economic activities and survival strategies of households can best be understood within a wider social dynamic. As the present-day context changes, all signs indicate that the social, political, economic, and environmental changes in the Senegal River Valley will be of great magnitude.

Social predictions are always difficult to make, for the factors that come into play are diverse and themselves unpredictable. Certain key variables associated with current transformations act as catalysts or as obstacles to expected developments.

The pyramidal organization of society is assimilating with difficulty the phenomena of migration, modern education, and irrigated agriculture, because these elements are elements of restructuring. The stability of the traditional social organization will depend heavily upon the magnitude and forms that these elements will take in the future.

6.1.1 Systems of Inequality: Traditional Logic and Changes

6.1.1.1 Political, Economic, and Religious Hierarchies

From the perspective of the hierarchy of political and religious power—the actual exercise of temporal and spiritual command—positions of power within the hierarchy change according to place and time. Thus, we see that in some of the *jeejegol* villages under study such as Doumga and Boyenadji Roumde, those who hold power are members of the *Tooroodo* caste. In the *jeeri*, as in Kaawel and Mogo Yalalbe, the functions of village chief and imam are held by the *Fulbe*. These same functions are carried out by *Subalbe* in Mbakna and Tiguere Cire, and by the *Sebbe* in the villages of the *daande maayo* (bordering the river) such as Thiemping. Other villages along the river are headed by *Toorobbe*, or even *Fulbe*.

For historical reasons, certain social categories considered to be inferior play highly visible roles in certain localities. This is the case for the *Maccube* of Kaawel and Boyenadji Roumde, who exercise the role of *jaagaraf* (collectors of land use fees), usually undertaken by the *Rimbe*; the *Toorobbe* at Doumga; and the *Sebbe* in the Thilogne area. Similarly, though the *jaawambe* continue to hold political power at Kanel, they occupy marginal positions in the areas of Doumga and Boyenadji Roumde.

The traditional economic hierarchy has always closely paralleled political and religious power. The social strata that dominate a particular locality control the major factor of production in the traditional Fuuta—land, in particular *waalo* land. Therefore, the *joom leydi* (master of the land) is always the *joom wuuro* (village chief), although the opposite is not always true in the cases where certain villages do not control any *leydi*. Control over recession land

is crucial to an agricultural subsistence economy in an environment with variable rainfall. In years when insufficient rainfall renders the *jeeri* unproductive, recession agriculture, even if reduced in dimension, alleviates food shortages. As in the Nile Valley in Egypt, the *waalo* is a gift of the *Fuuta* to its inhabitants. From all appearances, the landholding aristocracy is a political aristocracy, and control over recession land has always been of primary interest in the tumultuous history of this region.

Notwithstanding its strong hierarchy based on access to land, the Fuuta strives for economic egalitarianism that guarantees the minimal conditions for survival. The society has not allowed a feudal system to take hold, as one might expect with the elites' control over land. Thus, control of agriculture (the right of the *joom ngesa*) involving a large number of families is not threatened by control of land (the right of the *joom leydi*), a prerogative superior to that of the *joom ngesa*. The right of the *joom leydi*, which includes only the small group descended from village founders, could have spawned a feudal system had it been enforced. Instead, it appears that the major societal concern is to neutralize the economic factor. A leveling mechanism still operates in the *Fuuta Tooro*. In general, land holders and the landless alike find themselves with more or less the same quantities of grain after the harvest, in spite of the application of a rigid system of land use fees (see *waalo* land tenure).

In the same vein, the *joom leydi*, who traditionally collects the *asakal*—a tithe of the harvests—from all the cultivated *jeeri* and *waalo* fields, has not been involved in a process of accumulation. In localities such as Doumga and Kaawel, the *asakal* drawn for the profit of the *joom leydi* may represent a large or small amount of grain, but in these and other villages, the descendents of the *joom leydi* inherited no wealth from their predecessors other than their land. The *asakal* served instead as an emergency reserve for the community. The *joom leydi* was required to make use of the *asakal* discretely to help families—regardless of their social status—who were disadvantaged or who were the first to deplete their primary grain reserves. The society neutralized economic status through an elaborate system of redistribution of goods: each individual was responsible for redistributing wealth to maintain social recognition of his high social status. Most events can be interpreted as occasions for the redistribution of wealth: marriages, naming ceremonies, visits by strangers, religious ceremonies, pilgrimages to Mecca, etc.

In Wolof country, where the caste system is not supported by a system of land tenure comparable to that of the *Fuuta*, the economic foundation of the aristocracy is more precarious. Here we distinguish between organization by caste (related to principles of endogamy and the closed and specialized nature of professional activities) and the organization of social strata shaped either by privileges specific to each stratum or by economic criteria (Diop 1981).

The differences between these different levels of the hierarchy allow us better to understand the effects and the limitations of the current transformations upon traditional social organization.

6.1.1.2 Rights of Seniority

In traditional African society, the privileged position of the senior over junior is a permanent principle. There are more practical applications of this principle in the *Fuuta* than in the rest of northern Senegal—where it is manifested merely as respect for elders—because it is closely tied to the management of floodplain land, a limited and coveted resource. The basis for rights of seniority associated with access to land is a desire to distribute the lineage inheritance justly. Since individuals are allotted land according to their responsibilities, which normally increase with age, the rights of an individual to land increase as he gets older. In the present context of high population pressure, marked increase in life expectancy, and overall higher needs, the principle of seniority rights over land is being challenged and for many increasingly resembles an unjust social system tending toward a gerontocracy.

6.1.1.3 The Role of Women

As throughout the Sahel, women's increased work load limits their civil responsibilities concerning important community matters. This is manifested in their exclusion from village meetings, in their vows of obedience to their husbands, in their restricted rights over inheritance, and in their exclusion from participation in advanced Koranic instruction. At the same time, however, matrilineal descent is often considered to be a more important family tie than patrilineal descent. The discrete and marginal role of women becomes more glaring as their involvement in productive activities—one of the side effects of the large male labor migration—grows.

6.2 The Hierarchization of Land Tenure: Recession Lands

6.2.1 Intervillage *Waalo* Land Holdings

Villages in the Valley were usually settled by successive waves of people of various origins. This explains why some lineages maintain land use rights in their village of origin. In villages that were attraction points as well as points of departure, control of land in the local cuvettes is often open to people who live in other villages. The geographical spread of holding rights over recession cuvettes is a process linked both to past and present migrations and to intervillage relations through marriage.

Marriages sometimes involve the transfer of land from one family to another, or from one village to another. Though the patrilineal regime, which is the norm in the village, rarely involves women in inheritance procedures, especially of land, occasionally a woman may inherit plots. These women may then remove them from their lineage patrimony when they pass them on to their heirs who may belong to a different lineage. This rarely occurs, however.

In the former province of Bosséa, the origin of most of the inhabitants of Doumga Rindiaw, lands are held in *joowre*—indivisible lands held by a lineage or lineage segment and managed by the *mawdo lenyol*, or lineage elder. Their transfer to a woman is virtually

impossible. If the *mawdo lenyol* dies, the next oldest male of the lineage replaces him and manages the lineage patrimony, which remains indivisible. It is unlikely that there would not be an adult male in a lineage.

Traditionally, landholdings at the household level may be inherited only by men. If a woman is single or a widow without resources, or if in a polygynous household she is the daughter of a wife who has no sons, she may challenge this rule, and may obtain half of a man's share. Likewise, in the event that the *joowre* is subdivided, which necessitates the distribution of lands to various households, or *galleeji* forming the lineage, a woman may demand half of the part that would be hers if she were male. Still, she may stake a claim only in the case of one of the two special situations mentioned above. Finally, if a *joom ngesa* dies without a male heir, his lands will be equally distributed among his daughters and his sisters. In some villages (e.g., Kaawel), the sisters of a man who has died are traditionally excluded from the inheritance of land.

In rare cases, women loosen, through "exogamous marriages outside their own *galle*, lineage, or village, the monopoly exercised over recession lands by certain households, *galleeji*, or lineages, or by the village over "its" cuvettes. The tendency toward "cosmopolitanism" (from the perspective of those with access to land but not enjoying the rights of master of agriculture) is inherent in land tenure arrangements on recession lands, arrangements that necessarily evolve toward greater democratization.

6.2.2 Rights and Regulations Tied to Land Use

Decision-making concerning the use of land is the responsibility of the master of agriculture, the *joom leydi*. Sometimes this control is exercised collectively at the level of the lineage, lineage segment, or of the *galle* if it involves *joowre* (collective lands) held, indivisible, by a family. Whether collective or individual, the control of agriculture can be linked to control of the land (*joom ngesa*). Since the *joom ngesa* may choose between cultivating his land, lending it, or leasing it for use by others for variable periods of time, the control of *waalo* fields is quite complex. Several forms are presented here.

6.2.2.1 Complete Control over Land

The *joom leydi* is responsible for managing the territory, including lands for pastoral, agricultural, fishing, and habitation purposes. This responsibility includes the absolute right to endow vacant or abandoned plots to neighboring families, to resolve conflicts over lands, to determine appropriate dates for planting and harvesting, and to open harvested fields to herds (*nyaayngal*). The *joom leydi* enforces a rational use of land, determining, for instance, whether off-season lands should be left fallow. Although he consults the village assembly about these questions, only his decision counts.

Complete control of land is exercised by the *joom leydi/joom ngesa* cultivating his own plot. The *joom ngesa* transfers the *asakal* to the *joom leydi*. Receptor of the land *asakal*, the

joom leydi is not obliged to pay any fees other than the tithe destined for the poor (*miskineebe*). In Doumga Rindiaw, this type of tenure involves the entire lineage segment of the village chief, and, by association, another segment of the same lineage responsible for religious functions. The latter segment was excused from paying the asakal by the village founding father who, wishing his relatives' support in his new *leydi*, thought it wise to grant them this favor.

Thus, in certain communities such as Thiemping and Boyenadji Roumde, complete control over land (joom leydi) has totally disappeared. The only landholding form is that of the joom ngesa. No one pays the *asakal*, or any other fees, to the *joom leydi*, or to the village chief. Even in Doumga Rindiaw and Kaawel, where the title of joom leydi uncontestably belongs to families exercising the function of village chief, this right is losing its relevance.

6.2.2.2 Partial Control of Land

Originally, the *joom leydi* welcomed newcomers in the village and allotted them agricultural lands from his domaine. A member of one of the higher castes would often receive holding rights (*joom ngesa*) for his allegiance to the family of the *joom leydi*. Otherwise, he would receive the title by clearing plots with an axe (*jambere*), a machete (*lewre*), or with fire (*jeyngo*). Members of the lower caste groups (artisans, or *Nyeenybe*, and slaves, or *Maccube*) traditionally received usufruct rights in reward for their service to higher castes. As long as he pays the land-use fees (the *asakal*, or one-tenth of the harvest in Doumga Rindiaw) associated with his rights, the *joom ngesa* may not be dispossessed of his lands by the *joom leydi*. When the *joom ngesa* dies, his heirs inherit his fields after payment of the cootiigu (in the form of an ox, in the tradition of Doumga Rindiaw) to the joom leydi. Likewise, if the joom leydi dies or is replaced (in case of mental deficiency, for example), the joom ngesa must pay the cootiigu to the joom leydi's successor. This right must be renewed each time one of the two parties in the contract (the joom leydi or the joom ngesa) changes. Thus the grantor and the grantee are always tied by a direct contract.

Of the two land control rights, that of the joom ngesa gives a greater flexibility to its holder. He may cultivate his lands, rent them out for variable periods of time, lend them free of charge or conditionally, have them sharecropped, or pass them on to his heirs.

It is at this level, and not at the level of the joom leydi—whose powers are very limited—that real control over land in the waalo must be studied.[50]

Partial control of land is more difficult to describe in detail, because of the complexity of the management of collective land (*joowre*). The first gifts donated by the village founder were given to heads of households, or *galle*, who witnessed the growth of their lineage segment

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[50] The same rights exist in the *jeeri*, but since land there is not scarce, the *joom ngesa* usually lend their plots free of charge to those who ask. Traditionally, however, the *joom leydi* collects the *asakal* for all cultivated fields. Today, this practice is observed less frequently.

with each successive generation and continued to manage collectively the patrimonial inheritance of their ancestors.

If the *joowre* remains whole, its management is the responsibility of the eldest of the lineage (*mawdo lenyol*) or the eldest in the *galle (mawdo galle*). Having more responsibilities overall than his juniors or the other male members of the lineage, he may use the largest portion of the inheritance, but only if he cultivates it himself. This field is called *gesa mangu*. The other fields are distributed to his brothers in descending order of age, plot size decreasing with the age of the recipient. Subsequently, married sons are considered, and usually each is allotted a small plot of land (*ciifol*). If the lineage has more land than it can use, the remaining fields may be ceded to outsiders, through the *mawdo lenyol/mawdo galle*, for a certain period of time and under variable conditions. Each cultivator, whether a member of the *lenyol* or not, must pay the *asakal* of the *joom leydi* through the intermediary of the oldest member of the lineage. The *mawdo* (eldest) takes a portion of the harvest from members of the collectivity and from harvests gathered from ceded lands, and distributes it to women in the lineage. A specific share is assigned to each woman according to her needs and thus, by association, to her familial responsibilities. This type of *joowre* management conforms to principles of social justice, in that the patrimony is always distributed to the members of the lineage according to their responsibilities. Some of these include: family size, maturity, detailed knowledge of relationships within the lineage (and by association mastery of the principles of just distribution of land among the members of the collectivity to whom it belongs), the equitable distribution of the *caatal* (the portion of the harvest given to a person who has not cultivated) to women of the *lenyol* having familial responsibilities, etc.

This collectivism is continually threatened, however, especially by new generations, when the escalating population pressures land use, when the factors of lineage descent become unclear, when a market economy fosters individualism, or when affiliation with political parties divides families into opposing clans.

To discourage the formation of schisms leading to the subdivision of the *joowre*, the village community, under the leadership of the *joom leydi*, developed protective measures. Each time squabbles within the lineage result in the subdivision of the *joowre* and distribution of land among its members, the *joom leydi* divides the land into three parts. Each one of two opposing factions receives one portion and the third part falls within the jurisdiction of the *joom leydi*, who serves as a buffer between the two groups. The *joom leydi*'s portion is called the *bayti*, or land belonging to the muslim community (the village). The *joom leydi* may distribute the land to friends in need or to new inhabitants, or—as is often the case—he may add it to the patrimony of his lineage which then will hold double rights of *joom leydi* and *joom ngesa*. The establishment of this regulation is justified by the need to avoid juxtaposing feuding relatives who will dispute territorial boundaries. But the immediate consequence of the rule is that each of the opposing factions finds itself with access to less land than it would have had if they had remained under the auspices of the *joowre*.

This procedure does not eradicate the potential subdivision of the *joowre* but nevertheless explains the large size of the holdings of the families of the *joom leydi* (36.89 inundated hectares this year for one *galle*) and their distribution throughout the village basins. It explains the passage of the rights of master of agriculture at the lineage level to the rights of master of agriculture at the level of the *galle* and the household (*fooyre*) and also explains the trend toward the development of microproperties in the *waalo*.[51]

In some cases the subdivision of land held communally by a family results in a second form of joint holding. For example, after the subdivision of a *joowre* of inadequate size, a large family faction finds itself with so small an inheritance that the traditional system of management, which requires that arable plots be distributed annually according to seniority, is not applicable. Each participant would receive so small a plot as not to be worth cultivating. Instead, a rotation principle is adopted to alternate cultivation rights: the oldest farms the first year, his next younger brother the following year, and so forth, counting only years of sufficient inundation. In other words, households considered to be *joom ngesa* of certain fields will not hold the title the following year, this right having been ceded to other families in the lineage segment. If they want to cultivate the *waalo*, they must inquire with those who have land left uncultivated. In that case, they become temporarily members of the group of landless farmers, *the samba remooru*.

6.2.2.3 Precarious Land Tenure

This category includes those who cultivate a field of which they are not joom ngesa,[52] either at the individual level or through the influence of their lineage (in the case of the *joowre*). These are *samba remooru*. Several types of precarious land tenure that tie the *samba remooru* to the *joom ngesa* fall into two categories: those with fairly advantageous conditions for the cultivator (relatively "easy" conditions) and those that are a "burden" to the cultivator.

6.2.2.3.1 Precarious Land Tenure with "Easy" Conditions

When a field has not been cultivated for a long time because of insufficient flooding—which has been the case for several marginal fields between 1974-75 and 1988—it becomes overgrown with bushes and weeds. It needs to be cleared before it can be cultivated. The *joom ngesa* may do it himself before cultivating.

If he has enough land in the areas of the cuvette that are regularly flooded and cultivated, or if the land concerned is too extensive in terms of his labor capacity, he may cede his right to cultivate part or all of the newly-available land to somebody else. Because clearing it renders

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[51] For information on microproperties in the *waalo*, see Gueye (1957).

[52] One cannot be *joom leydi* over a field if one is not also *joom ngesa*, a status granted by the first condition.

it useful for several years, it entitles the other person to cultivate it for five to seven years, according to the amount of effort needed to clear it. This person is the *lewtu ngesa*, also known as the *rem itaa giye* (literally, "cultivate and remove the thorns," or, more logically, "remove the thorns and cultivate"). Only the years when the fields are flooded are counted. So long as the allowance period has not terminated, the farmer may transmit this right to his descendants.

When the *joom ngesa* lends one of his fields free of charge to a friend, slave, or artisan, the latter makes use of the land as if he were himself the *joom ngesa*. This loan is usually granted on a yearly basis and may be renewed. With the exception of the *asakal* for the *joom leydi*, which passes by way of the *joom ngesa*, he has rights to his entire harvest. The name *for this type of tenure arrangement, rem bamaa* (or *rem nawaa* "cultivate and take away"), is also known in the *Fuuta* as *lubal* (loan). (The term *lubal* is rarely used in tenure transactions in Doumga, in contrast to Boyenadji Roumde and Thiemping where it may represent a type of tenancy requiring compensation.) The *asakal leydi* is a symbol to remind the cultivator that he is not the holder and to guarantee him access to the field the following year if he so desires.

In certain instances, land is lent conditionally. These conditions are implied when the *joom ngesa* lends a field to "his" slave. The implied compensation is a variable number of work days (3 to 5 days) on his fields. This arrangement is generally honored for one year only and must be renegotiated after each flood.

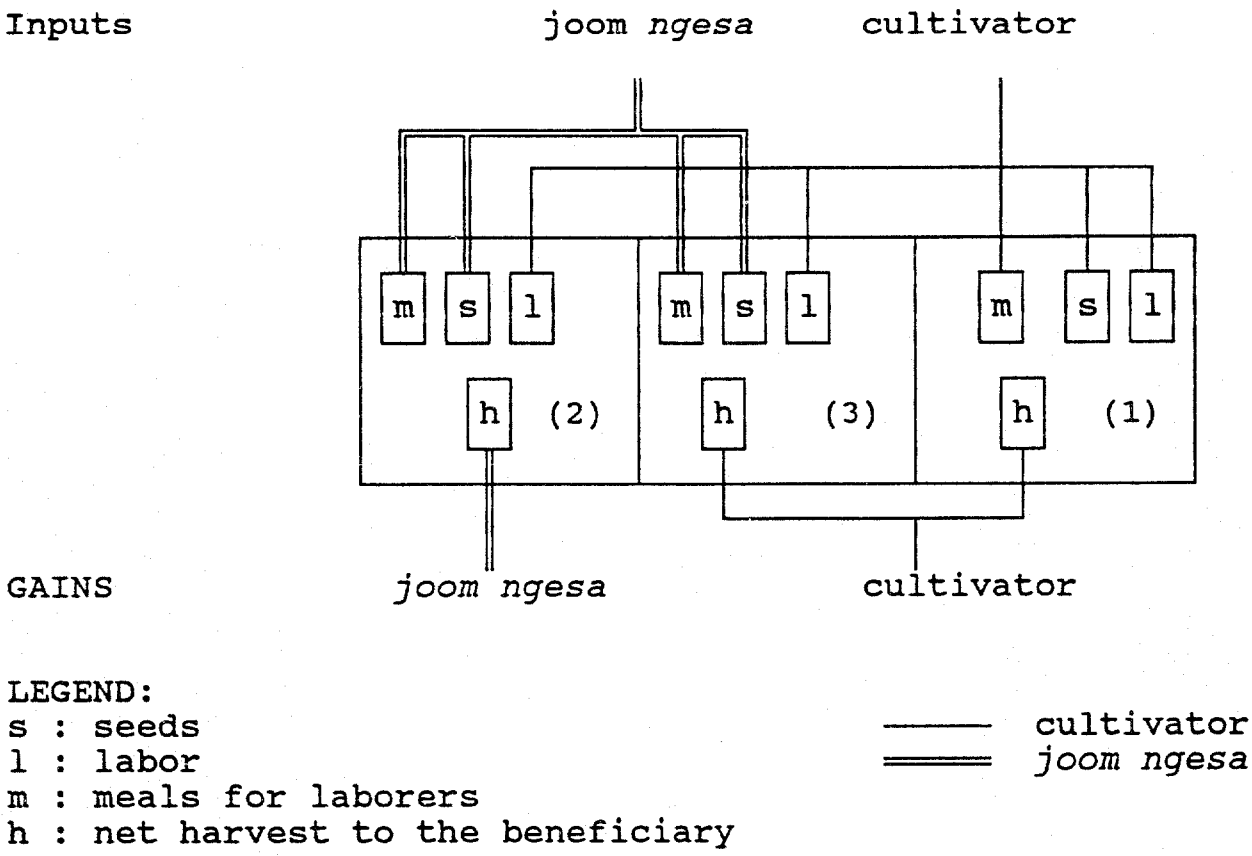
In sum, in all cases where the *samba remooru* is not obligated to provide a part of his harvest to the *joom ngesa* (with the exception, of course, of the *asakal*), the term *rem bamaa*, is used, since the result is more or less the same: the nonholder cultivator enjoys rights to his entire harvest, minus the land holder's *asakal*.

6.2.2.3.2 Precarious Land Tenure with "Hard" Conditions

The most frequently observed type of land tenure among the *samba remooru* is sharecropping, or *rem peccen* ("cultivate and let's share"). The type of sharecropping most frequently encountered in Doumga Rindiaw, Kaawel, and Thiemping is the *rem peccen tatabal*. *Tatabal* (from *tati*, which means "three") may be translated as "in thirds." In this type of contract, the field is divided into three equal parts: once the *asakal* is subtracted from the total production for the *joom leydi* through the *joom ngesa*, the harvest from the first part goes to the holder of the field. The harvest from the second, called the *lewre bottaari* (literally the "plot for the meal") is designated for the cultivator, representing his "food;" and the yield from the third section is supposed to be the profit of the cultivator. In sum then (see Figure 6.1) the holder gives a third of the field to the cultivator, who is responsible for all production costs on that piece of land, including seeds and his food (plot No. 1); the holder of the field keeps a third of the field for himself, which he arranges to have cultivated by the *samba remooru* in return for the loan he receives (plot No. 2). But because he has no rights to the harvest from the plot he is cultivating, he must be fed by his "employer" for his labor. This food is paid for by the *joom ngesa* through his donation to his "employee" of the third plot, which provides the means for the "reproduction of work." Thus, for the remaining two-thirds of the field, the *joom ngesa*

is responsible for all production costs, essentially consisting of—apart from the "food" for the cultivator—seeds.

Figure 6.1 Diagram of *Rem Peccen Tatabal*



This system, of subdividing the field and the harvest from each of three plots into three parts, has been simplified in most places. The harvest from the whole field is collected—eliminating the necessity of subdividing the field into three plots—and, once the *asakal* has been subtracted, divided into three equal parts: one for the *joom ngesa*, the other two for the cultivator. More than for simplification, the modification seems to have developed when it was observed that, in most cases, the producer tended to take better care of his own plots than of the plot of the *joom ngesa*.

In sum then, this type of *rem peccen* is relatively advantageous for the producer. In certain zones of the *Fuuta*, such as Boynadji Roumde, rem peccen didabal is practiced. This consists of dividing the harvest into two equal parts, one for the producer and one for the holder. The difference between the type of sharecropping in Doumga Rindiaw and that in Boyenadji Roumde may be explained by the difference in tradition, as well as the difference in the nature of the soils of the *waalo*. Soils in Doumga Rindiaw are allegedly of lower quality to the extent that they facilitate the growth of weeds (*haacoonde* and *nyippere*) immediately after the flood, which makes the task of clearing so difficult that no *samba remooru* would agree to a contract in *rem peccen didabal*. In any case, the difference between the types of *rem peccen* do not

appear to obey laws of supply and demand since, in Boyenadji Roumde, a great deal of flooded land did not seem to be cultivated, while in Doumga Rindiaw, all land touched by water was planted. Logically, sharecropping in Boyenadji Roumde should be more attractive and therefore more favorable for the producer, which is not the case. The *didabal* system almost always includes the payment of the *asakal leydi* (one tenth of the harvest). That is, 60 percent of the harvest is handed over to the holder. This type of contract was common in Thiemping and neighboring villages until roughly fifteen years ago, when the terms of the contract were modified in favor of the sharecropper. Of the 47 sharecroppers in Cangay Dow Seyji in 1989, 44 cultivated under *tatabal* agreements, and three under didabal agreement.

Land tenure includes the management not only of the land itself, but also of human capital. Even though the majority of holdings are managed by a *pooyre*, there can be cases of temporary management by two brothers. In the general framework of social relations, however, one often has recourse to sources of help within the family or lineage:

- *dawol* (collective work),
- *ballotiral* (reciprocal labor)
- *doftal* (unpaid day of work)
- *satindaade* (work paid in kind)
- *ballal* (help in a general sense)
- *dawol fedde* (collective work by an age grade)
- *njobdi* (daily wage earners)

6.3 Elements of Transition in Society

Social organization in the *Fuuta*, as elsewhere, is the product of history. It continually undergoes challenges. Each time, it adjusts itself, remodels, and redefines itself, bringing into play the social forces that give it its orientation. The Theocratic Revolution of the 18th century heavily influenced the present structures in the *Fuuta*, and Islam heavily influenced the role of women. Today the extensive emigration taking place in the valley, the spread of modern education, irrigation, and other more diffuse phenomena introduce "static" into the traditional order of things. It remains difficult to determine the influences of each factor, to evaluate the depth of the changes, and to identify the form of the structure that is establishing itself.

6.3.1 The Role of Emigration

The original causes of emigration—a phenomenon of spectacular dimension in the upstream Middle Valley and in the Upper Valley—have not been determined. It is certain, however, that they are no longer the decisive and/or the only ones explaining why the movement continues, seemingly in a self-sustained manner. Only a study of emigration will reveal the causes of its perpetuation.

No region in the Department of Matam has been spared by migration. In each village in the zone, a large number of people leave the "field of statutory relations" for a more or less

extended time (Lericollais 1990:39). In the three research sites, there is a high level of absenteeism among working-age men. In Doumga Rindiaw, 40 percent of all men between the ages of 10 and 64 have emigrated. In Boyenadji Roumde, the rate is 54.7 percent for the age group 15 to 65. At Thiemping, it is 56.6 percent of men between the ages of 15 and 60.

Emigration cannot be ignored regardless of the perspectives from which the *Haal Pulaar* are studied, particularly in the Department of Matam. Whether it be changes in the structure of agricultural labor, the financing of irrigated agriculture, the growth of the private sector, fulfillment of household monetary needs, modernization of the home, provision of villages with religious and social infrastructure, or the establishment of village associations for development, everything relates closely to migration.

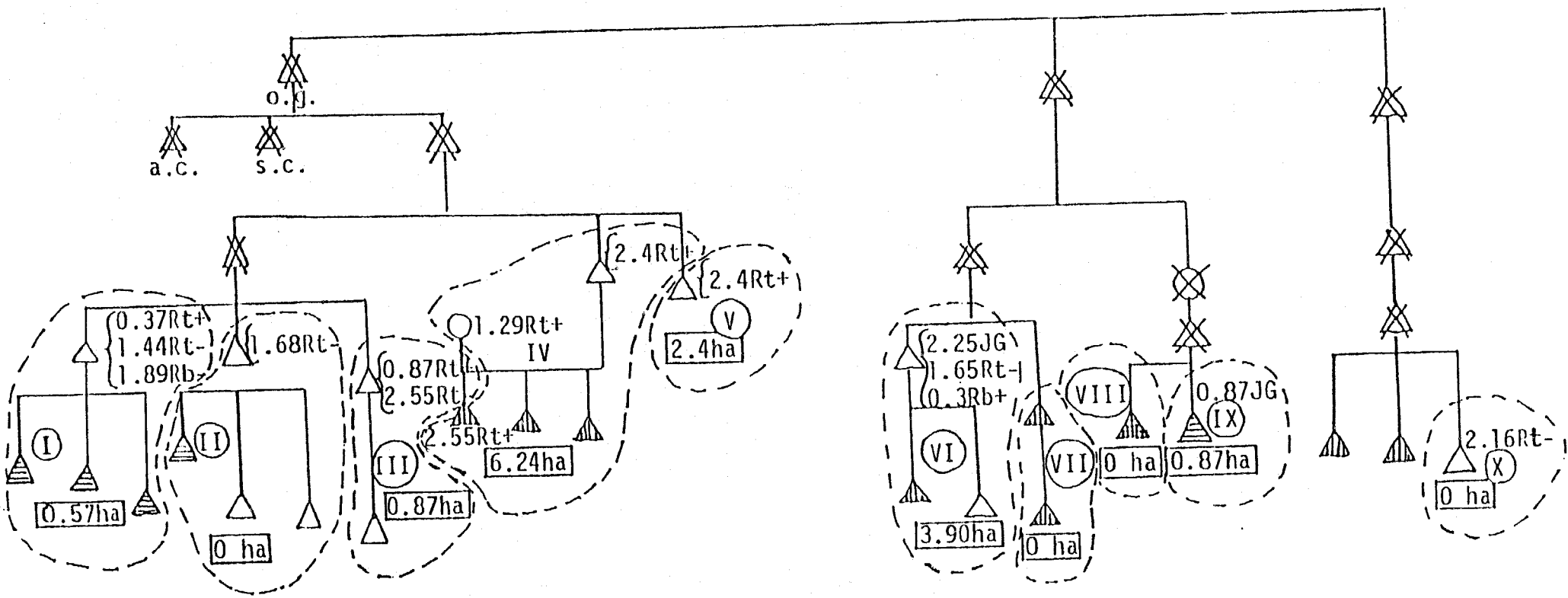
Clearly, the organization and functioning of traditional village institutions cannot remain unaffected by this phenomenon. The problem consists of determining in what terms and spheres migration operates. The different forms of hierarchy have been outlined: hierarchies of values, politics, and economy. It has been emphasized that economic hierarchy rests on a control of land organized in a manner such that all forms of capital accumulation and drastic economic differentiation were impossible. This represents a form of economic leveling. Migration liberates and invigorates the economic factor.

In the study sites, migration takes the same form and magnitude among all social strata. At Kaawel, it is fairly equally represented in the two main status groups in the village, but whereas the *Fulbe* are heavily involved in national and rural migration, the Maccube are involved more in urban, national, and international migration. In Doumga Rindiaw, migration has disturbed the economic order, while in Kaawel, it actually provoked an inversion of the economic hierarchy. Within lineages, lineage segments, and families, the youngest members use migration to mitigate the inferior position they have vis-à-vis control of land. There too, the roles are frequently reversed, the oldest finding themselves in a position of dependence on their juniors even though tradition dictates exactly the opposite.

Figure 6.2, depicting the household genealogy of one of the most influential *Toorobbe* lineages in Doumga Rindiaw, illustrates that: (1) access to recession lands even within landholding families is very inegalitarian; (2) the mode of land control and transmission favors the oldest and discriminates against the youngest; (3) the tendency to migrate is pronounced in families having very little land; (4) in these latter families and also in those whose access to land is controlled by elders, many young people take part in long-term migration; and (5) young members of the landed aristocracy residing in the village are often forced to work as sharecroppers in order to gain access to recession lands.

Haal Pulaar society is destabilized by migration, which has mobilized the economic factor previously controlled through a number of leveling mechanisms. Migration seeks to reestablish an economic order compatible with traditional organization by introducing a leveling effect from the top which would again neutralize the economy. In fact, if everyone enriches

Figure 6.2 Genealogy of the Niokane Family in Doumga: Access to Land, Age Relationships, and Migration



LEGEND:

Tenure Arrangements on the Waalo 1988/89

JG Joom ngesa; holder/cultivator

Rt+ Sharecropped out (rem peccen)

Rb+ Given out as free loan (rem bamaa)

Rt- Sharecropped

Rb- Received as free loan

0.3 ha Total area controlled

Household

Migration

Deceased

Migration-Senegal and neighboring countries

Migration-rest of Africa

Migration-Europe and the United States

himself through migration, land tenure will be the only notable economic differentiating factor. Thus, if those with no access to land (lower castes, junior members of a lineage, lineage segments disadvantaged for various reasons) make money by migrating, then land holders (upper castes, *joom leydi* families, senior members of a lineage, lineage segments privileged for one reason or another) must do the same to reestablish the traditional order. Apart from ecological reasons such as drought, which have results that affect everyone, there are purely sociological reasons for migration, whose magnitude is not proportional to the extent of the climatic crisis. The area of Bakel receives more rain than that of Matam, where the drought was less severe than in the Department of Podor. The magnitude of migration decreases, however, as you travel downstream from Bakel to Podor via Matam.

The fact that landholders have not tried to improve their economic status through improved use of the land either in the past or in the present, is problematic. Migration and the disorder it creates seem to be perceived as only a passing aggravation. This society may be operating according to two contradictory logics: a logic of individualism accompanied by a desire to become wealthy at any price, on the one hand, and a logic that places emphasis on the community and on economic equality, on the other hand. The type of thinking associated with the first is encountered only outside the village, while the origins of the second are strictly local. At most, migrants permit themselves to display their economic success in their homes in the village. But from all evidence, this hybrid situation cannot be managed in the long term either by collective institutions or by individuals.

Through the resolution of the major contradiction posed by migration and a greater receptivity to a market economy, the Middle Valley of the Senegal River will direct itself to deal better with the circumstances of the Après-Barrage.

6.3.2 The Role of Modern Education

Modern education has always been distrusted in the Senegal River Valley, as well as in the rest of the country. Indeed, each society has its own system of education whose principal role is to assure its reproduction and its development. Alongside the traditional and informal education and Koranic instruction, modern schooling introduces new values, other perspectives, and a different ideology; and it recruits impartially among men and women from all social strata.

Modern education has taken hold in certain more or less urbanized settings in the *Fuuta*, but in the study sites modern schooling and its by-products appear still to be mistrusted. Doumga Rindiaw has one primary school with three classes—shared with Mboloyel—and Kaawel Dialloubé has one school with two classes shared with Kaawel Kangal, Padé Boyengal, Thiéhel Padé, and Saracouro. These two buildings date from the early 1960s. Records are not particularly well kept at Kaawel, but are in fair order at Doumga Rindiaw.

The information gathered shows that for Doumga Rindiaw, counting only the total number of enrolled students whose families are known by the village instructor (students whose caste is unknown usually come from surrounding villages), the various castes have a fairly

positive attitude toward school: 67 percent *Toorobbe* (59 percent of households), 11 percent other *Rimbe* (19 percent of village households), 8 percent artisans (3 percent in the village), 14 percent *Maccube* (19 percent of the village). A slightly higher percentage of *Toorobbe* go to school, compared to other groups (see Table 6.1).

Table 6.1 Statutory Groups of Those Enrolled in the Schools in Doumga Rindiaw and Kaawel

	Castes	Recruitment Years										
		62/63	66/67	68/69	71/72	72/73	77/78	79/80	83/84	86/87	87/88	89/90
DOUMGA	Toorobbe		14	17	12	10	20	13	32	17	9	
	Rimbe		4	4	4	3	3	0	3	1	2	
	Nyeenybe		0	1	1	0	2	2	4	5	2	
	Maccube		1	4	4	1	3	3	9	4	1	
	Inconnu		5	5	7	3	14	23	32	18	15	
KAAWEL	Fulbe	16									12	13
	Maccube	4									22	22
	Autres	5									3	5
	Inconnu	0									7	4

At Kaawel in the early 1960s, the *Fulbe* were more involved in modern education. Today, they seem to have abandoned modern education, in contrast to the *Maccube*. But there is a big difference between enrolling in school and completing one's education. In both villages, the drop-out rate before the end of primary school is very high. Thus at Kaawel, only one high school diploma has been awarded; at Doumga Rindiaw, between five and ten. In the former village, no girls have remained in school long enough to receive a certificate of primary studies (CEPE), and in Doumga, only two girls have received this diploma since the school was established.

In sum then, the overall threat posed by modern education to social stability is more potential than real. In the two villages studied, there are virtually no instances of personal gain achieved through schooling that compare to the numerous cases of success achieved through emigration. For this reason, the Koranic schools have retained their prestige. Women have not been able to improve their situation through formal education because their schooling is often cut short for marriage and domestic responsibilities.

6.3.3 The Role of Irrigated Agriculture

Irrigated agriculture disrupts traditional organization at two levels:

In the traditional system, social strata whose rights to land are nonexistent or insignificant include inferior castes, noble but landless lineage segments, and families headed by young men or by women. By eradicating the discriminatory system of land control, irrigation undermines and diminishes the very base and mortar of the power hierarchy.

Irrigated agriculture emphasizes, in place of the control of land, the control of financial capital, which becomes indispensable to the cultivation of land. The bulk of revenues come from migration, and migration functions under its own particular logic and dynamic. Thus, irrigation establishes a new land tenure hierarchy based on economic factors whose neutralization was the sole method of guaranteeing the stability and reproduction of traditional institutions and hierarchies.

Even if the changes seem to be evolving slowly, *Haal Pulaar* society is probably undergoing modifications that are beyond its control. The control of one of the fundamental factors of its reproduction is out of its hands: the economic factor. The result leaves an impression of a society in pursuit of its own model—traditional organization—by embarking upon the uncertain waters of migration and a market economy.

6.4 The Challenge to Traditional Powers

6.4.1 Politics: The Two-fold Role of the Village Chief

If one agrees that power is not an attribute but a relationship oriented toward a goal and translated by relations of force (Crozier and Friedberg 1981:57-59), it follows that the traditional system of domination cannot be insensitive to the multiple changes that are affecting the daily life of inhabitants in the Valley.

Under the traditional system, control over land was the principle source of political power because it gave the land holder means of punishing or rewarding his dependents according to whether they had infringed upon or respected established regulations. Today, the *joom leydi* in his relationships with land users, and the *joom ngesa* in his relationships with *samba remooru*, cannot use these privileges to any significant degree for several reasons:

Production on traditional agricultural land for many families no longer represents the sole means of survival. Income from traditional crops is minimal for certain families heavily engaged in migration, or who receive military or retirement pensions.

The *joom leydi/joom wuuro* (village chief) is almost always implicated in national political affairs and in faction disputes. For this reason, he needs to be responsible to his potential constituency.

The traditional prerogatives of the landlord are threatened by the new institutional environment: land tenure reform, rural council, and the presence of SAED.

The village chief, stripped of his basic functions, appears today to be simply a *jaagaraaf* responsible for collecting rural taxes for the Rural Council and serving as the intermediary between the local administrations and villagers. Thus, from the point of view of the central government, the village chief, whose power is legitimized by tradition, is an administrative agent. His nomination by the village must be approved by the local authorities before it is put into effect. The administration has occasionally chosen village chiefs who were not supported by the local council. In each village of the Fuuta, families close to the title of the village chief dispute contentiously. Traditional institutions that had trustworthy mechanisms for choosing village chiefs are also threatened.

Local power has changed form. It no longer signifies the right and duty to administrate the collectivity, to manage in a rational manner the land patrimony, to resolve conflicts, and to assist the poor. Holding local power today means getting as close as possible—even if it is just in appearance—to public power and to all that it symbolizes.

Thus, the Opposition has no chance of significantly infiltrating the rural milieu in the Valley because it does not hold power. Similarly, the ruling party is not the one creating the political schisms (called "leanings") in the villages. Each location is split between "leaning A" and "leaning B," which seek to give support to the leader able to prove he is close to, or speaking for, the established central power. The same desire for recognition by public authorities can make the president of the PIV a difficult person to deal with. He is the exclusive voice of SAED whose technicians he hosts and houses when they visit the village. Finally, he controls the perimeter as if it were his *leydi*.

6.4.2 Religious Power: Slow but Inevitable Change

In the Fuuta, the most extensively Islamicized region in Senegal, religious education and functions are highly honored. The marabout (*ceerno*) and the Imam who leads the Friday prayers are respected, even venerated personalities. The *Tooroobe* are traditionally known to be the most strict in terms of religious education and respect for Koranic rules. The principal imams and marabouts are recruited among them.

In today's context of the devaluation of agricultural activity, a large number of marabouts are finding themselves occupying a less important role. The most prestigious have managed to adapt to the hard times. They make money giving advice locally and abroad. Two marabouts from Doumga Rindiaw almost every year are invited to France for two to three months by the village migrants for a series of well-paid consultations.

7. Organization and Relations of Production in the Middle Valley

7.1 The Organization of Production before the Introduction of Irrigation

The organization of production among the Haal Pulaar is the product of a historical process covering the precolonial, colonial, and postcolonial periods. It is reported that the precolonial era was characterized by a self-sufficient domestic economy in which access to resources were determined by the control of elders over juniors and by a rigid caste system that put some members of the society in a subservient patron-client relationship to others. The Haal Pulaar caste system is based on three strata: the *rimbe* (freemen), the *nyeenybe* (artisans), and the *maccube* (slaves; former slaves). The rimbe are further divided into the *toorobbe* (an elite clerical caste, descendants of the conquerors of the Fuuta Tooro), the *sebbe* (warriors), the *subalbe* (fishermen), and the *jawambe* (advisors to toorobbe). The colonial era, which began formally in the late nineteenth century but made its effects felt much earlier, led—through a mixture of corvée labor, taxation, and development projects that expropriated labor and land—to the gradual commoditization of labor and resources. The transformation of the Valley economy continues through the postcolonial era with increases in labor mobility and commoditization, agrarian reforms, international donor involvement, national development policies and objectives, and progressive incorporation into a world capitalist economy.

Before the introduction of irrigation, Haal Pulaar agriculture was comprised of two complementary systems that utilized different types of land and land tenure: rainfed cultivation of millet, practiced on sandy uphill fields known as *jeeri*, and flood recession farming of sorghum, cowpea, maize and other vegetables on flood plains or *waalo*. Waalo lands are divided into three categories, depending on soil type and distance from the river: *falo* refers to the highly fertile alluvial river banks that are used for the cultivation of garden crops, mostly by women; *hollade* fc ms the bulk of waalo fields and refers to fertile and clayey depressions where sorghum, cowpea, and sometimes millet are grown; and *fonde* denotes higher up areas that are inundated only during years of very high flood. The greater value attached to waalo than to jeeri land is expressed in the land tenure practices that prevail in each system. While access to jeeri land is more or less open to village members, access to waalo is highly structured and unequal. Historically, the Toorobbe maintained control over waalo lands and accorded use rights to other castes, usually in exchange for produce and/or labor. Rights to waalo today are somewhat more open, but almost entirely restricted to free castes.

Jeeri and waalo cultivation calendars complement each other so that despite adverse climatic conditions, the Haalpulaar have achieved self-sufficiency in cereals in most years (Jamin 1986:45). Planting of jeeri fields begins in July; August through October is occupied with weeding and guarding of fields. November presents the first major agricultural bottleneck since harvesting of jeeri fields coincides with planting of the waalo. Waalo harvesting takes place in April.

Jeeri and recession cultivation are complemented by herding, both sedentary and transhumant; fishing; gathering; artisanal work and labor migration, both seasonal and long

term. This diversified production system is pursued at the inter- and intrahousehold levels with some caste-associated occupational specialization.

7.2 Factors That Have Altered the Diversified Production System

Three factors have modified this diversified production system: the introduction of irrigation first in the Delta in the early 1940s and later in the Middle Valley in the 1970s; the 1967-74 severe Sahelian drought; and the construction of the Diama and Manantali Dams.

> The introduction of irrigated agriculture initially was more in response to national needs than to regional development: for the large perimeters, it was a question of producing rice for domestic consumption. The development of village agriculture in the river basin was of secondary importance. Efforts were concentrated in the Delta, a relatively unpopulated region, where migrants from the jeeri and other areas supplied most of the labor.
>
> Beginning in 1968, a dry spell set in that made it impossible for traditional agriculture (rainfed and recession farming) in the river basin to feed villagers. Also, the large perimeters were encountering difficulties. The development of small-scale village perimeters, or PIV (Périmètres Irrigués Villageois), in the Middle and Upper Valley was thus encouraged to meet the subsistence needs of valley households. These households, however, continue to engage in their traditional agricultural activities when the climate permits (IDA translation) (Jamin 1986:45-46).

8. Agriculture and Herding in Household Production Strategies

8.1 Introduction

Households in the Department of Matam, in the heart of the Sudano-sahelian zone, endure a precarious environment and unpredictable rainfall. In addition to the usual interannual, annual, and spatial irregularities in rainfall, the Valley has been subjected in the last twenty years to an almost chronic water deficit.

Recession agriculture depends on the river regime, which is dictated mainly by the yearly rainfall recorded in the upper basin and, to a lesser extent, by local rainfall. Even if water deficits in the river do not follow the same periodicity and magnitude as the local rainfall shortages, the river regime shares in the unpredictable nature and the precariousness of rainfall.

During the great drought in the 1970s, which led to a severe reduction in rainfed and recession agriculture, irrigation in the form of small village irrigated perimeters made great progress in the Middle Valley. Still, in the Department of Matam, it has remained a relief activity, whose objectives don't go beyond the need to mitigate household grain deficits. Its development was limited by the traditional regime of the river, which usually allowed for only one agricultural season per year, the rainy season corresponding to the high water period.

Since 1988 the Manantali dam built in the upper basin has greatly modified the local hydrology through its ability to moderate extremely high and low floods. It is meant to assure a minimum flow for the purposes of irrigation. Furthermore, at least for a few more years, it should help to improve the flood, both quantitatively and qualitatively.

In other words, new opportunities linked to water are opening to both irrigated and recession agriculture. Rainfed agriculture remains totally dependent on uncontrolled factors, even though, generally speaking, a slight improvement in both the amount and the distribution of rainfall has been noted these last few years.

In contrast, herding does not seem to have found its place in the Après-Barrages era. Despite its important contribution to household revenues and its enormous potential, herding has remained marginal as far as decision makers are concerned. This state of mind stems largely from a lack of knowledge of the sociological nature of the activity. The legal and ownership status of herds in Fulbe communities are some of these obstacles.

Diversified production, widespread among households of the Valley, minimizes risk in an ecology precarious for farming and herding. But this diversification of sources of income, which applies equally to craft, trade, and migration, is obtained only at the cost of a rigorously tight management of household labor and capital—often limited. In many cases, it also involves the thorny problem of land access.

The cut-and-dried argument between promoting modern production activities and preserving so-called traditional activities is often a mechanistic evaluation that is not adapted to the needs of the populations in the Valley. Our study looked at real-life (versus theoretical) household strategies to integrate traditional and modern agropastoral activities.

For the sake of clarity, this study of household agropastoral strategies is preceded by a detailed description of each activity in terms of access to and management of basic resources.

8.2 Recession Agriculture

Recession cultivation is practiced on river banks—*falo* agriculture—and in cuvettes, after the flood waters have receded. Local terminology distinguishes three types of floods, according to the importance of the area flooded:

- the *soonyo* corresponds to a nonexisting or deficient flood, such as the flood of 1986.
- the *amo* corresponds to an abundant flood, such as the floods of 1988 and 1989.
- the *pusam* is a very high flood, similar in certain cases to a deluge. It can destroy houses built on the *foonde*.

This typology does not always correspond to a scientific analysis of river hydrology. Rather, villagers refer to the extent of the area flooded, which is evaluated by each village according to its topography, lowland availability, and its demand for arable land.

The magnitude and quality of the flood varied considerably between the 1988 and 1989 seasons, but in general, both were viewed as exceptionally good years by local farmers in comparison to floods during the previous fifteen years. Since 1975, the maximum height of the flood recorded at Matam has averaged 6.28 meters.

In 1988, the flood reached 8 meters on September 15th, a height that had not been registered since 1975. Farmers in Thiemping noted a period of field submersion slightly under the thirty-day preferred standard. This field observation corresponds to the sudden rise and decline in the peak of the hydrogram, as recorded at Bakel. Two minor releases of water from the Manantali Dam in October had no bearing on the duration of flooding in the *waalo* because of their magnitude and relatively late release.

In contrast, the volume and intensity of the 1989 flood were reduced, but two dam releases in September caused it to last longer. The peak of the flood occurred two weeks earlier, on September 1st, reaching a river level of seven meters at Matam. Unlike the experience of one of the floodplains near Doumga Rindiaw, the sharp decline of the flood peak in September and the ensuing artificial rise in the water level three weeks later did not adversely affect planting conditions on Thiemping's floodplain. Indeed, farmers in Thiemping indicated

that flood conditions were ideal. The slow, prolonged period of submersion of fields permitted even the outerlying fields to remain under water for longer than normal.

In Doumga Rindiaw, the second discharge from Manantali caused massive damage. Seeding had already started on all cuvettes immediately following the beginning of the recession of flood waters after the first peak. The second discharge destroyed a good deal of these crops at a time when seed reserves were getting low.

8.2.1 Doumga Rindiaw-Kaawel Landholdings

Doumga Rindiaw (a *Tooroodo* village) and Kaawel (a *Pullo* village) belong to the same traditional integrated territory (*leydi*). The *leydi* is an intervillage territory devoted to agropastoral and fishing activities. Within this system, each village has specific rights over parts of the usable space. This does not preclude the establishment of extended trade networks between villages or the complementary use of the territory according to the socioprofessional specialization of various groups.

Doumga Rindiaw's territory, the most intensively studied, includes four clearly differentiated specialized zones:

- *waalo*: the recession depressions (Honi, Sori Less, and Dila) are actually one. In their center is a pond called Honi, or Wendou Honi. This area is inundated from the Diamel by means of a marsh (*caangol*) called Siw-Siw. This marsh, which diverges upstream from the Diamel, near Ranwa, floods the depression counter-current to the flood. It appears as if the water is flowing back to Matam contrary to physics and endows this village *waalo* with particular hydrological characteristics. Adjacent to the irrigated perimeters lies a marsh more standard in its upstream-downstream orientation than Siw-Siw, but which does not extend to high water. During dry years, because there was not enough water to flood Siw-Siw and inundate the depressions, the villagers of Doumga Rindiaw tried to transform the pseudo-*caangol* into a true marsh. They had to dredge yearly and extend it in the direction of Wendou Honi to "help" the flood into the depressions. Its name, *Waawnere* literally means "make possible," and implies the words "to enter." The topographical levels in this zone vary from 10 meters IGN (level of the Honi pond) to 13 m IGN. L'Unité Naturelle d'Equipement (U.N.E.) to which this area belongs has an average altitude of 13 meters (Lericollais and Diallo 1980:50).

- Agricultural lands on the river banks (*falo*) at Doumga Rindiaw extend from the irrigated perimeters to Ranwa, and include the following sections: Karloon, Harifunda, Dounubal, Bissiri and Diamel. The Diamel is rather steep in that area and the surface area available on its banks after flood waters recede is of limited width, usually only thirty meters or so. The only section where the slope is gentle (Harifunda) is a watering area and crossing point for herds and thus a poor spot for crops.

- Elevated lands (*foonde*) are comprised of sandy clay soils too high to be flooded except by a high, or even exceptionally high flood (*pusam*). When such lands are situated between the lower river bed (the Diamel in this case) and the cuvettes (*kolaade*), they form ridges (*togge*, sing. *toggere*). These are favored sites for permanent villages (of fishermen) or dry season villages for *Toorobbe* farmers or the *Fulbe* agropastoralists. Sites inhabited by the latter are called *seedaanooji*. Thus Sumbur Ayre (between the Diamel and Dila) and Tulde Gido (a narrow band of gonakiers (*Acacia nilotica*) between Wendou Honi and Honi) are ridges (*toggere*) inhabited during the waalo season. The village irrigated perimeters are also situated on the *foonde*, but near the Diamel. The most extensive *foonde* lands lie between the cuvettes and the jeeri. In this case, they are considered to be recession lands (in case of *pusam*) or, more often, rainfed lands, when they are not flooded (rainfed sorghum crops). Lands of this type controlled by Doumga Rindiaw are represented by Barol (a portion of which was flooded and cultivated this year), Jabbe, Jammi Salli, Poongel Irlaabe and, to the east of the village, Gummal, Ganngel, Maacora, and Idiije.

- The lower lands in the cuvettes or on the banks, which can be inundated by a high flood (*amo*), are called *deedal*. These are different from the higher *foonde* lands that can be flooded only by a very high or exceptional flood (*pusam*).

- Lands that cannot be reached by the flood (*jeeri*) are cultivated during the rainy season with *suuna* millet if they are sandy (*seeno*), and with rainfed sorghum if they are clayey (*doppere*). The sectors comprising this zone are Ceenel, Parawol, Jaabi Samba, Luggere Jammi, Bobori, Gasde Pobi, Megnelli, and Pade.

The present day village of Doumga Rindiaw is situated in the *jeejegol* zone, between the *foonde* and the *jeeri*.

The village of Kaawel, established in the *jeeri* about 7 kilometers from the National Highway to the southeast of Doumga Rindiaw, has a more scattered territory. Its *jeeri* fields lie near the present village site. Its recession fields, on the other hand, are located near the land that separates the main bed of the Senegal and the Diamel, at the level of Bokidiawé. The distances between Kaawel cuvettes, Lewel, Deedal, Berkengal, and Lelli Ardo, and the village itself, vary from about 10 to 15 kilometers. Kaawel controls one of the largest *waalo* areas in the region.

Recession agriculture in Doumga Rindiaw was monitored for two agricultural seasons in Doumga Rindiaw (1988-89 and 1989-90) and one in Kaawel for one season (1989-90). The monitoring of the first season in Doumga Rindiaw was more systematic than that of the second season in the same village or in Kaawel. There, the only quantitative data gathered concerns the sample.

Nearly 250 hectares, for the most part belonging to inhabitants of Doumga Rindiaw, were flooded in 1988. An average of 1.5 hectares were available per household in a village of 163

households. This is not insignificant, especially since the demographic structure of some households does not permit them to practice recession agriculture. But the fact that every flooded area was cultivated indicates that the village demands for recession land were not fully met. That is why the flood was not considered to be big. Nevertheless, it was exceptional within the context of the last decade.

For instance, in 1987, the river flood was so limited that it didn't reach the village cuvettes. In contrast, local rainfall was enough to allow run-off (*torndoogam*) to flood the lower areas of the cuvettes, which were cultivated as if a real flood had occurred.

The 1989 *waalo* season was especially disastrous because of unforeseen variations in the level of the flood, late rains, and locust invasions, all of which greatly impeded plant growth.

8.2.2 The *Waalo* of Thiemping

Traditional recession agriculture in the inner floodplain of the Senegal river, referred to as the *waalo*, is the principal component of an array of productive activities among smallholders in Thiemping. Benefiting from its close proximity to the floodplain and the dispersed nature of the geomorphological depressions, the village population farms a total of ten distinct *waalo* areas, known as *kolaade*. For Thiemping farmers, recession *waalo* cultivation takes precedence over all agricultural activities, both traditional and modern. The extensive and dispersed location of *waalo* landholdings reduces the risk of low or moderate flooding, since many families are able to exploit at least one field that is well situated in a low-lying flooded area. For those without landholding rights, both the abundant supply of *waalo* and the chronic shortage of labor experienced by many landholding households permit the less fortunate to farm the *waalo* under sharecropping, loan, or lease arrangements.

The nearest *waalo* landholding is one kilometer south of the village. Contiguous to it are the other *waalo* areas that extend southward in an open radius of approximately seven kilometers. These depressions are fed by the convergence of two channels of the Senegal river, the Dioulol and the Navel, whose courses begin in opposite directions and meander for long distances, finally intersecting at a major marsh area known as Wendou Kanel, located at a distance south of Thiemping in the *jeejangol* or higher area of the *waalo*. Given the long watercourse, the alluvial floodwaters reach the higher elevations of the floodplain situated just south of Thiemping relatively late compared to their entry in other areas located considerably further downstream in the Matam Department. As a result, cultivation of the Thiemping floodplain begins late and culminates in one of the last sorghum harvests in the region.

The largest and most productive *kolaade* of Thiemping, Cangay Dow Seyji, is the most distant, about four kilometers from the village. As floodwaters from the branches of the river enter Wendou Kanel in mid-August, the current moves north to fill the marsh area, known as Hemoli, which feeds Cangay Dow Seyji in late August. The water then begins to deviate, flowing laterally into the floodplain along three shallow gullies extending northward into the adjacent *waalo* area. The flood continues along this course moving north toward the village,

filling each of the ten fields consecutively. As the water recedes, the last fields inundated closest to the village are the first to be cultivated; Cangay Dow Seyji is the last. Fields such as Cangay Dow Seyji, in the heart of the floodplain, are more highly valued for their greater productivity and predictability of flooding than those in the periphery.

Two flood seasons were observed, from August to October 1988 and again during the same period in 1989. The topographical elevation of the area inundated ranged from 11 to 14.3 meters IGN in 1988 and 11 to 13.4 meters in 1989. In 1988, water entered Cangay Dow Seyji on August 22nd with the river level at 4.7 meters, and was fully receded from the floodplain by October 7th. The longest duration of the flood in the Thiemping *waalo*, therefore, was approximately forty-seven days. This represents the maximum for field submersion, considerably in excess of the thirty-day period generally believed to be sufficient by farmers for a good agricultural season. In 1989 the fields located at the outer edge of the flood, just above 13 meters IGN, were inundated for about ten days. The average for the range is 28.5 days and is consistent with the estimates of local farmers. Field planting in peripheral *waalo* areas such as Bari Sali and Bari Diallo began as early as October 7th and in Cangay Dow Seyji continued as late as October 21st. The staggered planting dates in the various *kolaade* according to when the flood waters recede allow some farmers to cultivate consecutively fields in two or more areas, thereby mitigating critical labor bottlenecks during the planting period.

In 1988 extensive flooding permitted farmers to cultivate many *waalo* fields that had not been farmed for at least fifteen years. With the height of the flood in mid-September, the earliest cultivation of fields in Cangay Dow Seyji occurred approximately forty days later on October 25th. A massive locust invasion in mid-November forced farmers to extend the planting season late into mid-December, as the seedlings were repeatedly devastated after each planting.

Waalo harvests are easily threatened by annual fluctuations in rainfall and flooding. A number of other environmental factors, however, must combine with proper flood conditions in order for an adequate harvest to take place. Crop infestation by animals, birds, insects, and plant viruses is a recurrent problem that demands the constant surveillance and energy of farm families in order to avert a major disaster. The 1988/89 and 1989/90 seasons represent the extreme range in the spectrum of crop yields: from an almost total crop failure in 1988/89, to a bumper crop in 1989/90 that had not been experienced in the village for close to thirty years, according to one farmer. The 1990 sorghum harvest in Thiemping demonstrates that the rational management of two key variables, water and crop pests, goes a long way to assuring a major improvement in crop yields.

The floodplain of Cangay Dow Seyji, when fully inundated, covers a surface area of approximately nine square kilometers. The total area inundated was 357.2 hectares in 1988 and 349.7 hectares in 1989. Farmers took full advantage of the *waalo* in both seasons, cultivating 95 percent of the flooded area the first year and 100 percent the second. The impact of locust resulted in a major crop failure in 1989. Only 60 percent of fields in Cangay Dow Seyji were harvested, with a low sorghum yield of 145 kilo per hectare. This scenario was repeated in other *waalo* fields in the region. The trauma of a devastating crop harvest in March 1989 was

amplified considerably by a second unanticipated calamity soon after, this one manmade, the massive expulsion of refugees brought on by the Senegal-Mauritania border conflict in April 1989. Only the timely infusion of international food aid was able to stave off famine during the second half of 1989.

In the fall of 1989, low rainfall in conjunction with a sudden ominous colonization of grasshoppers throughout the region forecast a repeat of the March 1989 crop failure. While natural hydrological conditions for flooding of the *waalo* were poor, a critically-needed dam release resulted in the even, sustained pattern of flooding described above. Furthermore, the manual application of insecticides by area farmers and aerial spraying of the floodplain in mid-November succeeded in eradicating the grasshopper population. Several light rains and cool evening winds late in the year provided an ideal growing season that resulted in a fourfold increase in the sorghum crop from the year before. In all, 97 percent of the fields were harvested in Cangay Dow Seyji, only one being abandoned due to the entry of small ruminants. Thus, an ideal post-rain growing season and an effectively orchestrated dam release and grasshopper eradication campaign resulted in a global harvest in Cangay of 152 tons of sorghum for 340 hectares, compared with only 25 tons the year before. This translates to an average yield of 536 kilo per hectare,[53] above the 400-kilo average cited in the major studies for recession agriculture for different areas of the Senegal River Valley (Boutillier et al. 1962; Minvielle 1985). The maximum yield recorded was 1,571 kilos, almost twice that of the 1989 figure of 833 kilos.

In addition to sorghum, some beans were cultivated in the *waalo*, although the quantities harvested in Cangay were marginal. More important to local farmers and herders is the volume of crop residues such as sorghum stalks (*nyaayko*) and bean vines (*gooji*) that remain in the fields after the sorghum harvest. In 1990, the total harvest of these by-products, which are highly valued both as a fresh source of fodder for livestock and for their commercial value, was estimated at 35 tons.[54] This figure, representing only the harvested portion of the crop, underestimates the true volume of organic material, much of which is consumed directly by livestock on the *waalo* immediately after the sorghum harvest.

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[53] This figure is based on the average yield per hectare for 134 fields. Yields above 2,000 kilo were recorded in four fields, and not included in the average for all the fields since these figures are well in excess of the average and must be called into question. If these two fields are included, the average yield is 565 kilo per hectare.

[54] This figure is a rough estimate based upon several field measures of sorghum stalks and bean vines. An average dry weight of 8 kilo per bundle (*fagots* in French) of sorghum and 4 kilo per bundle for beans was obtained by measuring numerous bundles.

8.2.3 Boyenadji Roumde's *Waalo*

The main recession depression controlled by the village is Noussoum Yirlabe. The Noussoum *kolangal* is situated in the Unité Naturelle d'Equipement MOG (ORSTOM-OMVS nomenclature). As in Cangay Dow Seyji, Noussoum is a depression located at the confluence of an upstream branch and a downstream branch of the Senegal River, whose water, having nowhere to go, stays trapped there. In 1988, the flood at Noussoum reached 14.82 m IGN and maintained this level for 12 hours. Only the fields situated below 13 m were cultivated as they had benefited from a 30-day flood: the flood arrived at the 632 cm level on the water board in Matam on September 3rd 1988, and receded below the same level on October 2nd 1988.

8.2.4 Control of Land and Crops in the *Waalo*

The study of waalo land tenure in Doumga Rindiaw, Kaawel, Thiemping, and Boyenadji Roumde reveals important local differences and similarities that allow us to open—rather than close, as is currently the case—the debate over the viability of traditional land tenure in relation to national agrarian policies.

For the most part, socially dominant caste groups control the land, but land and caste hierarchies do not entirely overlap at the level of the lineage, the *galle*, or the *fooyre*, as observed in Doumga Rindiaw. Indeed, socially dominant castes are themselves highly stratified as far as land tenure is concerned. This stratification, founded on such a precious resource as recession land in the *Fuuta,* necessarily finds expression socially and politically, a fact which could be masked by present generalizations based on castes.

8.2.4.1 Control of *Waalo* Land in Doumga Rindiaw

(i) Intervillage Level

The study of land tenure on Doumga Rindiaw's waalo depressions shows that the village does not have an absolute monopoly over "its" lands. In fact, this village controls only 84 percent of "its" *waalo*. The remaining 16 percent "belongs" to populations living in neighboring villages (10.5 percent), and in the Mauritanian Fuuta (5.5 percent).[55] The distribution of

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[55] Those villages are Mboloyel, Doumga Ouro Alpha, Doumga Ouro Thierno, Bokidiawé, Ndouloumadji Dembé, Sinthiou Mbal, Thiehel, Sedo Sebbe, Oréfondé, and Sadel. The villages in the Mauritanian *Fuuta* are Rindiaw Belimodi, and Silla Rindiaw. These localities are located either near Doumga Rindiaw, have played an active part in the settlement of the village (Mauritanian *Fuuta*), or still maintain extensive relationships through marriage (*Toorobbe* villages and, to a lesser extent, *Sebbe* villages—Sadel, Sedo Sebbe—in the Senegalese *Fuuta*) with Doumga Rindiaw. Note also that all the villages, except for Rindiaw Belimodi and Silla Rindiaw, in Mauritania, and Sadel, in Senegal, are located in the *jeejegol*. The villages of Mbakhna, Dow, and Less, though very close to Doumga Rindiaw, do not control any land in

surface area within the three zones is similar to that of plots: 83 percent for Doumga Rindiaw, 11 percent for the Senegalese *Fuuta*, and 6 percent for the Mauritanian *Fuuta*, for a total cultivated surface area of 248.90 hectares (see Table 8.1).

Table 8.1 Control of *Waalo* Lands of Doumga Rindiaw According to Locality

	Number of Parcels	% of Parcels	Area (Hectares)	% of Total Area
Doumga Rindiaw	151	83.89	206.75	83.07
Fuuta Sénégalais	19	10.56	28.26	11.35
Fuuta Mauritanien	10	5.56	13.89	5.58
Total	180	100.0	248.90	100.0

The study of caste structure in relation to intervillage control over the *kolaade* of Doumga Rindiaw is equally revealing. Not one person of the *Maccube* caste (slaves and former slaves) or the *Nyeenybe* caste (artisans) enjoys the title of *joom ngesa* in the village *waalo*. Ninety-two percent of the masters of the fields from Doumga Rindiaw proper are *Toorobbe*, who represent 59 percent of all village households. The remaining 9 percent are represented by other *Rimbe*, that is to say other free men, including the *Fulbe*, the *Sebbe*, the *Jaawambe*, and, by extension, the *Safalbe* (Black Moors). Together, they make up 19 percent of the village households. For the other villages of the Senegalese *Fuuta*, the *Toorobbe* represent 68 percent of land holders in the *waalo* of Doumga Rindiaw, as compared to 32 percent for other *Rimbe*, mainly the *sebbe* (see Table 8.2). The high representation of other *rimbe* among the "landowners" who live outside Doumga Rindiaw and in the Senegalese *Fuuta* can be explained by the fact that, since these groups represent small minorities in Doumga Rindiaw, they tend to develop links to outside communities belonging to the same caste group. With regard to Doumga Rindiaw's cuvettes in the Mauritanian Fuuta, only *Toorobbe* are *joom ngesa*. In fact, they belong either to the founding family of the village, or to the extended family of the former *jaagaraaf* (collector of land-use fees for the master of the land). Conversely, a number of residents of Doumga Rindiaw hold rights to land in remote cuvettes.

In any case, the waalo of Doumga Rindiaw provides a good example of the geographical flexibility of the tenure of recession lands, as well as of the strong ties between *Haal Pulaar* families. Control over the cuvettes shows that the populations benefiting from recession lands are not only those living near the vast areas devoted to recession agriculture. Villages can exercise various rights over remote cuvettes, even though their geographical locations would suggest that they might not have the opportunity to participate in recession agriculture.

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the village cuvettes because the caste groups who dominate politically and demographically in these villages (*Toorobbe* in Doumga Rindiaw and *Subalbe* in Mbakhna) are not linked by marriage. There is a similar situation in Kaawel, where *Fulbe* dominate. Marriages between *Fulbe* and *Toorobbe* do exist, but are very infrequent between Doumga Rindiaw and Kaawel.

Table 8.2 Representation of Joom Ngesa on 180 *Waalo* Parcels of Doumga Rindiaw by Caste and Locality (Percentages by Locality)

	Castes				
	Maccube	Artisans	Other rimbe	Toorobbe	Total
Doumga Rindiaw	0	0	9	91	100
Fuuta Senegal	0	0	32	68	100
Fuuta Mauritania	0	0	0	100	100
Total	0	0	11	89	100

(ii) Doumga Rindiaw Level

At the village level, when examining the system of control over recession lands, the strong inequality among lineages, *galleeji*, and households is striking. Five of the most influential lineages in the village are *joom ngesa*[56] for almost 60 percent of the lands flooded in 1988—146.1 hectares. The lineage of the village founder (both the *joom wuro* and imam branches and including the two families settled in Mauritania) controls 25 percent (62.49 hectares) of this land. Each of the other lineages mentioned controls a minimum of 10 hectares. Overall, seven lineage segments control 2/5 of the lands flooded in the village *waalo* in 1988.

Furthermore, 48 *galleeji*, of the 98 counted in Doumga Rindiaw, control all of the recession lands of the village (see Tables 8.3 and 8.4). Among them, 20 percent (1/5 of the village) control 167.79 ha (or 2/3 of the land). One-seventh of the *galleeji* (14) control 2/5 of the *waalo*, and 1/20 of the *galleeji* hold 1/3 of the land, including 1/16 for the *galle* of the village chief.

The analysis reveals that even among the lineages and *galleeji* belonging to the castes of the social elite, many do not have any land in the village waalo. These include 19 *Toorobbe galleeji*, and 11 other *Rimbe galleeji*. More conclusive evidence for a tenure hierarchy within the caste hierarchy is the fact that 58 percent of *joom ngesa galleeji* have properties of less than 3 hectares, even though they all belong to the social aristocracy. In sum, land tenure in Doumga Rindiaw demonstrates the inequality in the control of *waalo* land, and by extension, in Haal Pulaar society.

But since neither the *lenyol* (lineage) nor the *galle* are production units in the *Fuuta*, these observations do not account entirely for the differential access to control of village land. Thus, the study must focus on the household (*fooyre*), which is generally the production and consumption unit, in order to understand the true nature of land-related inequalities.

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[56] This right is combined with the rights of the *joom leydi* for descendents of the village founder, who bear the title of *joom wuro* (village chief).

Table 8.3 Control of *Waalo* Lands of Doumga Rindiaw by Galle and by Caste (galle in units; area in hectares)

Area of Combine Lands of Galle													
	<1	<2	<3	<4	<5	<6	<7	<10	<11	<12	<13	<37	TOTAL
Maccube	0	0	0	0	0	0	0	0	0	0	0	0	0
Nyeenybe	0	0	0	0	0	0	0	0	0	0	0	0	0
Other rimbe	2	4	1	0	0	0	1	0	0	0	0	0	8
Toorobbe	8	9	4	4	2	5	1	2	2	1	1	1	40
Total	10	13	5	4	2	5	2	2	2	1	1	1	48

Table 8.4 *Waalo* Tracts Controlled by Doumga Rindiaw Households (number of households)

Area (<1 = 0 to 0.99 ha)											
	<1	<2	<3	<4	<5	<6	<7	<10	<11	<18	TOTAL
Other rimbe	2	6	1	1	0	0	0	0	0	0	10
Toorobbe	21	13	6	5	4	5	2	3	2	1	62
Total	23	19	7	6	4	5	2	3	2	1	72

Hence, as shown in Table 8.4, of the 96 *Toorobbe* households in the village, 34 hold no *waalo* land. Among the 31 other *Rimbe* households in the village, only 10 (1/3) are land holders in the *kolaade*, with only two having significant domains, that is, of more than 2 hectares. Of the village's 163 households, 72, a minority, are *joom ngesa*. Of them, 2/3 (49) have holdings of less than 3 ha. In terms of surface area, 13 households, each with at least 5 ha, control half (51 percent) of the recession land of the village. Within such a framework, the many "landless" farmers have no recourse but to flock around the *joom ngesa* who don't have the labor needed to cultivate their lands. Thus, after the control over space (the *joom leydi*) and over fields (the *joom ngesa*), there appears a third type of relationship to the land, that of actual cultivation of the plots by the farmer (*demoowo*) (see Table 8.5).

(iii) Rights and Statutes Linked to the Cultivation of Waalo Land

- Complete Control of Land

Complete control concerns the *joom leydi* or the *joom ngesa* who cultivates his own fields. Recipient of the land *asakal*, he has no land fee obligations except for the religious tithe for the poor (*miskineebe*). This type of land tenure concerns the entire lineage segment of the village chief in Doumga Rindiaw, but also, by extension, the other segment of the same lineage responsible for religious functions. Complete control of the land combining the three rights of

Table 8.5 Area (in ha) of *Waalo* Tracts of Households and Castes in Doumga Rindiaw

	Area (<1 = 0 to 0.99; <18 = 17 to 17.99 ha)										
	<1	<2	<3	<4	<5	<6	<9	<10	<11	<18	TOTAL
Other rimbe	1	9	3	3	0	0	0	0	0	0	16
Toorobbe	14	21	14	17	17	27	13	29	21	17	190
Total	15	30	17	20	17	27	13	29	21	17	206

master of the land, master of agriculture, and direct use involves 6 plots—a total of 11.32 hectares.

- Partial Control of Land

Partial control of the land occurs when the *joom ngesa* cultivates his fields directly, regardless of whether he combines both rights of master of the land (*joom leydi*) and of agriculture (*joom ngesa*), and regardless of whether he heads collective holdings (*joowre*) or his own. Seventy-one plots covering an area of 100.01 hectares (or 40 percent of cultivated land in the waalo of Doumga Rindiaw) fall within this category.

The tradition in Kaawel is different on certain points from that in Doumga Rindiaw: (1) if the *joowre* is subdivided, the *joom leydi* does not receive a part. Rather, it is an affair internal to the *lineage* concerned. (2) if a *joom ngesa* dies leaving only female heirs, a portion of the land patrimony is passed on to the *joom leydi*. This portion is not called *bayti* as in Doumga Rindiaw, but rather *asbugol*. Obviously, the aim of this procedure is to limit the decrease of village control of its own original lands, which can result from marriages of village women with men from other villages.

On the joowre, rights to cultivate are rotated or alternated: the oldest man cultivates the first year, the second oldest the second year, and so on—counting only the years when the land is flooded. In other words, households that have *joom ngesa* rights over certain plots will not exercise that right the following year. This right will have been passed to another family within the same lineage segment. In Kaawel, this arrangement of alternating cultivation rights is called *jontannde*.

- Precarious Land Tenure

Precarious land tenure involves all those who are not *joom ngesa* of plots they cultivate. These are the *samba remooru*. Depending on the type of contract that ties the *samba remooru* to the *joom ngesa*, several categories of precarious land tenure can be identified.

For the sake of simplification, in all instances where the *samba remooru* is not required to give a portion of his harvest to the *joom ngesa* (with the exception of the *asakal*), we

generally talk of *rem bamaa* (loan), since the result is comparable: the landless farmer is entitled to his entire harvest, except for the *asakal*, which is paid to the master of the land. In the *waalo* of Doumga Rindiaw, 25 plots (24.99 hectares in total) or 10 percent of the cultivated surface area—were cultivated under *rem bamaa* in the broad sense of the term in 1988-89. They included loans granted free of charge, *rem itaa giye* (cultivation rights obtained by clearing a plot belonging to someone else), or cultivation rights received in exchange for work.

But the *joom ngesa* can also rent his plot against payment (monetary or in kind). The annual rent for a 1.5 ha plot in Doumga Rindiaw this year averaged 10,000 FCFA (1988-89).[57]

In Doumga Rindiaw, 84 plots were sharecropped covering a surface area of 123.90 hectares, or 50 percent of cultivated land.

To recapitulate the various forms of land tenure in the cuvettes of Doumga Rindiaw (see Table 8.6), we can say that sharecropping arrangements involved half of the cultivated area, direct cultivation two-fifths, and loans one-tenth. Sharecroppers (*samba remooru*) come from all caste groups. *Maccube* form the bulk of them, since they cultivate under this agreement virtually the same surface area as the *Toorobbe*, who represent 59 percent of households in Doumga Rindiaw, as compared to 19 percent for the *Maccube*. Likewise, they are the main beneficiaries of favors granted by *joom ngesa* to cultivators (*rem bamaa* contracts). The *Toorobbe* and, to a lesser extent, other *Rimbe* (*Sebbe, Jaawambe,* and *Fulbe*) are the only groups with access to cultivation rights (*joom ngesa*). Perhaps because of the scarcity of recession lands and of the high demand for arable land, a large segment of the aristocracy is relegated to the lower rungs of the land tenure hierarchy. In fact, 51 percent of sharecropped land is cultivated by *Rimbe* (47 percent by *Toorobbe*, and 4 percent by other *Rimbe*).

8.2.4.2 Control of *Waalo* Lands in Thiemping

The historical evolution of land tenure practices among the *Pulaar* in the Senegal River Valley has been well documented in a number of authoritative sociological studies (Boutillier et al. 1962; Minvielle 1976, 1985; Schmitz 1980, 1986). These commentaries elaborate on the historical transition of land in the *waalo* from one dominant social group to another throughout the past several centuries. The critical role of traditional social hierarchies in determining differential access to land is a central thesis embodied in the corpus of that literature. The discussion here focuses on the extent to which these historical social relations continue to play a decisive role in differentiating various social groups in their capacity to gain access to the *waalo*.

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[57] This unique case was encountered in the recession cuvettes of the village: the village jeweler rented a plot from a *Tooroodo joom ngesa* and arranged to have it sharecropped by another *Tooroodo*.

Table 8.6 *Waalo* Area Cultivated by Caste and Land Tenure Arrangement in 1988-89 (Doumga Rindiaw)

	Tenure			
	Joom ngesa	Rem bamaa	Rem peccen	Total
Maccube		13.23	57.00	70.23
Nyeenybe		0.36	3.00	3.36
Other rimbe	9.58		5.67	15.25
Toorobbe	90.43	11.40	58.23	160.06
Total	100.01	24.99	123.90	248.90
% of Total	40.20	10.00	49.80	100.00

These studies conclude that differential land-use rights are a function of traditional *Pulaar* caste hierarchies. An analysis of land-use practices among 137 smallholders in Cangay Dow Seyji and a sample study of *waalo* landholdings among 15 households in Thiemping concurs with the conclusion drawn from the studies above. The findings from the present study, however, do not support the idea that traditional land use, based upon caste differences, is an inherently undemocratic practice resulting in the marginalization of certain segments of the population. The observations from this study suggest that while differences in landholding rights are based on caste affiliation, the disparities are minimized by compensation in increased field sizes to sharecroppers. In this manner, customary land-use practices may be viewed not as exploitive and inegalitarian, but rather as a system of compensatory or complimentary exchanges among groups permitting an optimum utilization of *waalo* land.

The historical evolution of landholding rights in Cangay Dow Seyji is unique among the *waalo kolaade* of Thiemping. Landholding rights to all *waalo* territory, with the exception of Cangay Dow Seyji, were originally granted to the founding Salsalbe lineage that settled in the village in the 18th century before the revolution of the *Toorobbe* clerical caste in the latter half of the century. The historical landholding title of *joom leydi* (literally "master of the land"), elaborated by both Schmitz (1986) and Minvielle (1985), applied exclusively to members of the Dia lineage from Nguidjilone (forty kilometers downstream) who were granted land holding rights in Cangay Dow Seyji during the *Toorobbe* revolution. To maintain its status as absentee land holder of the entire *kolaade*, this family granted usufructory rights to Thiemping households in exchange for an annual field rent, known as *asakal leydi*, of one-tenth of the harvest. With Senegalese independence in 1960, the traditional *leydi* status was annulled by the new government, and all land holding rights reverted to Thiemping farmers. Consequently, the traditional *asakal* land rent is no longer paid to its past holders in Ngidjilone, and the title of *joom leydi* has become obsolete.

Historically, control of land was reserved exclusively for freeman castes. As the analysis on landholding in Thiemping will show, although control continues to be concentrated among

the freeman castes, households within many of the lower castes including ex-slaves have acquired a land holder status today. Indeed, examples now exist of landholding *Maccube* who actually sharecrop out their fields to members of the artisan or freeman castes.[58]

A survey of land use rights among 137 farmers in Cangay Dow Seyji in 1989 demonstrates that landholding status continues to be differentiated along traditional caste lines (see Table 8.7). This conclusion corroborates data gathered from a sample of 13 households in Thiemping cultivating a total of 29 *waalo* fields in 1989. In both cases, the majority of farmers from the traditional landholding castes maintain a favorable profile as landholders, while the ex-slave *Maccube* are principally nonlandholders. A notable exception are the *Fulbe* who cultivate the *waalo* almost exclusively as nonlandholders. *Fulbe* herders in other parts of the Middle Senegal Valley, however, enjoy landholding rights to extensive tracts of *waalo*, a legacy of their early control of the region during the Saltigi dynasty. The *Fulbe's* status as nonlandholders is explained in part by the fact that in 1989 50 percent of Mauritanian refugees farming on Cangay were *Fulbe*.

A second group displaying a landholding profile somewhat incongruent with their historical status as nonlandholders is the *Nyeenybe* or artisan order. Their highly favorable position in Cangay[59] is a result of their early historical arrival into the region and the allotment of land by the founding village lineage in exchange for their close allegiance and clientelism.

The acquisition of land through field loans and tenancies occurs most frequently among the Fulbe and Maccube who generally do not hold land. Only three cases of a temporary field lease were noted in Cangay and only one in the Thiemping sample. The Fulbe were those leasing the parcels in all four cases. It is not clear why this was so. Although cash payment

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[58] The castes engaged in agricultural production in Cangay Dow Seyji and included in this analysis are:

1. Freeman order (*Rimbe*)
    a. *Fulbe*—herding caste.
    b. *Sebbe*—warrior caste.
    c. *Subalbe*—fishing caste.
    d. *Toorobbe*—clerical caste.
2. Artisan order (*Nyeenybe*)
    a. *Maabube*—weaving caste.
    b. *Waylube*—smithing caste.
3. Ex-slave order (*Maccube*)

[59] The *Nyeenybe* are not represented in the 1989 Thiemping study sample of 13 households. A *Baylo* family studied in the general village sample in 1988 rented out its only *waalo* field in 1989.

Table 8.7 Differential Land Access by Caste in Thiemping *Waalo* (Cangay Dow Seyji) in Percent

Caste	Percentage of Landholding				
	Landholder	Loan	Tenancy	Lease	Total
Fulbe	5.0	20.0	70.0	5.0	100
Maccube	9.4	28.1	59.4	3.1	100
Nyeenybe	80.0	10.0	10.0	-	100
Sebbe	75.5	8.2	14.2	2.0	100
Subalbe	54.5	9.1	36.4	-	100
Toorobbe	64.3	21.4	14.3	-	100
Total	47.0	16.2	34.6	2.2	100

Thiemping Sample Percentage of Landholding					
Caste	Landholder	Loan	Tenancy	Lease	Total
Fulbe	-	50.0	-	50.0	100
Maccube	-	57.1	42.9	-	100
Nyeenybe	-	-	-	-	-
Sebbe	66.6	22.3	11.1	-	100
Subalbe	66.6	-	33.4	-	100
Toorobbe	50.0	25.0	25.0	-	100
Total	41.4	31.0	24.2	3.4	100

for access to *waalo* land is generally not viewed well among area farmers, a plausible explanation may be that the social or cultural distance felt between farmers and herders makes it possible for cash transactions to take place between these two groups.

8.2.4.3 Control of *Waalo* Lands in Boyenadji Roumde

The Noussoum *kolangal* was chosen for this research because it was the subject of a similar study in 1974-1975 (Minvielle 1985). It provides the occasion for a comparative analysis spanning 15 years.

During the past fifteen years, the distribution of plots has remained very stable. The *queeri* (small mounds marking the borders of the plots) have not been changed. The land situation has proven itself to be constant. In 1989, we counted 88 plots (with an average surface area of 2.3 ha) of which 18 were not cultivated, compared to 1975. Only two plots had been subdivided since 1975, while 6 were joined together in twos.

Minvielle, on the other hand, reported that in the space of two generations, 49 plots with an average surface area of 3 hectares had been transformed into 77 plots with an average surface area of 1.9 ha in 1975. This subdivision of plots was a result of the significant segmentation of the lineage into *galleeji* and then into *pooye*. Thus, *joowre* lands belonging to the family community whose head is the *mawdo galle* were rendered subject to increasing claims following his death, bringing about a process of direct vertical transition of land from father to son, instead of a wider redistribution arbitrated by the oldest member according to need.

The past 15 years have witnessed a change of orientation, notably for plots held in *joowre*. In one instance, plots that had been divided in two by the lineage chief, half of which were given in *rem peccen* and the other half lent out, were combined together again. In another case, plots that had been subdivided for inheritance were rejoined by two sons who had migrated abroad. Responsible for a segment of the lineage, they preferred to entrust the whole of their land inheritance to another member of the family for continued cultivation, in return for which a part of the harvest was delivered to the wives of the departed men.

In fact, today, even though the majority of plots have a total surface area of between 1 and 1.9 ha, the average size exceeds 2.4 ha because of this new strategy of regrouping. This explains the existence of two plots whose size is superior to 5 ha. However, there are still a few very small fields, less than 1 ha in size.

Plots left uncultivated, for the most part on the periphery, and inadequately flooded during the last five years, have become waste lands requiring too much labor to be cultivated.

Such is the physical evolution of the division of land; land tenure too did not change considerably between 1975 and 1989 (see Table 8.8).

The few differences that we did note between 1975 and 1989 are not significant. They may be due to differences of interpretation. For example, the village chief, formerly wielding control of land (*joom leydi*) in the *kolangal*, now does so only on his own plot to which he has the rights of a *joom ngesa*.

Table 8.8 Evolution of Land Tenure Arrangements on Noussoum Yirlabe between 1975 and 1989 (as a % of total *waalo* area)

Land Tenure	1975	1989
Joom ngesa	60.5	66.5
Demoowo	36.6	32.3
Lubal (rem bamaa)	2.9	1.2

Table 8.9 shows the differences in land tenure according to caste affiliation. All castes, except for the Moors, whose presence in Boyenadji Roumde was fortuitous, farm most of their

fields themselves. But all of these castes, to a significant degree, also seek access to land through sharecropping. This was to be expected of former captives whose access to recession land has always been limited, but here they enjoy as much direct access to land as the *Toorobbe*. About a quarter of the latter group is involved in sharecropping, as compared to just under half for the *Maccube*. However, the *Toorobbe* seem to partake in a method of harvest sharing between the holder and the sharecropper that appears to be less restrictive than that for the *Maccube*: they turn over only a third of their harvest as compared to a half for the former captives. Artisans also seem to be fairly well placed. They cultivate two thirds of their plots themselves, like the *Fulbe*, who through a system of lending (*lubal*, in general obtained to pasture the owner's cattle after harvest on all the fields of the *Fulbe*) sharecrop only a quarter of their lands. The *Fulbe* also maintain more than any other group a collective approach to farming by maintaining indivisible familial lands, since a large percentage of *Fulbe* are otherwise occupied watching over herds belonging to Boyenadji Roumde and Boyenadji Sinthiou.

Table 8.9 Castes and Land Tenure Arrangements on Noussoum Yirlabe in 1989 (as a % of caste)

Land Tenure	Nyeenybe	Sebbe	Maccube	Safalbe	Fulbe	Toorobbe
Joom ngesa	70.2	100.0	56.6	0.0	69.0	72.9
Demoowo	29.8	0.0	43.4	100.0	24.1	27.1
Luubal	0.0	0.0	0.0	0.0	6.9	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

8.2.5 Profile of Plots and Household Holdings in the *Waalo*

As mentioned in reference to land control, the depressions in the valley are subject to intervillage control. But the openness of the *waalo* becomes even clearer when viewed from the perspective of the geographical location of the users. Such openness, described in the works of Lericollais and Diallo (1980) becomes evident again in the three sectors studied: the *waalo* depressions are cultivated by peasants originating from more or less distant villages.

Again from the perspective of the caste affiliation of the user, and in terms of the capacities and /or the opportunities for cultivation of more or less space, important inequalities among producers surface. These inequalities manifest themselves in the large range in plot sizes, in the wide distribution of plots across the depressions, and above all, in the high variation in the number of plots cultivated.

8.2.5.1 Origins of Cultivators of Depression Areas

8.2.5.1.1 Origins of *Waalo* Farmers in Doumga Rindiaw

In terms of control of land, it has already been shown that the recession lands of Doumga Rindiaw are the objects of intervillage or even international co-ownership in the case of the Mauritanian *joom ngesa*. In identifying the residence of those actively using village *waalo* lands, one discovers that they are located in a radius extending beyond the boundaries of Doumga Rindiaw. Indeed, the producers on the depressions of Doumga Rindiaw coming from all the neighboring villages cultivated 25 plots there in 1988-89, or 14 percent of the total. This is equivalent to a surface area of nearly 33 hectares, or 13 percent of the total cultivated land. By cultivating more than 86 percent of the plots and of the total surface area, Doumga Rindiaw opens access to its *waalo* to neighboring villages but exercises a quasi-monopoly over production (see Table 8.10).

Table 8.10 Parcels Cultivated According to the Place of Residence of Cultivators on Doumga Rindiaw's *Waalo*

	Number of Parcels	% of Total Parcels	Area (ha)	% of Total Area
Doumga Rindiaw	155	86	215.72	86.67
Environs	25	14	33.18	13.33
Total	180	100	248.90	100.00

The home villages of cultivators in the *waalo* of Doumga Rindiaw are Mboloyel (18 fields), Doumga Ouro Alpha (4 fields), Doumga Ouro Thierno (2 fields), and Mbakhna (1 field). Matrimonial connections associated with the proximity of the villages to the agricultural land explain the geographical distribution of *kolaade* users of Doumga Rindiaw.

In contrast, the inhabitants of Doumga Rindiaw are very sedentary. Among the long-time residents, only 2 households cultivated lands other than the village lands: one in the *waalo* of Doumga Ouro Thierno and one in the *waalo* controlled by Mboloyel. Of the rest, two *Fulbe* households originally from Kaawel cultivated fields in the *kolaade* of the same village, on the other side of the Diamel.

8.2.5.1.2 The Geographical and Social Profile of Farmers on Cangay Dow Seyji

Farmers on Cangay Dow Seyji come from villages on both sides of the Senegal River as well as from some farther south in the *jeeri*. Fourteen area villages in 1988 and nine in 1989 were represented on the floodplain. A number of these villages are as far as thirty kilometers away. So broad a geographical distribution of farmers reveals that *waalo* land is highly sought after in the region and that the local populations occupying the floodplain are interdependent.

The villages of farmers cultivating on Cangay in 1988 and 1989 are grouped below according to a set of boundaries. Four major subareas have been identified for purposes of comparison. The areas and their respective villages include:

1988	1989
1. Thiemping	1. Thiemping
2. Riverine villages -Odobere -Thially Makka -Garly Worgo -Dolol Subalo	2. Riverine villages -Odobere -Thially Makka -Garly Worgo -Dolol Subalo
3. Jeeri villages -Kanel -Boyenadji -Sinthiane -Sinthou Garba -Wasa Kodé -Hombo	3. Jeeri villages -Sinthiane -Sinthou Garba -Wasa Kodé
4. Mauritanian villages -Youmane Yire -Yama Ndiaye -Garly Reo	4. Refugee villages -Dembaka -Garly Worgo -Odobere -Thiemping -Thially

The impact of the Senegal Mauritania conflict becomes evident when we examine the change in the geographical constellation of farmers in Cangay in 1988 and 1989 (see Table 8.11). In 1989, the number of farmers from Thiemping declined by 15 percent. The reduction in the number of farmers from Thiemping was partially compensated for by a 10 percent increase in the population from Mauritania and a 6 percent increase in that from the riverine villages. Comparable changes in the proportion of land cultivated by each group are also noted.

In all, the refugee population constituted about one-fifth (21.4 percent) of all farmers in 1989. With the introduction of this new labor force into the area, a number of farmers from Thiemping opted to loan or rent out their fields.

An examination of land tenure in Cangay in 1988 and 1989 reveals a shift in landholding patterns (see Table 8.12). Many landholders in 1989 chose to loan or rent out their fields to others. In 1988, 62 percent of landholders farmed their own fields, while in 1989 only 47

Table 8.11 The Evolution in Social Composition of Cangay between 1988 and 1989

Farmer Origin	Number of Farmers		Surface Cultivated		Average Size of Cultivated Parcels (ha)	
	1988	1989	1988	1989	1988	1989
Thiemping	70.0	56.6	64.6	50.6	2.5	2.3
Riverine	12.4	18.3	15.7	23.8	4.0	3.4
Jeeri	6.2	3.7	6.2	3.3	2.5	2.3
Mauritania/ Refugee	11.4	21.4	13.5	22.3	3.2	2.7
Total	100.0	100.0	100.0	100.0		

Table 8.12 Landholding Status and Caste Composition of Refugees in Cangay

Landholding Status	Number of Farmers %	Area Cultivated %	Average Plot Size (ha)
Landholder	21.4	12.9	1.7
Loan	17.9	8.0	1.2
Tenancy	57.1	76.6	3.7
Rent	3.6	2.5	1.9

percent did so. Thus, over half of all fields (53 percent) were cultivated as loans, tenancies, or temporary purchases. In 1989, 36 percent of sharecroppers on Cangay were refugees.

Among the refugees themselves, 57 percent were sharecroppers and 21.4 percent were landholders. An examination of the relationship of plot size to landholding status shows that refugees were compensated for their rent fee obligations by receiving plots more than twice the size of those farmed by the other status groups.

Of all the refugees farming on Cangay, 50 percent were *Fulbe*. That most *Fulbe* were expelled from Mauritania without their herds probably explains their preponderance here. Destitute, with little or no land or cattle, herders were forced to sharecrop the *waalo* in order to survive. The *Fulbe* cultivated fields larger than those of the other caste groups, with the exception of one *Tooroodo* who sharecropped the largest plot in Cangay (12 ha).

8.2.5.1.3 Origin and Caste Affiliation of Cultivators in Noussoum Yirlabe

Those farming on the Noussoum Yirlabe *kolangal* come from three villages: Boyenadji Roumde, Boyenadji Sinthiou, and Mbanane. Farmers from Boyenadji Roumde and Boyenadji Sinthiou share 89 percent of the cultivated land in the *kolangal*, 41.8 percent (64 ha) and 47

percent (72 ha), respectively. The inhabitants of Mbanane cultivate only 11 percent of the *kolangal* land, or 17 ha, of 202.4 hectares total, of which 158.8 were cultivated in 1988-89.

8.2.5.2 Size of *Waalo* Plots

The average plot size in the different research sites is highly variable: 1.4 ha on the depressions of Doumga Rindiaw, 2.5 ha at Cangay Dow Seyji (Thiemping), 2.4 ha at Noussoum Yirlabe (Boyenadji Roumde). From one site to the next, the evolution of the distribution of plots is vague and sometimes contradictory. At Noussoum Yirlabe, Minvielle, after reviewing the land distribution in the depression, reported fragmentation and predicted that this process would continue. Observations of the same depression in 1988/89 revealed, on the contrary, a process of involution that manifested itself in the regrouping of lands: the average plot size expanded from 1.9 ha in 1975 to 2.4 ha at present. At Doumga Rindiaw, however, even though no data on land distribution from the past is available, it appears that the present average plot size is so small that it can only be the result of severe subdivision. The likelihood of a general tendency toward micro-properties and the subdivision of plots lies in the fact that with the increase in pressure of population growth and the development of individualism, the last remaining *joowre* are on the verge of breaking up. In the case of Doumga Rindiaw, the fragmentation of land is even more evident when one examines plot size according to a surface area grid. With this method, 43 percent of the plots (77 in absolute figures) are less than one ha. Thirty-six percent (or 65 plots) are between 1 and 1.99 ha. Plots of more than 2 ha represent only 21 percent of all plots, and none of them is larger than 5 ha.

8.2.5.3 From Plots to Household Holdings

Often, one household cultivates several plots in the *waalo*. In certain cases, the use of several plots may be explained by the dispersion of the land inheritance of the *joom ngesa*, the land controlled either by him or by his lineage. In other cases, it is simply the result of unmet needs for agricultural lands mitigated on the part of farmers by a combination of several types of land tenure.

The following study of the *waalo* according to the size of the holdings was carried out only in Doumga Rindiaw, because in this village the inhabitants generally cultivate in their own depressions, which are not dispersed. Thus it was relatively easy to measure all the plots cultivated by village households. On the other hand, at Thiemping, Boyenadji Roumde,and Kaawel, this measurement would have been much more difficult because of the dispersion of household plots over numerous large depressions.

Of the 163 households in Doumga Rindiaw, 94 (or 58 percent) cultivated one or more plots in the *waalo*, or 1.6 plots per household practicing recession agriculture. The holdings cultivated per household in the *waalo* varied from .69 ha to 5.76 ha, or 1 to 8 despite the predominance of small plots. Thus, as can be seen in Table 8.13, the number of holdings decreases almost evenly, and quickly from small (less than 3 ha) to large surface areas. Of the

94 holdings, 74 (79 percent of the total) are less than 3 ha. Of the 21 percent remaining, large holdings of 5 hectares or more represent only 5 percent of the total.

Table 8.13 Distribution by Size and Caste of Tracts Cultivated by Doumga Rindiaw Households in the Local Basins (by number of holdings)

	Total Area by Holding (in hectares)									
	<1	1-1.9	2-2.9	3-3.9	4-4.9	5-5.9	7-7.9	9-9.9	Total	% Total
Maccube	0	3	6	2	3	1	0	1	16	17.0
Nyeenybe	1	0	0	0	0	0	0	0	1	1.1
Other rimbe	2	4	1	0	0	0	0	0	7	7.4
Toorobbe	18	21	18	6	4	2	1	0	70	74.5
Total	21	28	25	8	7	3	1	1	94	100.0
% Total	22	30	27	9	7	3	1	1	100	

The degree of household involvement in recession cultivation seems to correspond somewhat for each status group to caste affiliation, despite the overall predominance of small cultivated areas. A closer analysis reveals:

- The curve for the number of *Maccube* holdings is the only one to rise evenly from 0.1 to 2.9 hectares. No *Maccudo* household cultivates less than one hectare.

- The proportion of small holdings—less than 3 hectares—by household is larger for the *Toorobbe* (81 percent) than for the *Maccube* (56 percent). This observation tends to confirm the first one.

- In the same vein, and even more clearly noticeable is that the average cultivated holding per household is higher for the *Maccube* (3.56 hectares for a total of 58 ha) than for the *Toorobbe* (2.13 hectares for a total of 149 ha under production)[60] (see Table 8.14).

8.2.5.4 Landholding, Caste, and Principles of Compensation

How can the differences between the amount of surface area cultivated by the *Toorobbe* households and that cultivated by *Maccudo* be explained? No *Maccube* is a *joom ngesa* in the *kolaade* of Doumga Rindiaw. In other words, 18 percent of the surface area that they cultivated

[60] Other *Rimbe* and artisans comprise several castes. This heterogeneity and the low numbers of them—above all for the artisans—are such that it is perhaps prudent not to attempt to draw general conclusions concerning their behavior.

Table 8.14 Distribution of Areas Cultivated on the Local *Waalo* by Households and by Castes in Doumga Rindiaw (in hectares)

	0-0.9	1-1.9	2-2.9	3-3.9	4-4.9	5-5.9	7-7.9	9-9.9	Total
Maccube	0	5	17	6	14	6	0	10	58
Nyeenybe	1	0	0	0	0	0	0	0	1
Other Rimbe	1	5	3	0	0	0	0	0	9
Toorobbe	13	35	44	20	18	11	8	0	149
Total	15	45	64	26	32	17	8	10	217

Note: The numbers are rounded.

was lent to them free of charge (*lubal*) and 82 percent was sharecropped (*rem peccen tatabal*). Overall, the *Maccube* benefit from only two thirds of their harvest—once the *asakal* has been subtracted (see Table 8.15).

On the other hand, the *Toorobbe* are the principal *joom ngesa* in the depressions of Doumga Rindiaw. Fifty-five percent of the land they cultivated they did so under the title of *joom leydi* and/or *joom ngesa*.[61] The *Toorobbe* benefit from their entire harvest on this land—again, after the *asakal* has been subtracted.

Bringing these two status groups in relation to recession lands on the one hand, and the average size of the cultivated holdings according to each caste on the other, the following relationship may be noted, which are certainly not fortuitous: the *Toorobbe* benefit from the total production from the fields they cultivate, while the *Maccube* must pay land use fees equal to one third of their harvest. Inversely, a *Tooroodo* household cultivates only two thirds of the amount of land cultivated by a *Maccudo* household (see Figure 8.1).

Table 8.15 Areas Cultivated by Caste and Tenure Arrangement: *Waalo* and Village of Doumga Rindiaw (in hectares)

	Joom . gesa	Rem Bamaa	Rem peccen	Total
Maccube		11	48	59
Nyeenybe		0		0
Other Rimbe	9		1	10
Toorobbe	81	11	55	147
Total	89	23	104	216

[61] The percentage of land cultivated through sharecropping by the *Toorobbe* is still large: 37 percent of the surface area.

Figure 8.1 System of Compensation in Land for Harvest Foregone in Sharecropping Arrangements

$$\frac{\text{Harvest portion to Tooroodo}}{\text{Harvest portion to Maccudo}} = \frac{3/3}{2/3} = \frac{3}{2}$$

and

$$\frac{\text{Average area cultivated by the Toorobbe}}{\text{Average area cultivated by the Maccube}} = \frac{2.13\text{ha}}{3.56\text{ha}} = \frac{2}{3}$$

In all cases, this situation is confirmed by the observations made for the sample for Kaawel, whose owned and/or cultivated plots in 1989-90 were measured. Table 8.16 summarizes the land tenure arrangements for sample households in Kaawel. The *Fulbe* sharecrop out the majority of their land. The principle of quasi-exclusive control of land by the nobility—the *Fulbe* in this case—is verified in the sample. Similarly, the hypothesis concerning compensation according to land tenure observed for Doumga Rindiaw holds for the Kaawel sample. In this case, the *Fulbe* have sharecropped out on average 1.38 hectares per household—each one thus benefiting from the harvest from .46 ha. Each Fulbe household cultivates only 1.11 hectares, as opposed to 2.38 on average for *Maccube* households who usually sharecrop and lay claim to the harvest gained from 1.58 ha. Thus, after a harvest, *Fulbe* landholders and *Maccube* sharecroppers find themselves, all else equal, with the same quantities of grain. It bears mentioning, however, that (1) the sample for Kaawel is too small to extrapolate from and (2) the specialization of certain *Fulbe* in herding activities sometimes limits their involvement in recession agriculture.

At Thiemping, an analogous comparison was made concerning the size of plots cultivated at Cangay Dow Seyji. The relationship of plot size to landholding and social status reflects the compensation to sharecroppers for their rent fee obligations (see Table 8.17).

It may be argued that the principle of compensation does not apply to landless smallholders who acquire fields either through loan or cash rent. Neither loans nor cash rentals require the cultivator to make substantial payments in kind. Therefore, there is little need to provide compensation in the form of a larger plot.

The notion, then, that traditional *waalo* agriculture is an inherently inequitable system that maintains the status quo of a favored landholding aristocracy is challenged here. The present analysis demonstrates that a principle of compensation obtains allowing for equitable access and full optimization of the floodplain by all caste groups.

With this system of compensation and the nature of recession cultivation, *Haal Pulaar* society is characterized by a form of economic egalitarianism where land holders and landless peasants find themselves at the end of a season with more or less the same amount of grain.

Table 8.16 Tenure Arrangements of *Waalo* Parcels Cultivated and/or Controlled by Households in the Kaawel Sample, in hectares (1989-90)

Tenure		Fulbe	Maccube
Number of Households		9.00	6.00
ceded	Sharecropped out	12.46	0.00
	Leased then loaned	0.00	0.24
Subtotal		12.46	0.24
Subtotal per household		1.38	0.04
(1) Area of anticipated harvest (ha)		0.46	0.00
cultivated	Farmed on sharecropping basis	2.17	11.33
	Leased (coggu)	0.00	0.42
	Borrowed	0.00	2.12
	Owned and Cultivated	7.83	0.42
Subtotal (ha)		10.00	14.29
Subtotal per household		1.11	2.38
(2) Area of anticipated harvest (ha)		1.11	1.58
(1)+(2) Total harvest		1.57	1.58

This economic leveling appears to operate from below, in that those who enjoy the greatest access to land content themselves with utilizing only a relatively small portion of their land and that the landless "do what they can" to cultivate what is necessary to obtain the same amount of grain as the land holders, after paying the required fees.

Table 8.17 Landholding Status, Caste and Plot Size in the Thiemping *Waalo*

Cangay Dow Seyji			
Landholding Status	Number of Farmers %	Area Cultivated %	Average Plot Size (ha)
Landholder	47.0	41.2	2.3
Loan	16.2	10.6	1.7
Tenancy	34.6	45.5	3.2
Lease	2.2	2.7	3.2
Total	100.0	100.0	2.7

Caste	Number of Farmers %	Area Cultivated %	Average Plot Size (ha)
Fulbe	14.7	14.7	2.6
Maccube	23.5	26.9	2.9
Nyeenybe	7.4	7.4	2.6
Sebbe	36.0	31.5	2.3
Subalbe	8.1	8.5	2.7
Toorobbe	10.3	11.0	2.8
Total	100.0	100.0	2.7

The Thiemping Sample			
Landholding Status	Number of Farmers %	Area Cultivated %	Average Plot Size (ha)
Landholder	41.4	33.1	2.0
Loan	31.0	30.2	2.4
Tenancy	24.2	35.2	3.6
Lease	3.4	1.5	1.1
Total	100.0	100.0	2.3

Caste	Number of Farmers %	Area Cultivated %	Average Plot Size (ha)
Fulbe	6.9	4.9	1.8
Maccube	24.1	38.6	3.9
Nyeenybe	-	-	-
Sebbe	31.0	30.5	2.4
Subalbe	10.3	6.8	1.6
Toorobbe	27.6	19.2	1.7
Total	100.0	100.0	2.3

In any case, what was noted at Doumga Rindiaw, verified at Thiemping, and partly valid for Kaawel is extremely important to an understanding of *Haal Pulaar* society: it offsets a principle of economic egalitarianism with a system of social inequality whose permanence is assured by the very system of land tenure in the *waalo*. If this observation is verified on a larger scale, it may help to explain why there has been no capital accumulation in the past—a fact which has been validated by the impoverishment of many village chiefs who inherited nothing but their father's lands, though their fathers were *joom leydi* in a historical context where customary land rights were far more respected than they are today. Further, the *asakal leydi* that was paid by each cultivator to the chief of the land represented more than anything else

a form of social security for the village community. The *joom leydi*, whether at Kaawel or Doumga Rindiaw, could not dispose of it as he liked, but was expected to redistribute it to the needy.

8.2.6 The Organization of Work and Productivity in the *Waalo*

Monitoring of recession agriculture was carried out during a period (1988/89 and 1989/90) when the *waalo* was revived after almost fifteen successive years of low production. At the same time, the physical environment and the socioeconomic context suffered more or less serious disturbances.

In certain localities such as Doumga Rindiaw, the inhabitants noted in 1988 a marked change in hydrological particulars on the depressions (a relatively high flood after fifteen years of inadequate floods), the nature of the recession waters (more sand than alluvial content, few fish), the mechanisms for filling the depressions (slower and more difficult) and even the surface texture of the flooded soils (sandy covering).

Moreover, the long period of no rain and insignificant flood—known as *tobaani ilaani* ("no rain/no flood")—brought about a loss on the part of the local populations of certain knowledge and basic principles associated with a rational management of land. This came about in the context of greatly increased long-term migration among young men, which posed the problem of transmitting knowledge from elders to the younger generations within a society that, despite the strong influence of Islam, is principally one of oral tradition. Finally, migration has certainly effected important changes in *Haal Pulaar* society concerning several aspects of rural life:

- Relationships among people have probably been reoriented toward questioning forms of traditional cooperation and toward the development of individualism, bringing increasingly the centers of decision-making from the large-scale level—the territory (*leydi*), the village (*wuuro*), the neighborhood (*leegal*), the lineage (*lenyol*), the compound (*galle*)—to the level of the nuclear group—the household (*fooyre*), the house (*suudu*), and the individual.

- The deficit of adult male workers has often been compensated for with women's, children's, and old people's involvement in activities in which they had had only a limited participation traditionally, and even in activities that had been traditionally reserved for adult males.

- The opening of villages toward the outside world was accompanied by increased monetarization of the economy, which certainly created new needs above all for housing, equipment, and food (associated with new eating habits), all of which could not be satisfied by means of the surplus gained from traditional agriculture—whatever the extent of the rainfall or the flood (whether or not it was combined with rice culture in the PIVs). Peasant strategies where agriculture in all its forms occupies a secondary place

compared to migration are to be expected. Fluctuations in prices for local grains encourage this trend as they negatively affect the purchasing power of local producers.

The data concerning the organization of work and the productivity of the *waalo* must be understood in relation to all of these new or newly-perceived factors.

The most comprehensive studies of *waalo* agriculture (Boutillier et al. 1962; Lericollais and Schmitz 1984; Minvielle 1985) recognize that the main virtue of *waalo* production is its limited use of labor and capital. This section will focus on household labor allocation and the tasks involved in the flood recession production cycle. Data corroborate the conclusions of the studies above, and reveal that the modest labor requirements are well-suited to the realities of high migration among adult men and chronic shortages of labor in the Middle Valley.

The labor constraint in recession agriculture is examined at several levels. At the village level, the relationship between surface area under cultivation and the demographic profile of associated households is a subject of study. At the level of the sample, all factors related to labor time, properly speaking, are examined.

The conclusions drawn in this section are based on labor data from random household samples in Thiemping, Doumga Rindiaw and Boyenadji Roumde:

- For Thiemping: 13 households cultivating 28 fields in several *waalo kolaade* near Thiemping including Cangay Dow Seyji.[62] Only the data findings from the 1989/90 season are presented because in 1988/89 the production cycle was seriously disrupted by the locust infestation.[63] Discussion begins with a chronology of the various tasks involved in the production cycle. This is followed by an analysis of labor allocation according to the demographic composition of the sample by age group and sex. Finally, a few brief remarks are made with respect to the circulation of labor within and among the households involved in the study.

- The data for Doumga Rindiaw are for 1989/90. These data are associated with an initial sample of sixteen households that was later reduced to 15.

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[62] The analysis of the Thiemping sample in the preceding section on land tenure was based upon 29 fields. One has been eliminated in this section because problems were encountered while collecting the labor data.

[63] Conclusions based upon labor allocation in 1988 would be slightly misleading since a skewing of labor inputs occurred in response to the locust. For example, farmers were forced to resow their fields on several occasions and many abandoned other critical tasks such as weeding and guarding since their sorghum crop was negligible.

- The data for Boyenadji Roumde cover the 1988/89 season and concern all the plots cultivated in Noussoum Yirlabé.

8.2.6.1 The Agricultural Cycle

Tasks associated with *waalo* agriculture, especially field preparation and weeding, are heavily influenced by the quality of the inundation in the floodplain. In Thiemping in 1989, farmers noted nearly ideal flood conditions that resulted in a minimal growth of weeds after the waters receded. It is not known exactly whether this phenomenon is due only to the duration of the flood and to the quantity of water or to these factors in addition to climate and the soils in the plains.

On the other hand, in Doumga Rindiaw, massive field preparations were necessary in 1988/89, the year during which plant growth on local depressions was very heavy despite heavy land clearing in the zones. The particular characteristic of this production cycle is the period of guarding of the fields, called *lulnde*, during which family members often establish a camp very near their fields and remain in the *waalo* for several weeks until the time of the harvest, to protect their fields from birds and other animals.

The five-month *waalo* season begins in October when farmers clear their fields for planting and extends until mid or late March when they harvest. Its labor calendar overlaps with the latter half of the rainfed *jeeri* season, but farmers stagger tasks to avoid severe bottlenecks. Planting and weeding in the *jeeri* are usually completed when *waalo* seeding begins. The *jeeri* harvest takes place late in November just after completion of seeding and some weeding in the *waalo*. Tasks vary in duration and intensity, and some are usually carried out by a specific age group or sex. Most tasks require only the labor of the immediate household, but planting and harvesting must occur within a very short time frame and thus require the cooperation of relatives or friends outside the household. The six principal stages of the agricultural calendar are summarized here according to each task, its time, and the gender and form of labor most frequently involved in it. A *doftal* is a collective, nonreciprocal work party.

Agricultural Labor in the Waalo

Task	Labor Period	Sex	Cooperative Labor
Clearing	early October	M	
Planting	early, mid October	M,F	doftal
Weeding	November, December	M	doftal
Guarding	January - March	M,F	
Harvesting	mid to late March	M,F	doftal
Transporting	mid to late March	M,F	

1. Field clearing - *Lewre*: Clearing begins approximately three weeks after the retreat of water from the fields. Depending on the general vegetative condition of the field and the duration since the flood before the most recent flood, tasks may include light field clearing such

as the removal of weeds and thorns (*dassiri*), burning of small bush (*duppude*), or the felling of larger trees in the case of fields that have not been flooded for many years. Fields at the outer edge of the floodplain (*itita*) may occasionally require a weeding, (*haw-hawo*) before the planting season begins. The tools used are the axe (*jambere*), the machete (*jaasi*), and the sickle (*wafdu*). Fields in the interior of the kolaade (*der-dera*) usually require weeding after planting has begun. These weeding tasks were minimal in Cangay in 1989 since little weed growth occurred after the flood. Thorn fences are constructed (*sakkade*) during the initial phase of field clearing, although only in those *kolaade* closest to the village. Field clearing among sample households was an exclusively male task. It began in early October and generally lasted for only two or three days.

2. Planting - *Jabbere*: Planting begins soon after field clearing. One of the most arduous tasks (with weeding and the harvest), it requires a substantial mobilization of labor, often in the form of a *doftal*. Planting involves a distinct sexual division of labor (Lericollais and Schmitz 1984), which is carried out in four well-synchronized stages: 1. Picking (*jabbere*): An adult male breaks the soil with a long-handled hoe (*njinaangu*) approximately every meter; 2. Placing a hole (*lugol*): A female with a pointed wooden pole (*lugal*) opens a hole ten to fifteen centimeters deep for the seed; 3. Sowing (*awdi*): An adolescent, often a female, plants seven to ten seeds (usually a mix of sorghum varieties and a few beans) in each hole; 4. Covering (*bekkugol*): Either a younger child or an elder pours a small handful of sand in the hole to protect the seed from insects. These roles are no longer clearly designated by age and sex, perhaps as a result of the absence of adult males from the region. Women of all ages as well as children (male and female) were observed carrying out each task except for the digging. Battery acid is now frequently used instead of sand to protect the seed, which reduces the labor needed for planting.

The ability to mobilize labor during planting is critical to a successful harvest. Seeds must be planted in less than two weeks while the soil remains moist enough to encourage optimum germination. Households must intensify their physical output and rely upon social networks for additional labor at this time. Those families experiencing a labor shortage for any number of reasons (outmigration of adult males and illness being the most common) often are at high risk. Since all households are physically taxed and fully occupied by the demands of planting at the same time, the labor reserve available that can be solicited is limited. The capacity to call upon an additional hand at this time may be related to one's social standing in the village. In 1988 several farmers of high caste (nobles) in the study sample were able to mobilize large numbers of individuals outside their own households[64] in order to plant quickly during a crisis of locust infestation. Caste status and social standing in the village, therefore, may well contribute to the success of a *waalo* season under conditions of environmental crisis.

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[64] On two occasions, *doftal* work parties of 40 and 112 individuals respectively were mobilized.

Within several weeks after planting, a process of plant thinning (*doftaade*) is necessary. As the seedlings grow to a height of at least thirty centimeters, several are removed to reduce competition for moisture in the ground, leaving only three or four for optimal growing conditions.

3. Weeding - *Remru*: Weeding may begin within days after planting, depending on the extent of weed growth after the flood. It is undertaken exclusively by males, usually in their adolescence or adulthood, since it requires considerable physical energy. Normally only one major weeding is needed after the planting season. Because this task was negligible in Cangay, occurring briefly during the months of November and December, cooperative labor (*doftal*) was rarely solicited for weeding in 1989.

4. Guarding - *Kurnal*: Field surveillance demanding constant vigilance during the day begins as the sorghum heads start to mature within 45 days to 2 months of planting. Two distinct phases of guarding occur: 1) *ndennal*—a general surveillance particularly against animals, that begins soon after the seedlings have begun to grow; 2) *kirwal*—a surveillance against birds that occurs later as the sorghum heads approach maturation. It is most often the responsibility of children, who remain in the fields for long hours each day. The period of field guarding begins in early January and continues until harvest in mid March. While requiring little physical exertion, it is this long duration that accounts for the largest portion of labor time in *waalo* cultivation.

5. Harvest - *Conyal*: Field harvest in Cangay occurred during a one week period beginning on March 12th. The village elders specifically designated this date to mark a period of village-wide harvest in the *kolangal* (*tiwande*). Only at this time are farmers in the *kolangal* permitted to begin their harvest. At the end of harvest, the opening of the *nyaayngal* begins, during which herders enter their livestock to graze on the fresh crop stubble.

The harvest entails a series of tasks. First, women remove the sorghum heads from their stalks, carefully count them, and place them in different piles (*dobale* and *geerngal*). They carry the harvest in plastic basins, which have replaced a traditional stick basket or *cengalaal*. After counting the basins, they remit appropriate quantities to various individuals as either land rent fees (*rempeccen didibal* and *tatibal*, *asakal leydi*, or as social prestations (*caatal*) to family members, friends, and the artisan castes. The harvest itself is carried out largely by adult women, while the payment of field rents and prestations is most often the responsibility of the male household head farming the field. In 1989 Thiemping residents remitted a portion of their abundant harvest to three marabouts in the region.

6. Transport - *Dimgaal*: Transport occurs on the last day of harvest after all field remittances have been paid. First, sorghum is transported, usually in horse-drawn carts during years of good harvest, and then the sorghum stalks are cut and transported in the same manner. Transport by mule or directly by women may occur in a bad harvest year like 1988. Farmers who do not possess their own cart or mule either rent the services of another in cash or kind (sorghum), or borrow one for free if possible. The cost of transport by cart varies from year

to year according to the quality of harvest. In 1988, farmers paid either one-tenth of their net harvest in sorghum or 500 CFA for every ten plastic basins. In 1989, almost all transport costs were paid in sorghum thanks to the plentiful harvest. Cart owners received one-twelfth of the quantity transported. The exceptional harvests in the Thiemping *waalo* had a beneficial spinoff effect temporarily on the local village economy as nineteen cart owners from twelve area villages arrived for approximately two weeks to transport the sorghum crop.

8.2.6.2 Labor Time Per Unit Surface Area in the *Waalo*

Compared to other systems of agriculture, *waalo* requires less labor. However, from one year to the next—depending on the nature of the flood and the progress of the agricultural season—and above all from one depression to the next, the average volume of labor per unit surface area can vary considerably: 85.5 days for the Podor zone according to Boutillier et al. (1962:107), 72.5 days at Boyenadji Roumde according to Minvielle (1985:155), 42.4 again at Boyenadji Roumde in 1988, 122.1 at Doumga Rindiaw in 1988, 136 at Kaawel in 1989, and finally 26 at Thiemping in 1989 (see Table 8.18). To understand such radical differences (a two to five-fold variation), labor time must be deconstructed according to the agricultural activities. When comparing the amount of labor performed per hectare of *waalo* in Doumga Rindiaw (1988), Kaawel (1989), Thiemping (1989), Boyenadji Roumde (1988 and 1974-75) and the Podor zone at the end of the 1950s, the most obvious differences concern guarding and field preparation, and tending the crops (clearing, weeding, and fence building).

Table 8.18 Labor Time Allotted to Agricultural Tasks; A Comparison of Doumga Rindiaw, Kaawel, Podor, and Boyenadji Roumde[65]

	Boyenadji 1988	Thiem-ping 89	Doumga R. 1988	Kaawel 1989	Podor 1957	Boyenadji 1974-75
Land Clearing; Weeding; Fencing	8.5	0.9	20.0	6.4	20.7	12.6
Sowing	5.6	6.4	11.2	13.7	11.1	10.5
Guarding	21.5	15.0	82.8	110.1	47.8	44.4
Harvesting						
Drying	4.8	3.2	6.5	6.3	4.7	4.0
Threshing						
Transporting	2.0	0.5	1.6		1.2	1.0
Total	42.4	26.0	122.1	136.5	85.5	72.5

[65] The sources for the Podor region are Boutillier et al. (1962:107) and for Boyenadji Roumde in 1974-75 Minvielle (1985:256).

Concerning preparatory activities and maintenance, the important differences noted between Thiemping, where they are practically nonexistent, and the zone of Doumga Rindiaw and Podor are most probably tied to the nature of the soils in the different depressions. It seems that the heavier the soils (pure *hollalde*), the less labor is required. Certain parts of the *waalo* of Doumga Rindiaw are very sandy (*diacre* soils) and seem to favor weed growth. Inversely, the heavy soils of the depressions of Thiemping and Kaawel, and to a lesser extent of Boyenadji Roumde, discourage the growth of any vegetation other than the crops themselves.

8.2.6.3 The Demographic Profile of Households Practicing Recession Cultivation (The Case of Doumga Rindiaw)

Table 8.19 provides the average demographic parameters that characterize the households cultivating the depressions of Doumga Rindiaw.[66] General observations that may be drawn from the table include:

Table 8.19 Areas Cultivated and Demographic Profile of *Waalo* Households in Doumga Rindiaw[a]

	Household Size			Household Size Working Age Members			
Area (ha)	Total Household Members	Household Members Present	Percent of Household Members Absent	Working Age Members	Working Age Members Present	Percent of Working Age Members Absent	Labor Migration
0-0.99	8.16	6.42	21	6.00	4.37	27	1.05
1-1.99	9.28	6.60	29	6.76	4.44	34	1.84
2-2.99	9.44	7.88	16	6.96	5.48	21	1.60
3-3.99	10.63	8.50	20	7.25	5.13	29	1.50
4-4.99	13.43	10.86	19	9.57	7.00	27	1.43
5 and +	17.25	14.75	14	14.25	12.00	16	1.50
Total	9.90	7.81	21	7.26	5.33	26	1.52
Vil.	8.66	6.44	26	6.13	4.14	32	1.34

[a]Note: Area (ha) = Households are grouped according to the areas they cultivated in the waalo. Example: the group for 0-0.99 ha includes those households that farmed a total of less than one hectare on Doumga Rindiaw's waalo. Total = refers to the average household size of all the households in Doumga Rindiaw that participated in waalo agriculture in the local basins.

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[66] Recall that the category 0-0.99 ha includes 21 households; 1-1.99 includes 28 households; 25 households for 2 to 2.99 ha; 8 households for 3-3.99 ha; 7 households for 4 to 4.99 ha and 5 households cultivated more than 5 ha. An analysis of the relationship of household demographic profiles to land tenure was not undertaken because there is often a mix of tenure arrangements within one household, some members cultivating plots as *joom ngesa*, others borrowing or sharecropping land.

- Households practicing recession agriculture are larger on average than those that don't practice recession agriculture. Their average individual size (absent and present members included) is 9.9 members as compared to 8.66 for Doumga Rindiaw as a whole. Household size increases with the amount of surface area cultivated with recession crops, from 8.16 people for households cultivating less than a hectare to 17.25 for households cultivating 5 or more hectares.

- The same is applicable for the total population present.[67] The average number of household members present to practice recession cultivation (7.28 as compared to 6.44 for the entire village), increases steadily from small-scale to large-scale landholders in the *waalo*: from 6.42 for those utilizing less than a hectare to 14.75 for those cultivating more than 5 hectares.

- On the other hand, the level of absenteeism does not seem to be closely related to the degree of household participation in *waalo* agriculture. However, households cultivating more than 5 ha appear to be the most sedentarized (14 percent absent as compared to an average of 21 percent for all households involved in *waalo* agriculture). *Similarly, absenteeism is higher in households that are not involved in recession agriculture since the level of absenteeism for the whole village is 26 percent.*

- Household participation or nonparticipation in recession agriculture is more closely tied to the profile of their population according to the "age range of waalo cultivators" (10 to 64 years). Only those households cultivating more than 5 hectares in the *waalo* seem to allocate a large portion of their labor force to this system of agriculture. Indeed, the level of absenteeism for working-age individuals is particularly low: 16 percent compared to an average of 27 percent for all households cultivating in the *waalo* and 32 percent for all households in the village.

- But it appears that the participation of households in *waalo* agriculture does not preclude their participation in migration. On the contrary, the average number of migrant laborers is even higher in households cultivating the *waalo* (1.52) than in those who are not involved (1.34 for all of the households in the village).

To recapitulate, the availability of agricultural labor affects the level of household participation in recession agriculture. It is no less true, however, that the relationships between recession agriculture and emigration are extremely complex. The data in Table 8.19 may be interpreted to yield many conclusions: recession agriculture contributes to the slowing down of migration because households who are involved in it have a lower proportion of absentees among working age individuals; recession agriculture does not seem to be having serious effects on

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[67] From data gathered for a general population census in September 1988. Thus, the information here concerns only the people present at the start of recession cultivation and who could have left the village before the end of the *waalo* season.

migration in that households with the largest recession holdings are among those in which a substantial number of members are migrant workers, etc. If there is an impact of recession agriculture on migration, it will appear over the medium or long term, if recession agriculture is made increasingly possible.

In any case, the relationship between the demographic profile of households and their participation in recession agriculture must be put into its proper context given that the *waalo* is one of the arenas in which multiform cooperative relationships among villagers are practiced most intensively. Thus it may be reductionist to compare households that cultivate in the *waalo* with those that do not. In fact, all households participate in one form or another and to different degrees in recession agriculture: land holders lend their property to other households, lineage members who hold *joowre* land arrange for portions of it to be sharecropped, some help relatives or neighbors cultivate a plot, etc. In every case, a household considered to be a nonparticipant in the *waalo* turns out to be heavily involved in production, and, what's more, it benefits from a part of the harvest. Thus the gap is narrowed between units of production that enjoy high labor potential and those who, individually, have access to very little.

Examination of the origin of those who work in the *waalo* reveals, grossly speaking, three types of laborers: households who work for themselves on their own plots; households who provide help of various kinds to those with plots, and plot holders who help, with or without a reciprocal arrangement, other plot holders. The mobilization of labor of households not cultivating the *waalo* is often very extensive—12 percent of the entire volume of labor mobilized in Doumga Rindiaw and Boyenadji Roumde in 1988/89, 26 percent in Thiemping for the same season.

8.2.6.4 The Composition of Labor in the *Waalo*

It is generally assumed that labor needs in the *waalo* are increasingly being met by women and children, while adult men, particularly from the ages of 25 to 55, migrate out of the valley in growing numbers in search of income. Data on the labor time and demographic composition of those farming the *waalo* indicate that women and children do fill the labor void resulting from the absence of male migrants (see Table 8.20). This compensation in labor by one segment of the population for the other remains well defined by field task however, as men continue to carry out the most physically taxing activities such as weeding and hoeing the soil, while women continue to be associated with such specific tasks as planting and harvesting. Labor time for young children is mostly devoted toward field surveillance. Nevertheless, some women and children—particularly at Thiemping—can be seen executing the heavier tasks such as hoeing and weeding.

In the Thiemping study, women accounted for more than one-half (57 percent) of the total labor time and children almost 12 percent. These figures, however, must be compared to their respective proportions of the population available for labor. In this context, it may be concluded that women work the *waalo* in direct proportion to their availability in the study sample (55.6 percent of the sample and 57 percent in the *waalo*), while children between the

Table 8.20 Labor Time by Gender and Age Groups in Doumga Rindiaw, Kaawel, and Thiemping (as a % of the total)

Age	5-14	15-24	25-34	35-44	45-54	55-64	65-74	Total
Doumga								
Women	17.0	10.2	7.7	3.6	3.3	1.9	3.3	46.9
Men	28.5	12.0	1.4	7.4	2.3	0.8	0.8	53.1
Total	45.5	22.2	9.1	11.0	5.6	2.6	4.1	100.0
Kaawel								
Women	7.0	14.0	6.0	10	10.0	0.0	0.0	47.0
Men	20.0	12.0	6.0	0	0.0	8.0	7.0	53.0
Total	27.0	26.0	12.0	10	10.0	8.0	7.0	100.0
Thiemping								
Women	6.7	33.5	7.3	2.0	5.9	1.3	0.6	57.3
Men	5.1	16.0	5.4	3.7	2.0	9.1	1.5	42.7
Total	11.7	49.5	12.7	5.7	7.9	10.4	2.1	100.0
Total Boyenadji	22.3	35.8		25.4		16.5		100.0

ages of 5 and 15 are actually underutilized (11.7 percent in the waalo) in relation to their proportion of the available population (39.5 percent). This discrepancy may relate to an underestimation of labor time of children in field guarding. The most disproportionate contribution of labor by a group in relation to its availability is in the age range 15 to 24, in which women in particular (15.8 percent of the sample, 33.5 percent in the *waalo*) provide the greatest proportion of time in relation to all other groups in the sample. As a whole, 60 percent of labor was carried out largely by the younger segment of the population, ranging in age from 5 to 24. This is roughly equivalent to their representation in the study (64 percent). The availability of men is characteristically low after the age of 25 because of their outmigration, while the contribution of men over 55 in the fields is noticeably important (10.6 percent of total labor time). This reflects the fact that, while many men are absent, those men remaining behind or who return to the village engage in the heaviest tasks requiring considerable time and contribute significantly to the overall labor output in the *waalo*.

In Boyenadji Roumde, those under 25 years of age essentially provide labor for recession agriculture. Young men in this age group have not yet begun to migrate, or migrate only seasonally, which allows for their presence in the village during the period of recession cultivation. The 15-to-24-year age group is the most often called upon for all work (35.8 percent), above all for the most arduous tasks. Inversely, the least arduous tasks, such as guarding, usually involve children aged 5 to 14 years, and elders over 55.

In Doumga Rindiaw, women were active in recession agriculture, where they did almost as much work as men (47 percent of the total work done as compared to 53 percent for men). Activities in which women participated are planting (just over a third of the labor provided by men), transporting the harvest (one tenth of the male participation), and above all guarding, which comprises three quarters of the labor time in the *waalo* (at a level of participation just under twice that of men), and harvesting (where they contributed a little more than men). If guarding is excluded, the proportion of female participation in the *waalo* is 17.3 percent, which is very close to the level of female participation in rice culture (19.69 percent) where guarding is minimal.

Taking into consideration the age of the workers, one discovers that in the *waalo* the labor force is made up essentially of girls and boys under 25: 67.7 percent of labor input in the *waalo*, or more than two thirds the total volume of labor. Furthermore, children between 5 and 14 provide 45 percent of the labor required for recession cultivation.[68] In this respect, the situation in Doumga Rindiaw is very different from that of the other villages studied. The reasons behind these differences have not been clearly identified.

Overall, in the cases studied, recession agriculture is not entirely the domain of tradition, and consequently, of gerontocracy, even if tradition and the influence of history continue to weigh heavily on land rights and on associated land-use contracts. Because recession agriculture relies on younger people (those under 25) to provide the bulk of the labor it requires, recession cultivation cannot be totally closed to innovations, necessary adaptations, and notably to technical improvements.

Recession agriculture does not disrupt migration, but adapts to the new demographics by relying on those individuals who are not yet old enough to be involved in long-term migration. Essentially, young men under 20 become involved only in seasonal migration, which allows them to be present in the village from July to December/January, when weeding in the *waalo* is finished. Their long period of absence also coincides with periods of unreplenished grain stocks, which must be managed carefully; the presence of all household members would render this situation more problematic. The heavy reliance on female labor for specific periods seems to reveal a concern for the necessity of freeing young men to participate in seasonal migration. In fact, from December and January on, the only work left to be carried out on the *waalo* is guarding and harvesting, which women are capable of directing.

In sum then, recession agriculture and migration are not necessarily at odds with one another. On the contrary, migration allows grain reserves gathered after the harvest of the *waalo*, which must feed the family until the end of the *jeeri* season, to last as long as possible.

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[68] The population present for our sample in September 1988 included 62 percent of young people aged 5 to 24 years of age; 34 percent between 5 and 14 years of age, and 28 percent between 15 and 24 years of age.

Seasonal migrants—*joltoobe waalo*—are present to help perform the most difficult tasks. When they leave, and only the less arduous tasks remain, women take over.

8.2.7 Harvests and Yields

8.2.7.1 Spatial and Interannual Variability of *Waalo* Yields

Harvests measured in the three sites in 1988/89 and in 1989/90 varied highly from one locality to another as well as within each *kolangal*. This high variability is not characteristic of the *waalo only*. It also characterizes recession cultivation on banks, and rainfed agriculture. It bears witness to the great vulnerability of production systems in the Valley and justifies at the same time the strategy of diversification of revenue sources practiced by households.

To date, there have been no attempts at adapting varieties of sorghum to soil types or to the topography of the agricultural land. On a given plot, several varieties of recession sorghum (*samme*) may be cultivated. The most frequently used varieties of samme are *samme bodeejo* or red *samme*, *daneejo*, or white *samme*, *samme baleejo*, or *black samme*, *sewil* (smaller, red- or white-grained *samme*), the *yaki*, and the *purdi jorngal* (*large-grained black samme*). Traditionally, it seems as though *sewil*, particularly prized by grain-eating birds, was planted on a specific area of the field uniquely to attract predators and thus spare the rest of the field. In Kaawel, where no form of adaptation of sorghum varieties to soil types is practiced, this tradition is considered to be particularly characteristic of the *Toorobbe*. Everywhere, though, *samme* is intercropped with cowpeas.

In Thiemping, sorghum yields recorded in the *waalo* in 1989 demonstrate the capacity of floodplain agriculture to provide a favorable return on labor when several environmental parameters are brought under control. With yields averaging 536 kg per hectare in Cangay and 501 in the other area *kolaade*, production was considered to be quite high in 1989. Farmers intercrop cowpeas (*niébé*) with sorghum in an arbitrary manner, but little value is placed on this crop because yields are very low. More value is placed on the sorghum stalk, which, as mentioned above, provides an important secondary crop for livestock. An average yield of 147 kg per hectare was recorded, but this represents only the stubble that was removed from the fields immediately after the sorghum harvest.

In Doumga Rindiaw, *waalo* yields in 1988/89 were very low, and extremely variable: from 0 to 857 kg/ha. The average yield per plot (248 kg/ha) means little in this context. Several reasons account for these disappointing overall results: (1) grasshoppers, which only passed through recession fields for a short time; and (2) many phytosanitary problems. The *Mbaatu*, which causes the dwarfing of sorghum and cowpea plants, was encountered virtually everywhere in the depression. The appearance of this disease in certain *kolaade* and not in others was problematic. For some cultivators, the most heavily affected zones were cultivated areas that had been flooded by run-off (*torndoogam*) in 1987. Some of the most damaged plots were found in the lowest sections in the agricultural zone, but some of these low zones were spared, and evidence of the disease was noted also in plots on the periphery of the depressions,

in the highest areas of the zone. This phenomenon probably is tied to the lack of water contained in the soils, which is related to both the length and the speed of the flood and the soil profile.

Data concerning the cowpea harvest were not available for Doumga Rindiaw because of the nature of this crop. Even if the producer is willing, often he does not have the means to estimate correctly his production because two months after planting, the cowpeas are harvested daily in variable quantities up until the time of the *samme* harvest. To reduce the margin of error, the cowpea harvest was not calculated.

Excluding plots situated near the pond and those that were the last to be planted—sorghum had not yet matured at harvest time—and plots situated to the southeast of the agricultural zone, which were ravaged by the *mbaatu*, the yields from the *waalo* were heterogeneous. But on the whole, low yields (well under 400 kg/ha) predominated. Only 35 plots (19 percent of the total) yielded more than 400 kg/ha. Certain plots had yields higher than 600 kg/ha (15 plots) and on one field even more than 800 kg/ha.

In 1989/90 then, the average yield for 150 of the plots was only 165 kg. Among these, 40 were considered to be a total failure. There are a number of reasons for the alarming drop in yields in Doumga Rindiaw this year:

- The release of water from Manantali Dam just after the beginning of the recession of the natural flood confused several farmers who had already begun to plant. Plants inundated and drowned by the new flood had to be replaced, often with a smaller seed reserve, which resulted in a less dense planting.

- The same phenomenon of depleted seed reserves was observed following the proliferation of grasshoppers in the depressions. As in the *jeeri*, it became necessary to replant, sometimes completely, sometimes partially, in affected areas. Certain individuals were able to deal with the problem effectively, but others, quite simply, gave up.

- The interior and exterior margins of the depressions were not very productive because: (1) producers, more interested in growing fodder, intentionally planted later in the low zones, and (2) land in the periphery of the depressions was insufficiently submerged. The inhabitants of Doumga Rindiaw habitually plant all land that has been inundated either by the flood or by run-off, however long it has been submerged.

- The possibility of a natural drop in yields on certain light and relatively poor soils must not be rejected. The *Haal Pulaaren* say: "When your *foonde* is inundated for the first time, cultivate it yourself; when it is inundated a second time consecutively, leave it to your son; when it is flooded for the third consecutive time, give it to your slave." *Foonde* soils here are elevated lands in the *waalo* inundated only during a high flood. Their light texture resembles that of certain soils in the cuvettes of Doumga Rindiaw. In past years, the poor soils of the *waalo*—in other words those not of the *hollalde*

type—could always be regenerated. Since high floods rarely occurred in succession, these soils, found on the periphery of the planting areas, were rarely exploited on a continual basis. During their fallow years these areas are used as pastures, and as such are fertilized before the arrival of another high flood. Henceforth, given the presence of the Manantali dam, this new information will have to be taken into consideration.

This year's yields for the Kaawel sample were clearly better than those measured in Doumga Rindiaw: the average yield for the 42 plots out of 43 total cultivated and/or contained in the sample was 224 kg/ha, varying from 0 (6 plots) to more than 400 kg/ha (7 plots). The highest yield recorded in the sample was 928 kg/ha.

In the cuvette of Noussoum Yirlabe in Boyenadji Roumde, the dry measure yields of sorghum after pounding were for the most part low in 1988/89, on average 121 kg per hectare. Yields on certain plots surpassed 300 kg/ha, but only for a half-dozen fields (including one whose yields surpassed 500 kg/ha) out of a total of 65. In contrast to farmers at the other sites studied, farmers still exercise precise choices concerning varieties of *cultivated samme*: *baleejo*, *sawa suuka*, white *sewil*, black *sewil*, and red *sewil*.

In general, high heterogeneity in the spatial distribution of yields was noted. Possible explanations for the low yields noted for Noussoum in 1988/89 fall for the most part into three categories:

1. The high rainfall and subsequent runoff that preceded the flood may have deposited large amounts of sedimentary material on the floor of the cuvette, which could have blocked recession fissures in the clay soils and rendered them impervious to water. Flood waters would only have been able to penetrate the soils slowly and with difficulty. But the average duration of the flood was only 30 days.

2. Locusts arrived at the moment when the plants, only 5 to 10 centimeters high, were extremely vulnerable. It became even more difficult to combat this attack since the locusts found ideal refuge in the fissures of the *hollalde*. After the second, and even the third planting (for some), many discouraged cultivators gave up.

3. The harvest was not conducted at the same time throughout the *kolangal* because of the loss of authority of the village chief, who had formerly filled the role of the *joom leydi*, and thus the role of the manager of the territory. Grain-eating birds, normally distributed evenly throughout the plots, converged upon the remaining unharvested fields. Because of this, to avoid the increasingly destructive invasion of these predators, farmers were forced to harvest their fields prematurely and content themselves with low or even nonexistent yields.

As with other villages, in Boyenadji Roumde, sorghum is always planted in association with cowpeas. Because cowpeas are consumed bit by bit mostly during the guarding period for

the plots, data concerning total yields can only be approximate, but average yields of cowpeas were estimated at 11 kg of dryweight per hectare.

In summary, yields from recession cultivation were particularly low for the first two years of controlled flood. The cuvette of Cangay Dow Seyji in Thiemping, with its especially high yields was an exception in 1989/90. Thiemping aside, this observation reveals the extreme vulnerability of present-day recession agriculture. From the beginning to the end of the agricultural season, disaster threatened for various reasons. In chronological order, some of the problems encountered during the agricultural cycle included: the quality of the flood, pest infestations, late rains, bird invasions, and, finally, phytosanitary problems, which were encountered throughout the season.

Despite this extreme vulnerability, recession agriculture has great potential, as witnessed by the of very high sorghum yields gained from certain plots: from 800 to 900 kg/ha at Doumga Rindiaw and Kaawel, and even exceeding 2 tons/ha in Thiemping during the exceptional season of 1989/90. Better yet, sorghum has always been intercropped with cowpeas, yields of which during a poor year surpass ten kg/ha. The *waalo* also produces fresh cowpea leaves (*haako*) and above all fodder (dried cowpea leaves and stalks or *gooyi*, and leaves and stalks of millet *nyaayko*), which is in high demand at the local market because of the drying up and scarcity of grasses in the *jeeri*.

8.2.7.2 Yields and Land Tenure in the *Waalo*

Despite the overall low productivity of the *waalo*, certain plots yielded fairly high harvests. Consistently, whatever the year or the cuvette under study, a stable relationship exists between plot yields and land tenure. Holder-cultivators (the *joom ngesa* farmer) achieve the highest yields. Those farming plots the access to which is precarious achieve low yields. In other words, security of tenure favors optimal use of land.

Joom leydi obtain higher yields than those who practice sharecropping. This seems logical in that the *remoobe*, knowing that they are not working for themselves, might tend to neglect their plots somewhat. These results corroborate in part the analysis of yields according to caste affiliation. The *Maccube* have the lowest yields (69.7 kg/ha as compared to 121.4 kg/ha on average) on the cuvettes in comparison to other castes. On the other hand, this observation is not supported by the negligible differences in the hourly rate of return per unit surface area in relationship to the diversity of land tenure in the *kolangal* of Noussoum Yirlabe.

In Thiemping, crop yields directly correlate with landholding status. Landholders in both Cangay and the sample averaged 590 kg for both studies, while nonlandholders obtained yields noticeably lower, at 437 kg.

Analysis of production according to plot tenure at the scale of the sample for Doumga Rindiaw reveals also that in 1988/89, yields from fields cultivated by their holders (*joom ngesa*)

are generally higher (303 kg/ha on average) than those measured that had other forms of tenure: free loan (145 kg/ha) and sharecropping (152 kg/ha).

A certain number of hypotheses may be offered to explain the relationship observed time and again between yields achieved and land tenure in the *waalo*, especially in the case of direct use and sharecropping:

- It is possible that sharecropped plots are often situated on less fertile soils.

- The variability of yields according to tenure is—at least in part—the consequence of differences noted among labor inputs invested in the fields. For example, labor inputs monitored for 28 fields in the Thiemping sample show that land holders spend, on average, almost twice the amount of time in their fields (29 days per hectare) as those working on a tenancy or loan basis (17 days). This difference in performance cannot be explained either by disparities in the labor capacity of either group (both land holders and non land holders average 8.3 adult members per household) or by differential access to extrahousehold labor (both groups rely almost equally on their own households to provide 70 percent of the total labor time they devote to their fields). Thus it is reasonable to infer that smallholders with fields have a greater personal interest in the outcome and productive potential of their fields, while non land holders may be less motivated and committed since a portion of their labor is not invested in their own personal gain. Between 10 and 60 percent of the harvest must be paid to the holder according to the nature of access to the land.

- The same analysis of yields according to caste affiliation reveals a certain correlation, though it appears not to be direct. Rather, it represents another manifestation of the relation between land tenure and plot productivity—modes of control over land being tied to caste affiliation.

8.2.8 Conclusions

To a greater degree than other rural lands, *waalo* lands still bear the mark of traditions and of the history of different villages in the *Fuuta*. Of primary interest in the context of the subsistence economy, recession land is associated with an elaborate land tenure system and one that is made complex by the superposition of different rights over the same space. Today, the eminent right over the land, that of the *joom leydi* (or master of the territory) is becoming more obsolete at the same time as a reinforcement of control of land at the level of plots is being observed. The Senegalese land reform policy of 1964 likely contributed to this course of events, although even under the traditional regime the control of fields (the right of the *joom ngesa*) had always been the most powerful right concerning land.

From the point of view of control, rights over *waalo* land appear to be exclusively reserved for the traditional elite. But in spite of this very differential control of land, recession agriculture, an essential element of survival in the Valley, has remained open to all landless

populations. The often burdensome land-use fees are the by-product of this availability. The highly discriminatory nature of land control in the *waalo* is tempered by the overall effect of economic leveling that allows those who pay user fees to cultivate more land than those who receive them.

This system is rendered more surprising by the fact that it has persisted until modern times despite the heavy influence of a market economy, which logically should have led to individualist tendencies that would threaten guaranteed land access to landless populations. Apparently it is not the lack of manual labor that prevents families who control land from utilizing themselves larger surface areas. Indeed, recession cultivation requires little, sometimes negligible labor. Young people and women are very much involved in this form of agriculture. This heavy involvement is possible because only a few tasks, such as clearing, planting, and weeding, are very arduous. Guarding, which takes up the larger portion of the total time devoted to recession agriculture, requires actual physical presence on the fields.

Over the last two years, several factors have reduced yields on certain cuvettes: invasions of locusts and grain-eating birds, undesirable rains, and poor flooding conditions. Other social parameters perhaps also explain certain catastrophic results noted here and there: after 20 years of drought, peasant knowledge concerning recession agriculture has often been more latent than active. Young people, in heavy demand for production, participated for the first time in "true" recession agriculture.

With the maintenance of an artificial flood, the currently observed results could develop favorably. A more frequent and higher quality flood could have beneficial results for this type of agriculture: (1) if the flood itself could assure the regeneration of inundated land, one could count on greater soil fertility; (2) several successive years of flooding would certainly favor the renewal of peasant knowledge associated with *waalo* cultivation (seed selection and adaptation of grain varieties to local topography, soil types, and flood duration); (3) the labor force deployed for recession cultivation could increase quantitatively and qualitatively more or less over the long term not through the return—not very likely—of migrants, but rather through decreased levels of migration, which would make available for the *waalo* a greater number of more experienced workers.

As it is now, recession agriculture has revealed high potential, but remains fairly unpredictable. Improved recession agriculture requires more than water control, in other words the control of the date and length of inundation of the plots. To compensate for the losses due to maintaining an artificial flood and to assist riverine populations in establishing food security, careful attention should be given to increasing the productivity of this form of agriculture.

Large-scale pilot projects have been carried out, apparently successfully. Such is the case for the irrigation project on R'Kiz Lake financed by the CCCE. Yields of 1.7 to 2.2 tons/ha (gross) were obtained. Such excellent results were a result of:

- control of the movement of floodwaters through the division of the cuvette into three concentric depressions separated by dikes one meter high and 9,000 meters long in total. The depressions fill successively with the advent of a flood. A sluice gate installed in the dike, perpendicular to the flow in the thalweg, controlled the flow of water. Draining would occur through evaporation and infiltration.

- the planting density, here 13,200 to 14,000 plants per hectare compared to less than 10,000 (1 meter by 1 meter spacing) at Noussoum Yirlabe.

- use of antifungal seed treatments to eliminate the grain smut which causes a 20 to 30 percent drop in yield due to serious damage to the head of the grains.

- the large numbers of *Sesbania rostrata*, whose valuable capacity to fix nitrogen at the level of their cauline and radicular nodules has been demonstrated in ORSTOM studies.

Other improvements could be effected;

- cleaning fields before flooding, which favors better infiltration of water and eliminates some of the competition for water.

- genetic improvement of seeds which could be obtained on irrigated seed multiplication plots.

- fertilization, through large additions of chemical NPK fertilizers (14-7-7) applied directly at the base of the planting holes and covered over with sand when the land is being prepared.

- increasing the density of planting to 40,000 plants per hectare with 50 cm spacing.

- local control of water displacement.

8.3 Falo Cultivation

Many villages on the banks of the Senegal River and the main channels of the interior floodplain engage in a form of river garden recession agriculture known as *falo*. Characterized by a diversified cropping of both cereal and vegetable crops, *falo* constitutes a vital component of both the subsistence and cash sectors of the local economy, but its commercial contribution to smallholder households is underestimated and poorly understood by government and development officials. *Falo* fields are conveniently situated on the river banks close to villages and are farmed similarly to the *waalo*, as water levels recede after the annual flooding ends in September. A well synchronized production cycle permits local residents to farm both the *waalo* and *falo* without critical labor bottlenecks during the peak agricultural season. *Falo* gardening also conveniently provides an economic niche in area villages for older women, who, perhaps the only segment of the population free of labor demands occurring simultaneously in the *waalo*

and *jeeri*, exploit the fields and generate small revenues vital to the family economy. River gardens provide a stable, prolonged source of vegetables and cereal grain for human consumption, and fodder for small livestock, between the rainfed *jeeri* harvest in November and the *waalo* harvest in March. In years of poor rainfed harvests, the *falo* may serve as a critical food reserve bridging the gap until the *waalo* sorghum crop matures.

Stabilizing the river flow from the Manantali dam to create hydroelectricity will diminish significantly if not totally eliminate traditional *falo* agriculture. The implications for those households who depend on *falo* production to meet their daily nutritional and cash needs must be seriously considered. The elimination of an undervalued system of traditional agriculture will require a development strategy capable of making up for the loss of household revenues and the multiple nutritive functions that *falo* gardens provide.

8.3.1 Site Description

The critical subsistence and commercial role of *falo* cultivation has been closely observed at two research sites, Thiemping and Tiguere Cire. These two villages represent both the geographical and agronomic diversity to be found in *falo* agriculture. In Thiemping, *falo* gardens stretch for approximately four kilometers along the banks of the Senegal River and are a central component in the array of traditional production activities of the village. Production involves one staple cereal, maize, and several vegetables and leguminous crops including tomatoes, cowpeas, and sweet potatoes. In addition, residual products such as corn stalks (*nyaayko*) and cowpea vines (*gooji*) are harvested as crucial livestock fodder for the long, hot dry season. The *falo* in Tiguere Cire, much less expansive than at Thiemping, lies on the banks of the Diamel, a principal channel of the Senegal River entering the floodplain. Here more squash, melons and calabashes are grown, in addition to the crops listed above.

The Thiemping *falo* is comprised of two major areas on either side of the village. The entire zone lies on a moderately steep slope of the river at between 10 and 14 meters IGN. While the most productive *falo* is often located at slight bends in the river where fertile alluvial depositing occurs from the annual rainy season flood, the Thiemping *falo* is found on a relatively straight portion of the river. Thiemping is at one of the most shallow points along the river bed in the area at dry season, and alluvium is deposited on an island nearby in the middle of the river. Residents of Thiemping have farmed this island as *falo* for many years, but the Senegalese-Mauritanian border dispute forced them to abandon it in 1989 because of periodic gunfire by Mauritanian military and civilians while Thiemping families tried to work their fields. Several river plots near the village were also abandoned in 1989 as a result of occasional shooting from across the river.

The *falo* zone of Tiguere Cire, known as Talde, is located between nine and eleven meters IGN. Only 10 percent of the land along the river banks can be effectively put into production in the zone, because of the morphology of the terrain.

Falo production was observed at Thiemping during the 1989-1990 cool dry season and at Tiguere Cire during 1988-1989. The Thiemping area studied, known as *Goulmbol*, begins at the village and extends downstream for two and one-half kilometers. A total of 82 garden plots were farmed covering 17.5 hectares and ranging in size from .02 to 1.8 hectares. The average plot was .25 hectares. At Tiguere Cire, 15 plots covering 3.5 hectares were cultivated. Fields range in size from .12 to .54 hectare, and the average plot size approaches that of the Thiemping *falo* at .23 hectares.

8.3.2 Land Tenure

At both research sites, one notes a distinct difference in land tenure between *waalo* and *falo* production systems. *Falo* land is held and cultivated exclusively by farmers from the village, a noticeable contrast to the broader geographical constellation of farmers in the *waalo*. Access to land use is also more homogeneous in the *falo*. The large majority of farmers choose to exploit their own fields directly rather than rent or loan out to others as has been observed in the *waalo*. Of the 82 garden plots in the Thiemping *falo* at Goulmbol, three-quarters (76.3 percent) were cultivated by the landholders themselves. At Tiguere Cire, all 15 plots were farmed by the landholders. Sharecropping is extremely rare in the *falo*, only one example being noted at Thiemping. Field leasing arrangements, termed *coggu*, known to be relatively common in the *falo* elsewhere, were also rare, with only three cases noted at Thiemping. The most common form of land access in the Thiemping *falo* was by means of a field loan (18.8 percent) which entails only a modest crop payment to the field holder.

Land-use payments on the falo are similar to those practiced in the *waalo*. Sharecropping requires a payment of one-third to one-half of the harvest, while field loans are considerably less (approximately one-tenth). Field leases (*coggu*), on the other hand, require a small cash fee to be renegotiated annually or biannually.

Several factors may explain the tendency of landholders to exploit their own land in the *falo* despite labor shortages experienced by many households. First, garden plots are relatively small and close to the village, thus easier to reach than the more-distant *waalo*. Second, as observed in the case of the Thiemping *falo*, gardens are often the reserve of older women, who are relatively free from other agricultural activities and can thus work close to the village. Finally, the small cash incomes generated from *falo* fields encourage families to cultivate their own fields.

In the few instances of sharecropping, the sharecropper receives a large field to allow him to generate the land rent (usually 50 percent of his harvest) and still feed his family, a pattern of compensation similar to that in the *waalo*. At Thiemping, tenants received plots twice the size of the landholders' (.4 versus .2 hectares) and well above the .25 hectare average for all farmers.

8.3.2.1 Landholding and Gender

A study of both traditional and modern agriculture carried out in the late 1970s in the riverine village of Bow, approximately twelve kilometers upstream from Thiemping, has noted the prominent role of women in falo cultivation and a sexual division of labor in which men and women cultivate separate crops in the same fields (Fieloux 1980:24). This division of cropping according to gender has been confirmed at both Thiemping and Tiguere Cire. At Thiemping the majority of farmers in the falo are women, while at Tiguere Cire males constitute the majority.[69]

A survey of all household heads farming the Goulmbol *falo* in Thiemping reveals a mixed pattern of cropping among the sexes in which the large majority of fields are under the care of either a man or woman, while a small number are cultivated simultaneously by both sexes. Garden plots are usually held by men while their wives or other close female family members most often farm them. In 65 percent of the plots women were solely in charge of cultivation, while men farmed 23.8 percent of the plots alone. In the remaining 11.2 percent, both men and women cultivated the field together, each one usually responsible for a different crop. Men's plots were slightly larger than women's (.3 and .2 hectares, respectively).

8.3.3 Landholding and Caste

Because the *falo* is close to the river and its water channels, members of the fishing caste, *Subalbe*, often hold and farm parcels in the gardens. In Tiguere Cire, a predominantly fishing-caste village, the *Subalbe* comprise two-thirds of the field holders in the Talde *falo*. A second ethnic group, the *Soninke*, hold and farm the remaining one-third. In the Thiemping *falo* at Goulmbol, a much greater caste heterogeneity reflects the overall composition of the village. With the notable exception of the *Fulbe*, who do not hold or farm plots in the *falo*, the respective proportions of all other groups in the village are represented in the garden plots. Despite this equity in access, the members of one particular group, the *Maccube* (ex-slave caste), have a predominantly nonlandholding status. More than one-half received plots on loan and only 30 percent are actually landholders. This status contrasts with the predominantly landholding position of all other groups (see Table 8.21).

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[69] The smallest unit of household production and consumption, the *fooyre*, is headed by one male and one or more female spouses. In many instances the male head has migrated in search of cash earnings, in which case his spouse or spouses assume responsibility for all aspects of field production. In many other cases, females maintain this position despite the presence of the male head in the village. All household heads present were surveyed to determine who was the principal caretaker or steward of the household *falo* plot.

Table 8.21 Differential Landholding by Caste in Thiemping's Goulmbol Falo

Caste	Percentage				
	Landholder	Loan	Tenancy	Lease	Total
Maccube	30.0	55.0	5.0	10.0	100
Nyenybe	100.0	-	-	-	100
Sebbe	93.8	6.2	-	-	100
Subalbe	85.7	14.3	-	-	100
Toorobbe	86.6	6.7	-	6.7	100
Total	76.3	18.8	1.2	3.7	100

8.3.4 Aspects of Production

As with *waalo* cultivation, *falo* gardening depends upon ample flooding and a prolonged period of submersion of the soils on the banks of the river and its distributaries. In the past few years agriculture on the river banks has been somewhat disappointing because of insufficient and irregular floods. In 1987, the level of the water rose unexpectedly in the month of February as a result of releases made at Manantali, ruining the crops that had already been planted.

Field cultivation extends over six months as a result of a slow, staggered phase of planting that follows the natural rhythm of the receding flood waters. Since harvests are staggered in relation to the planting season, families have a modest source of cereal grain and vegetables during a three month period. Unlike the *waalo*, in which households traditionally abided by a communally determined date of field harvest, in river garden plots, because they are protected from predation by thorn fences, families can begin an early harvest of vegetables.

With the exception of an early period of field clearing and fence building, *falo* cultivation requires a low level of physical exertion spread over a longer period than in the *waalo* where planting, weeding, and harvesting are more labor intensive and carried out during a much shorter time span. Labor demands in the *falo* may be carried out by only one or two individuals, whereas field activities in the *waalo* often require a cooperative family effort or larger work parties. The labor input required in river gardening is therefore particularly well suited for older women. This individual orientation of labor in the *falo* minimizes the competitive demands for household labor occurring simultaneously in the *waalo*, *jeeri*, and irrigation.

8.3.4.1 The Production Cycle

The *falo* production cycle was observed during the 1988-1989 season at Tiguere Cire and the 1989-1990 season at Thiemping. In both villages, five major field activities occurred between the first week of October and early April. Field guarding, one of the essential tasks usually carried out in the gardens, was notably absent because of ongoing border tensions among

riverine villages in Senegal and Mauritania. Occasional shooting from the other side forced families to abandon watch over their fields. The calendar and sexual division of labor observed at Thiemping is summarized here:

Table 8.22 The Agricultural Cycle in Thiemping's Falo

Task	Period	Gender	Collective Work
Fencing	Oct-Dec	f	doftal
Sowing	Oct-Nov	m, f	doftal
Weeding	Nov-Dec	m, f	
Harvesting	Jan-April	f	
Transporting	Jan-April	m, f	

1. Fencing - *kowgol galle*: The start of field labor depends on the height of the flood and the date when waters have fully retreated from the top of the river banks. For the season observed, this occurred in early October. Men begin enclosing their fields with thorns (*galle*) and carry out some light field clearing if necessary, although weeds are usually not present after the flood. For this, the most intensive task in the garden, an additional friend or family member (*doftal*) may have to help out for several days. Households short of male labor may sometimes pay an individual (*dawol njobdi*) to construct the fence. In a sample of eight fields observed in Thiemping, wage labor made up only 1.6 percent of total labor time in the *falo*.[70]

2. Planting - *lewre:* Planting begins within five to eight days after the flood begins to recede, depending on the duration of flooding, and, following the natural pace of the recession, may continue for more than a month until the waters reach a level below the area suitable for cultivation. It is carried out most often by one or two women who make a hole for the seed in the moist soil with a long pointed digging stick (*lugal*). Three elevations are identified in the gardens for intercropping of different plant varieties. These areas differ according to their soil characteristics, each being adapted for particular crop mixes:

a. *wallere ballere* - the highest portion of the field near the top of the river bank. Soils are usually dark and have a high clay content. Maize and cowpeas (*niébé*) are intercropped along with some melons and calabashes. Tomatoes are also planted here, but are not intercropped with the other varieties.

[70] Of twelve fields observed in the study sample, four were abandoned because animals entered and destroyed the crops. These four plots were further from the village and were not fenced in or protected because of the occasional presence of armed Mauritanian soldiers and civilians on the opposite bank of the river.

b. *wallere ranere* - the middle zone of the garden with a lighter soil of sand and silt content. Maize and cowpeas are intercropped here, but the soil is generally less fertile.

c. *wallere ceenal* - the lower half of the garden where a light alluvial soil is planted in maize, sweet potatoes, tomatoes, cowpeas, and melons. Tomatoes and sweet potatoes are transplanted here from seedlings grown in the village. After the retreat of the floodwaters, a pasture of *falo* grass known as *siiwre* is found in the *ceenal* soils. This grass is a nutrient-rich fodder for small ruminants well into the dry season. The root of the *siiwre* grass, or *uguude*, is highly valued for its fragrance. Several village women earn an income by gathering and drying it as an incense for sale to local merchants. The *ceenal* is considered to be the most fertile portion of the garden and relies on adequate flooding since soils here have a lower capacity for water retention. In years of poor flooding and early warm temperatures, the soil dries rapidly and harvests are poor.

3. Weeding - *remru*: A light weeding is undertaken periodically during the growing season, mostly by women. Maize requires the majority of time for this task.

4. Harvest - *conyal:* The first harvests of maize and cowpeas begin as early as the end of January and extend into March. Tomatoes are harvested in February and March and sweet potatoes are the last crop to mature in early April. Women begin bringing maize, cowpeas, and tomatoes daily from the field for immediate consumption. They often sell tomatoes and sweet potatoes in the village for small cash revenues with which they may purchase other food items for the midday meal.

5. Transport - *dimgal*: Women carry small basins of crops from the field. Because the gardens are close to the village, horse drawn carts or donkeys are rarely required to transport the harvest.

8.3.4.2 Demographic Features of Labor Allocation

The two research sites differ in the sexual division of labor. While men and women in both tend to participate in specific field tasks, in Thiemping women contributed three-quarters of the total labor time (74.5 percent), while in Tiguere Cire their contribution was only 29.4 percent (see Table 8.23). Thus, the observation made earlier by Fieloux (1980) concerning the key role of women in garden agriculture is corroborated in only one of the two villages.

Of the various tasks in the gardens, planting, guarding, and harvesting require the largest portion of time. In Thiemping, planting and harvesting occupy almost three-quarters of the total time (72.1 percent), while at Tiguere all three tasks equal 76.6 percent. Since planting occurs over an extended period as flood waters recede, harvests similarly extend over time. These two tasks are largely the domain of women (64.3 percent of total time) at Thiemping and constitute the large portion of women's labor at Tiguere (23.9 percent) as well. Men engage primarily in the heaviest field tasks, fencing and weeding, at Thiemping (17.2 percent), but are noticeably present in all aspects of cultivation at Tiguere as the labor data in Table 8.23 indicate.

Table 8.23 Labor Allocation in the Falo by Task and Gender

Task	Percentage Labor Time by Gender					
	Thiemping			Tiguere Cire		
	Women	Men	Total	Women	Men	Total
Fencing	2.7	7.4	10.1	-	1.6	1.6
Guarding	-	-	-	3.8	16.1	19.9
Sowing	28.9	5.3	34.2	5.2	9.9	15.1
Weeding	3.7	9.8	13.5	.4	14.3	14.7
Harvesting	35.4	2.5	37.9	18.7	22.9	41.6
Transporting	3.8	.5	4.3	1.3	5.8	7.1
Total	74.5	25.5	100.0	29.4	70.6	100.0

8.3.4.3 Crop Productivity

Smallholders in the *falo* have individual preferences in the mix of crops planted. These crops are used for multiple purposes:

1) Corn, sweet potatoes, tomatoes, melon, and cowpeas are grown for sale, in contrast to *kolangal* sorghum, which is usually earmarked for consumption. Tomatoes and sweet potatoes especially are found in the markets of Thiemping and Tiguere Cire. Traditionally, and still today at Tiguere Cire, women go to Boyenadji Roumde daily to sell either vegetables or fish and return with sorghum and milk to sell the following day.

2) Bales of cowpeas and stalks of sorghum and corn are grown for animal consumption. Maize was harvested all at once. On the other hand, for two months, several times per week, a young child from a family cuts leaves to bring back to the compound for cattle fodder. Sorghum and corn stalks, and bales of cowpeas, are consumed later in the dry season, before the first rains.

3) Calabashes are emptied and dried out to make baskets and watertight receptacles for sale at the market. Similarly, gourds are fashioned into basins, primarily for herders.

Crops are planted in different proportions in each field. Yields are highest for maize and sweet potatoes and lowest for cowpeas (see Table 8.24). Maize production is particularly favorable, yielding more than 1,000 kg/ha in both villages. Several crops have been counted rather than weighed and are listed in units/ha below. These were recorded almost exclusively at Tiguere Cire. The overall yields seem high, although it is difficult to compare these systems to other systems of production. The amount of time devoted to this type of agriculture varies significantly between the two sites: 57 days per hectare on average in Thiemping, as compared to 229 days per hectare at Tiguere Cire. The difference between the two villages may be a

result of border problems that have seriously disrupted field work in Thiemping, especially with respect to guarding chores. In general, if yields are analyzed in terms of time input, a fairly high level of productivity in the *falo* can be noted. Taking into consideration the degree of commercialization and the costs of production, the level of production in the *falo* appears to be even higher.

8.3.5 Commercialization of Production

The commercial value of *falo* garden produce in the Senegal River Valley has rarely been quantified. Every two weeks, therefore, we carefully verified and measured the Thiemping and Tiguere *falo* harvests and the proportion sold. Crop yields for nonsample households were obtained by recall. The figures are a safe estimate of *minimum* yields in the *falo*, and show that *falo* gardens do provide an important cash revenue to families. In the Thiemping *falo*, 20 percent of total production was sold immediately after harvest, representing an average income of 16,753 CFA per household (see Table 8.25). This figure, of course, reveals only the immediate revenue to the farmer; a large portion of the harvest continues to be sold during the

Table 8.24 Crop Yields in Thiemping and Tiguere Falo

Crop	Average Yields (kg/ha)	
	Thiemping	Tiguere Cire
Cowpeas	22	56
Maize	1,059	1,559
Sweet Potatoes	750	1,326
Tomatoes	375	1,024
	Average Number/ha (unit/ha)	
Calabashes	-	50
Cowpea Vines	-	445
Maize Stalks	133	57
Melons	-	750
Millet Stalks	-	225
Squash	-	12

Table 8.25 The Commercial Value of Garden Production in Thiemping Falo

Crop	% of Crop Sold Immediately after the Harvest	% of Total Crop Sold	Total Revenue (Fcfa)	Revenue per Household (Fcfa)
Cowpeas	1.4	29.0	90,000	1,184
Maize	5.6	16.0	86,460	1,138
Nyaayko	2.0	7.0	64,375	847
Sweet Potatoes	7.2	36.0	921,500	12,125
Tomatoes	3.5	34.0	110,875	1,459
Total	19.7	-	1,273,210	16,753

course of the year. Sweet potatoes and tomatoes provide the largest revenue, followed by cowpeas, maize, and maize stalks (*nyaayko*). The percentages of each crop sold immediately after harvest show that perishable garden vegetables and legumes (sweet potatoes, tomatoes and cowpeas) are cultivated as cash crops. Approximately one-third of these crops are sold at the time of harvest. On the other hand, maize and maize stalks, which are more easily dried and preserved for storage, are preferred for their subsistence value, much smaller proportions of the harvest being sold (16 percent and 7 percent respectively).

Though we have not yet conducted a study of market transactions, at Tiguere Cire we estimate that 65 percent of the harvest is put on the market, 10 to 15 percent is consumed, and 20 to 25 percent is lost through spoilage. This corresponds to a potential of 830,000 FCFA for the entire harvest for the Talde *falo*, to be shared mainly among farmers tending four plots of intensively grown tomatoes. For these four fields, an hour of work nets 469 FCFA, which is comparatively high. Tomatoes sold on the market directly by women farmers for 25 FCFA per pile of 150 to 200 grams, represents an important income to them.

It is the same for sweet potatoes that are sold at the market for 200 FCFA for a pile of 350 to 400 grams. More than 80 percent of the harvest is marketed for the equivalent of 325,000 FCFA. For the two farmers who undertook this enterprise, an hour of work netted them 1,300 FCFA. The results here are even more convincing. It is easy to understand from this the visceral attachment the farmers have to their *palle*.

Corn is also sold in peripheral markets at 60 FCFA per kilo, for lower returns. Half of what is produced is sold, and households that grow corn make 115,600 FCFA total from the sales. An hour of work nets 70 FCFA.

Calabashes are sold for 1,000 to 2,000 per unit throughout the year as there is no problem of spoilage with them. The income is not insignificant: 150,000 FCFA, with a

minimum input of labor. Unfortunately, the demand is limited, and these crafted basins are in danger of being replaced by more "modern" containers made of plastic or enamel.

In fact, the primary worry of the inhabitants of the upstream Middle Valley is obtaining access to local sources of income, in light of the fact that the largest proportion of money comes from outside through migration. Data for production in both study sites confirm that *falo* agriculture provides both monetary revenue and a variety of grains, legumes, and vegetables for human and animal consumption. In certain villages along the river, like in Woudourou and Sadel, sweet potatoes are grown intensively in the *falo* and provide much income to the local economy. This must be taken into consideration when discussing the management of Manantali waters. If a high level of water throughout the year were maintained in the reservoir for irrigation needs in agricultural schemes, or for navigation along the river, this would adversely affect agriculture on the banks.

8.4 Rainfed Agriculture

Rainfed agriculture is practiced on the sandy soil (*seeno*) of the jeeri and on the sandy-clayey soils that are found most frequently in the elevated areas of the waalo. In the former regions, millet (*ndemiiri*) is grown. In the latter regions, rainfed sorghum is cultivated (*fela* and *nyendiko*). Millet and rainfed sorghum are always intercropped with cowpea beans and, quite often, with watermelon (*dende*) and sorrel (*follere*). In the Doumga region, rainfed agriculture over vast tracts takes place from July to October, involving most households.

Rainfed agriculture is the most variable of all the forms of agriculture practiced in this zone. The agricultural season is unpredictable from beginning to end. The first element of uncertainty is, obviously, the amount of rainfall. In this sudano-sahelian zone, rainfall is characterized by its unpredictability, its high annual and interannual variability, its unequal spatial distribution, and its excesses. Yet a sufficient and well-distributed rainfall does not necessarily guarantee a good agricultural season; grasshoppers and grain-eating birds represent a permanent threat.

In terms of quantity of rainfall, the situation on the whole has very clearly improved during the past few years. In Matam, the amount of rain measured annually since 1975 has never exceeded 400 mm. In contrast, in both 1987 and 1988 more than 400 mm was recorded. This seemed to mark the beginning of a new wet period, but 1989 crushed all hopes of a recovery. In Matam, only 330 mm of rain were measured. What really devastated the agricultural season that year, however, was not so much the quantity of rain as its very poor distribution over space (Bokidiawé, 4 kilometers from Doumga and about 40 km from Matam, received 462 mm), and over time:

- with 48.6 mm of rain falling in 9 days in June, the rainy season seemed off to a promising and, even better, an early, start.

- 40.2 mm fell in seven days in July, with a period of 20 days between two good rainfalls; the result being that many fields had to be replanted.

- 235.1 mm fell in 14 days in August, and the season, to the great relief of the local population, seemed to be saved.

- only 14.5 mm of rain fell in seven days in the month of September. As a result, most of the crops were lost. There were only one or two rains totaling barely 10 mm during the month of October. The rainy season, while satisfactory for the rest of Senegal, and even exceptionally good in the Department of Podor and the entire area of the northern Sahel, was disastrous in the Arrondissements of Kanel, Ourossogui, and Thilogne in the Department of Matam.

In addition to the limitations posed by rainfall, rainfed agriculture is also prey to destruction by agricultural pests. In 1989, for example, a year of insufficient rainfall, seeds were ravaged by grasshoppers and, subsequently, by birds. The result was a general catastrophe. In the sandy regions devoted to millet, no households succeeded past the planting stage. Certain hardy souls planted up to seven times, each time defeated by grasshoppers. The entire section stretching from Nabadji Siwol to Oréfondé was destroyed entirely. Not even grass remained. It was only at the end of August and the beginning of September that the villagers of Doumga Rindiaw admitted to the failure of the jeeri season. This did not, however, prevent certain individuals--already having missed the deadline for undertaking irrigated agriculture—from going all out on the *foonde* where several households managed to harvest very small quantities of *fela* and *nyendiko* toward the end of November. In the *ferlo*, however, hope was sustained until September. In Kaawel, for example, planting and weeding were undertaken at approximately the usual time before an enormous invasion of birds ravaged the crops despite extensive efforts on the part of the farmers to protect them.

With the relatively good 1988 season in mind, we hoped to monitor closely a productive jeeri season in Doumga in 1989. Even the villagers who had decided to put into fallow the zone that they had been cultivating for fifteen years shared this optimism.

It is within this context that rainfed agriculture was studied this year in Doumga Rindiaw, Kaawel, and Boyenadji Roumde. In the first village, the only information available concerns the quantities of seeds normally set aside for planting by households in the sample, which allows us to estimate the surface area each one was planning to cultivate. In the second village the information at hand describes (1) plots cultivated by households in the sample, all of which plots were measured; (2) the quantity of seeds needed by each household for a normal season, used to estimate the amount of surface area that would have been cultivated in Doumga; and (3) the amount of labor required, which we were able to calculate for a subsample until harvest time. In Boyenadji Roumde, where the season—although only a very poor one—continued through to the harvest, the monitoring was fairly consistent.

8.4.1 Plot Sizes in Rainfed Cultivation

In the sample monitored at Kaawel, all of the households cultivated a total of only 19 plots in the jeeri, compared to a total of 28 plots for 11 households farming the waalo. All arable land is controlled by the lineage, but the definition of individual plots is often hazy. Each villager is allotted rainfed fields according to his needs. Those without access to traditional lands can borrow land against the payment of the *asakal leydi*. Traditionally, this fee, collected by the land holders, had to be paid to the *joom leydi*. The latter collects the *asakal leydi* from all jeeri plots within the territory under his control. To an even greater degree than in the waalo, this tradition is becoming less and less respected in the jeeri where land is neither sharecropped nor rented. Access to rainfed agricultural land is somewhat open, and plots are less often spread over a wide area, which explains the low number of plots.

The average size of jeeri fields is 2.8 ha at Kaawel, as compared to 2.2 for waalo land in the same sample. The size of jeeri holdings varies significantly from one household to the next, from a minimum of 0.09 ha to a maximum of 6.79 ha. At Doumga Rindiaw, the average plot size of the sample, in which 13 out of 15 households planted in the jeeri, is estimated at 1.5 ha on average for each of 16 plots.[71] In comparison, in the same sample, twelve producers in the waalo in 1988 had cultivated an average surface area of 2.6 ha. The situation at Doumga Rindiaw is similar to that in Boyenadji Roumde, where the average size of a jeeri plot (1.5 to 1.7 ha) is smaller than in the waalo (2.3 ha at Noussoum).

The site of the village seems to govern the degree of household participation in the two forms of traditional agriculture. The fact that Kaawel is located more than 10 kilometers from its waalo is probably related to the larger surface area cultivated by households in the jeeri. But this needs to be verified, because many variables are involved: incompatibility between guarding cattle herds and cultivating the *waalo;* the lack of village participation in irrigated agriculture; the degree to which the sample is biased with respect to the overall situation of the village households, etc.

We noted in the section devoted to recession agriculture that in Kaawel the average size of cultivated holdings per household was two times larger for the *Maccube* than for the *Fulbe*, who constitute the majority of the holders in the waalo. This fact suggested that economic equalization was being achieved in Kaawel through a system of compensation described by the monograph on the waalo of Doumga and Thiemping. In the Kaawel jeeri, where sharecropping is unknown and where each household is entitled to the entirety of its harvest, the average surface area cultivated is virtually the same for the *Fulbe* (2.84 ha) as for the *Maccube* (2.80 ha). In the Doumga Rindiaw sample, however, the average size of cultivated holdings of the

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[71] This estimate was based on the amount of seeds to be sown if the agricultural season had been normal. Not having measured the plots themselves, we made use of this simple and time-saving technique, which needs nevertheless to be perfected and would be very helpful for rapid surveys.

Toorobbe (1.9 ha) is noticeably larger than that of the *Maccube* (1.3 ha). This should be investigated on a larger scale, because if the presence of an equalization strategy is confirmed, the degree of disruption brought about by the current economic differentiation, accelerated by migration, would be better understood.

8.4.1.1 Jeeri Production Cycle and Labor Inputs at Kaawel

Before the advent of the first rains, the fields are prepared. This is the time of *lewtaade* work (general clearing of land formerly fallowed for a long period of time), of *wadde galle* (placement of fencing), and of *duggitaade* (removing weeds and burning field stubble [*duppude*] from the preceding season). The first major rains at the end of July or the beginning of August mark the beginning of the planting season (*aawde*). Planting is undertaken with a long-handled hoe (*njinn daangu*). Seed germination is accompanied by the growth of a thick cover of weeds that must be removed (*demal*). Several weedings are often necessary: *arano* (first weeding), *beyaat* (second weeding), and *tatabo* (third weeding).

Thinning (*lorngo*) often takes place at the same time as the first weeding. It includes dividing a certain number of plants that have grown together and replanting them in holes where seeds failed to germinate. Between two weedings, if necessary, the fence is repaired (*kowgol galle*). Subsequently, the fields are guarded until harvest time. The harvest (*conyal*) takes place usually during the second half of the month of October. A new task was added this year: pest control. The peasants received some pesticides, albeit late and only in small quantities.

Animal traction is practiced by only a few households for clearing land, planting, and weeding. Mechanization and agricultural intensification are still not widespread in the Valley.

The study of labor inputs does not reflect jeeri agriculture under normal conditions. On the contrary, the situation was atypical, a disastrous year in the sites under study.

The average labor input per hectare in the seven households monitored from the beginning to the end of the rainfed agricultural season at Kaawel was 104.5 8-hour days. It varied among households, from 39 to 55 days up to a maximum of 168 days per hectare. In the former instances, large sections of fields had to be abandoned more or less prematurely during the season, cutting short the need for labor.

At Boyenadji Roumde, the data present a different picture. The total labor input on 28.2 hectares was 10,630 hours, for an average of 377 hours/ha or 47 8-hour days per ha. This figure for labor input is particularly low for the jeeri, abnormally low compared with the data provided by Minvielle (1976) for the same locality fifteen years earlier (950 h/ha or 118.75 d/ha). The figure for labor input at Boyenadji Roumde was low because (1) some farmers had to leave their fields prematurely because of the poor condition of crops; (2) harvesting was undertaken earlier than usual to minimize, among other things, damage by birds, which cut down considerably on time devoted to guarding. This period of hardship is not unique to

Boyenadji Roumde. It was equally hard for Kaawel, but in Kaawel the data on labor inputs apply only to the subsample of individuals who maintained their jeeri crops through to harvest.

Examination of data in Table 8.26 concerning the labor inputs by age group and sex reveals:

1. The amount of labor provided by youth (15 to 24 years old) varied little between the waalo and the jeeri at Kaawel: 53 percent in the waalo and 54 percent in the jeeri. Doumga Rindiaw utilizes more young laborers in its waalo: 68 percent. In Boyenadji Roumde, the participation of youth under 25 years of age, while important (43 percent) is relatively moderate.

2. In Kaawel, women take part less in rainfed agriculture (34 percent of the total labor time) than in recession agriculture (47 percent in the same sample for this village). In Boyenadji Roumde, this situation is less apparent than at Kaawel: women provide 16.4 percent of the labor in the jeeri as compared to 20 percent in the waalo (see Table 8.26). Women participate much less in the more physically demanding jeeri agriculture than in recession agriculture. This is confirmed by the distribution of labor among the various agricultural tasks.

Table 8.26 Labor Time by Age and Gender in Boyenadji Roumde's and Kaawel's Jeeri (in percentages)

Kaawel	5-14	15-24	25-34	35-44	45-54	55-64	65+	Total
Women	11	2	4	6	9	0	2	34
Men	11	30	2	1	6	13	3	66
Total	22	32	6	7	15	13	5	100
Boyen. Total	20.5	22.6	30.5			26.2		100

In the waalo of Kaawel, guarding of fields takes up more than 80 percent of the time devoted to crops, as compared to 56 percent for the jeeri (see Table 8.27). Given that more women guard crops in traditional agriculture, and that guarding usually occupies a longer period of time in the waalo than in the jeeri, the labor input for women in this task is higher in the waalo.

It can be seen that planting in the jeeri demands less of the overall labor (5 percent) than planting in the waalo (10 percent). This is due to the complexity of this operation and to the heaviness of the soils in the waalo. Also, certain households who cultivate in the jeeri undertake planting with the help of animal traction (horse or donkey).

Table 8.27 Labor Time by Gender and Agricultural Period in Kaawel and Boyenadji Roumde (as a percent of the total)

		Fencing	Land Clearing	Sowing	Weeding	Guarding	Harvesting	Total
KAAWEL	Women	0.0	0.0	1.0	0.0	32.0	1.0	34.0
	Men	3.0	5.0	4.0	27.0	24.0	3.0	66.0
	Total	3.0	5.0	5.0	27.0	56.0	4.0	100.0
BOYENA	Women	0.0	0.6	3.7	0.0	7.0	5.1	16.4
	Men	2.6	3.4	4.0	42.8	24.8	6.0	83.6
	Total	2.6	4.0	7.7	42.8	31.8	11.1	100.0

Weeding on the jeeri absorbs almost a third (just under half in Boyenadji Roumde) of the total labor input, because it is repeated two or three times in the course of the season. In the waalo—where it occupies only 4 percent of the total labor time—planting takes place only once and is relatively easy given the relative lack of weeds on *hollalde* soils.

The harvest demanded little labor input since it did not meet normal expectations.

8.4.1.2 Yields

In Kaawel, sorghum harvests were almost nonexistent in all fields. In Doumga Rindiaw, none of the households succeeded past the planting stage in the sandy part of the jeeri. In the *foonde*, a few households not included in the sample were able to harvest a few panfuls of rainfed sorghum.

In Boyenadji Roumde, the yields were only 91.2 kg/ha and 228.4 kg/ha at Mogo Yalalbé, in contrast to 512 kg/ha on average for the rainy season of 1988 in the same place. The preceding year, yields of 800 kg/ha were not unusual, and in some areas even up to 1000 kg/ha was produced.

Still in the region of Boyenadji Roumde, peanut harvests obtained by women from their rainfed intercropped fields yielded only 54.8 kg/ha. Gumbo harvests were inconsequential. Yields of *follere* (sorrel) averaged 78 kg of fresh leaves per hectare; cowpeas yielded approximately 100 kg/ha; watermelons averaged 48.8 kg of seeds per hectare. The dried seeds are substituted for peanuts in cooking.

In the region of Kaawel, the only significant harvests obtained were *nyaayko* (sorghum stalks and leaves)—very useful this year because of the lack of natural forage in the zone—and especially cowpeas, sorrel (*follere*), and watermelons.

8.4.2 Conclusions

In sum then, jeeri agriculture lived up to its reputation. Variable rainfall and serious depredations by agricultural pests render it a very risky production activity for all households living in a Sahelian or Sudano-sahelian region such as the Middle Valley. Still, two consecutive years of good rainfall and fairly good harvests were sufficient to rehabilitate the jeeri in the eyes of the inhabitants of the regions of Doumga Rindiaw and Kaawel. In this latter village, irrigated agriculture lost out in favor of rainfed agriculture. Therefore, the disaster was felt even more acutely. Granaries remained empty for long months, and the cycle of seasonal migration started earlier, and was more extensive, than usual.

Without recession agriculture, the villages of Kaawel and Doumga Rindiaw would have experienced true famine this year. This explains the panic that ensued when water released from the Manantali Dam submerged their newly-planted fields.

All this points to the economic fragility of households in the Valley. Development signifies to them food security above all. In this vein, *jeeri* agriculture cannot be counted upon for a steady food supply, since it depends on a crucial factor—rain—over which there is little control. Thus, the only alternative means of production are recession and irrigated agriculture.

This does not necessarily mean that jeeri agriculture should be ignored. In the event that there is adequate rainfall, sufficient control over pests—which are an issue for the waalo as well—permits jeeri agriculture to supply a significant amount of household food. In the long term, development of rainfed agriculture should include mechanization and crop selection: large-scale introduction of animal traction with hoe and planters, using as a framework the program in the peanut basin established in the 1960s; research on varieties of grain adapted to short growing seasons and arid conditions.

It is important within the framework of the Après-Barrages—and its concerns for regional development—to take into consideration the future of individuals who will not have access to irrigated agriculture because of their residence in jeeri zones. The jeeri is also the most democratic of the systems of agriculture in the Valley. Ensuring its viability will protect the most vulnerable segments of the population.

8.5 Herding

The site of Kaawel/Doumga Rindiaw was chosen partly so that a detailed study of herding activities could be conducted to reverse the unjustifiable marginalization of a sector that is of primary importance in the life of the people and that should be encouraged to occupy a central place in the local and national economy.

The complexity of herding in the Valley and the relative scarcity of recent detailed studies on the subject explain why it is difficult to circumscribe it within the framework of the study, which, after all, is global and not sectoral. It would have been necessary to expand the

scope of the study to include the distant *ferlo* in order to investigate professional herders. This proved to be incompatible with detailed, long-term studies of localities heavily dependent on the river.

In the discussion of the logic that underlies the management of intervillage territory (the *leydi*), the primary location of, and the key role played by herding was revealed. But the traditionally conceived *leydi* is disorganized today, and herding seems to have regressed significantly in the region under study.

Nevertheless, it has far from disappeared, and even though it is clearly better represented in *Fulbe* areas of the *jeeri* such as Kaawel, herding remains important not only in *jeegegol* villages such as Doumga Rindiaw, but even in *waalo* villages such as Mbakhna.

In the jeeri, cattle keeping is one of the principal activities that differentiates households. In the waalo and the jeejegol, revenues gained from raising small ruminants (mainly sheep and goats) complement income from agriculture and migration. But in the global context of poverty, herding provides important monetary income in both areas.

Only one of the many facets of local herding will be investigated: ownership of cattle and its attendant rights.[72] The subject parallels land tenure in agriculture. Just as an understanding of land tenure is important to any agricultural development program, an understanding of the jural status of herds is necessary to work effectively with traditional herders such as the *Fulbe* in the Middle Valley of the Senegal River.

8.5.1 The Overall Condition of the Flock in the Regions of Kaawel and Doumga Rindiaw

According to the census conducted at the beginning of the research period, the flocks located in Doumga Rindiaw and Kaawel were constituted as follows: 1,325 head of cattle (averaging 11 per household), and 4,407 small ruminants (26 per household) in the hamlets that make up Kaawel (Kaawel Dialloubé, Kaawel Kangal, and Padé Boyngal); 67 head of cattle, and 707 sheep and goats for the 163 households of Doumga Rindiaw.

The data concerning the size of the herders' flocks are often not accurate, especially in reference to specific information and when based on rapid surveys such as general censuses.[73]

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[72] The relationship between herding and agriculture—primarily irrigated agriculture—as well as the contribution of herding to household budgets are discussed in chapters devoted to these subjects.

[73] That reliable information about the nature of the flocks kept by herders is difficult to get has long been recognized by researchers in this sector. One recent reflection: in circumstances where data is crucial, using multiple methods, cross-checking information gathered through interviews, direct observations, and deductions based on leading questions have been

Generally speaking, however, they are sufficiently complete to confirm the impression that traditional specialization according to ecological zones among the *daande maayo* of the fishermen, the *jeej*egol of farmers, and the *jeeri* of herders, has not totally disappeared.

At the level of the samples, where greater confidence in the validity of data may be expected, the herds accounted for by the 16 households in Doumga Rindiaw include 2 head of cattle, 96 sheep, and 43 goats. In Kaawel, the 16 households originally chosen declared 182 head of cattle, 137 sheep, and 186 goats. In this village, with the exclusion of two herder households, 14 households kept only 68 head of cattle, 92 sheep, and 155 goats.

Herd composition by age and sex in the initial sample (before subtracting two households) and in the sample that was monitored throughout the year in Kaawel is presented in Table 8.28.[74]

During the course of the year monitored, the sample for Doumga Rindiaw recorded 82 births of small ruminants (46 sheep and 36 goats). Thirty-three sheep and 26 goats were sold. Six sheep and 5 goats were slaughtered. Most births took place in October-November, and February. The biggest sales were conducted in July-August and from November to December.

At Kaawel, there were 23 births in the cattle herd, especially between August and November, while of the four sales, three took place in June. For the sheep and goats, 113 births

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implemented with relatively satisfactory results (see Sutter 1982). The same concern was discussed in an interesting theoretical treatise comparing the attitudes of herders toward this question with status and roles in herding societies (Pouillon 1989).

[74] Surveys on herd composition were carried out using local terminology. Among cattle, for example, the *Fulbe* make the following distinctions:

Male bovines:
- Bull calf: *Gooleeji*
- Young bull: *Ngari tokoriri*
- Bull: *Garbaari tokosiri*
- Breeding bull: *Ngaari Kalhaldi*
- Old bull: *Nayeeje*

Female bovines:
- Heifer: *Gooleeji*
- Young cow (after weaning at three years): *Nyale*
- Young cow (older than three years but before reproduction): *Wiige*
- Cow: *Haange*
- Old cow: *Riginy*

Table 8.28 Composition of the Herd at Kaawel (Original Sample [OS] and Working Sample [WS])

	Cattle				Sheep				Goats			
	Male		Female		Males		Female		Male		Female	
	OS	WS	OS	WS	OS	WS	OS	WS	OS	WS	OS	WS
Before reproductive years	37	11	43	11	39	29	48	36	36	28	3	28
During reproductive years	28	11	64	33	15	12	125	105	17	16	95	72
After reproductive years	0	0	10	3	0	0	0	0	0	0	0	0
Total	65	22	117	47	54	41	173	141	53	44	132	100
% Total original sample	36		64		24		76		29		71	
% Total working sample		32		68		23		77		31		69

were recorded as having taken place at the close of the rainy season. Thirty-two sales took place during two periods (May-July and October-December). Of 22 deaths recorded, most occurred during the rainy season. Nine sheep and 1 goat were slaughtered.

No stock were lost in Doumga and one sheep died in Kaawel. There were no new acquisitions of stock in Kaawel, but 4 sheep and 2 goats were bought in Doumga.

8.5.2 The Status of the Herd

The development program for herding, which is now an integral part of the New Agricultural Policy (NAP), advocates specialization within each of the different ecological zones in Senegal for defined strata of herding production. This program, entitled the New Agricultural Policy-Herding Sector, in fact is borrowing ideas presented by the Society for Herding Development in the Sylvo-Pastoral Zone (SODESP), created in 1975, which recommends a strategy of herding production according to ecological zones most adapted to each stratum. Birthing (production and maintenance of calves until weaning) would take place primarily in the sylvo-pastoral zone—in other words, the *ferlo*—where the grazing potential is limited to natural forage; rearing (accelerating the growth of young cattle) would be carried out primarily in the Peanut Basin and the Senegal River Valley, where present and projected availability of agricultural by-products for proper nourishment of cattle is good. Fattening would take place near the urban centers (in the region of Dakar and certain towns in the Peanut Basin) where agro-food industries are located (oil factories, flour mills, etc.) The program should encourage

not only considerable growth of herding productivity, but also reduce overgrazing of poor pastures in the *ferlo*.[75]

At the present time, while the herding sector of the New Agricultural Policy is no longer under discussion, SODESP, which represents these interests, is encountering difficulties. One of the reasons given why ecological stratification has not been operationalized is that certain fundamental social parameters within the herder milieu are not adequately being taken into account—particularly for the *Fulbe* of northern Senegal, the principal group affected by the SODESP program and its "birthing" and "raising" components (for the Valley) of the New Agricultural Policy-Herding Sector.

In both components, intensification through the use of inputs is emphasized. With this in mind, SODESP experimented with a program of production credit for herders who signed up under the Contrat d'Assistance pour le Développement de l'Elevage Naisseur (CADEN). Credit takes the form of cattle or inputs such as cattle food, vitamin supplements, or veterinary care. The principle problem appeared to be that herders did not sign up their full herds under the CADEN, but they distributed the inputs they received on credit throughout the whole herd. The result of this practice was that anticipated gains in height and weight as well as in milk production—based on rigorous tests and experimentation—did not materialize for the participating herders, who had been trained, enrolled, and regularly monitored by project technicians (Deramon et al. 1984). Herder liquidity was threatened and program cohesion disintegrated.

It has been hypothesized that the wary herders did not *want* to become deeply involved with SODESP (Deramon et al. 1984). This is partly true, but does not tell the whole story. More importantly, the herders in question could not commit themselves to the extent expected because herders who sign up under the CADEN contract do not have unlimited rights over the herd that they supposedly own and represent. The status of *Fulbe* herds is comparable to that of *joowre* land in the *waalo* (see the section on recession agriculture).

In the world of the *Fulbe*, the herd functions like a family enterprise divided into numerous segments owned by various members of the household, and sometimes even by individuals outside of the household. This form of herd tenure is distinguishable only if a fairly large number of animals is involved. The smaller the herd of cattle owned by a household, the more difficult it is to obtain accurate information about it.

For this reason, examination of the local herd was undertaken using only households that claimed ownership to relatively large numbers of animals. What resulted was a study of a group outside the sample including, so far, only six households in Kaawel. The goal is to expand the

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[75] For the details of this program, see République du Sénégal (1985). MDR/DE. Note technique no. 16. Bilan technique et économique au 30 juin. Dakar: SODESP.

study t ıde 30 or so households located not only in Kaawel but also in nearby *Fulbe* villages and i *erlo*.

able 8.29 depicts the various owners associated with the six herds under study. It simply illustrates the hypothesis. Given the small number of households represented, no generalizations can be made from the information presented here.

8.5.3 Methods of Cattle Acquisition

Many regulations govern a herd because the different animals that comprise the herd were acquired by different means. In Kaawel, the methods of acquisition that have been identified so far are less varied than those noted in the *ferlo*, near Ranérou, by Bonfiglioli and Diallo (1988). It is true that these authors do not specify whether these methods are still practiced or not. Also, the number of large ruminants is much higher in the zone of Ranérou than in Kaawel, and for this reason, herding traditions might be better preserved there.

Inheritance, dowries, gifts, and purchases are the primary means identified by which an individual acquires cattle in *Fulbe* society. Inheritance (*donaadi*) procedures following a father's death are regulated by the Islamic Sharia: a son receives double the amount of a daughter.

The dowry (*tengne*) is given by a man to his wife at the time of marriage, traditionally in the form of cattle—preferably cows—up to 15 head or more. Currently, what is given is what is available—either cattle or money. Marriage also represented an occasion for the bride's family to donate animals to their daughter (*kurtordi*). The bride may brings these animals to her new house or leave them with her parents. Nowadays, more and more frequently, the *kurtordi* animals remain at the parents' house.

Table 8.29 Status of Herd in Kaawel (survey of 6 households)

Owners	Cattle	% of Total	Sheep/Goats	% of Total
Household head	142	44	253	67
Wives of household head	46	14	0	0
Married sons of household head	27	8	8	2
Wives of married sons	19	6	0	0
Married daughters	6	2	20	5
Unmarried sons	46	14	85	23
Unmarried daughters	0	0	6	2
Other men in the household	3	1	3	1
Other women in the household	0	0	0	0
Not belonging to household	34	11	0	0
Total	323	100	375	100

It is traditional for a newly born boy or girl to receive gifts of animals—usually a cow—from his/her parents. This is the *femmbirge*, generally considered to be a preinheritance (Bonfiglioli and Diallo 1988).

The household herd may also include animals contributed by close relatives (*desndaadi*) as well as by people bearing no relationship to the household (*mbereeji*).

A young groom who does not have sufficient capital in the form of cattle to maintain his household can receive an early inheritance from his mother's herd: the *jumtinaadi*. But his rights over this inheritance are restricted as long as his mother is alive.

8.5.4 Implications for Family Herd Management

The status of the family herd in *Fulbe* society is not simple. The rights of household members over all or part of the family herd are clearly defined and strictly respected. The head of the household, despite what one might expect, has limited rights over the family herd. He controls only the animals that belong to him: the *gorwori*. These animals must be managed equitably for the profit of the entire family. The *gorwori* are used to meet the usual needs of household members: taxes (or rural fees), food and clothing for the family, preinheritance for newborns, etc.

In the case of a monogamous family (such as that represented in Figure 8.2), the different sections of the herd—and notably the *gorwori*—are clearly identified, but the management of the herd as a whole is quite flexible. The wife is responsible for the milking and the sale of milk gained from the *gorwori* to meet daily expenses during the rainy season and the cool dry season; she may transfer early her own part of the herd to her married children who have few animals.

In the case of a polygamous family, (such as that represented in Figure 8.3), the wives have access to milk and milk products deriving from the *gorwori* alternating in turn. Perhaps because of this principal function of collective and equitable access to the household head's animals, the *gorwori* is often called *birnajo* (from *biirde*: to milk) in the eastern region of Lake Guiers (see Niasse 1985).

Each wife may have in the herd animals that belong to her, obtained through the dowry from her husband or through gifts from her parents before marriage, for the marriage, or through inheritance. The husband may have some rights over animals obtained in the dowry; with his wife's permission, he may sell some of them. The husband has no control over *sandareeje* animals that the woman obtained from her own parents. Furthermore, these animals often are not integrated with the rest of the herd controlled by the husband but rather kept at the house of the wife's parents (for example, the married daughters from S.S.B and M.S.'s households). In a polygamous household, where individual possessions of each wife represent her personal wealth and her influence within the household, the husband may sell his wives' animals only in cases of extreme urgency. If he is particularly desperate, he may take one animal at a time, alternating among wives so that none is favored over the others.

Figure 8.2 Status of the Herd Among the Peul: A Monogamous Household

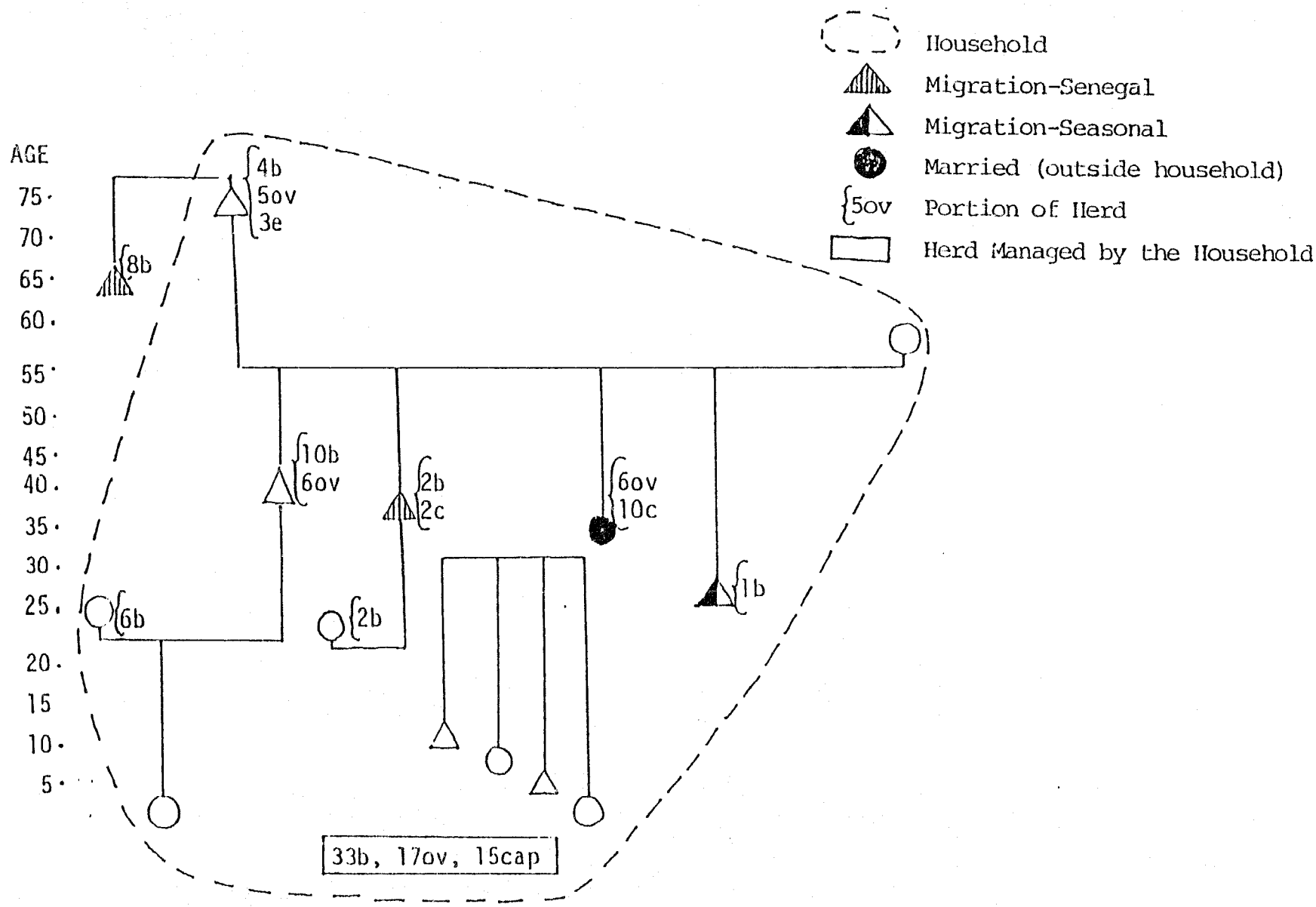
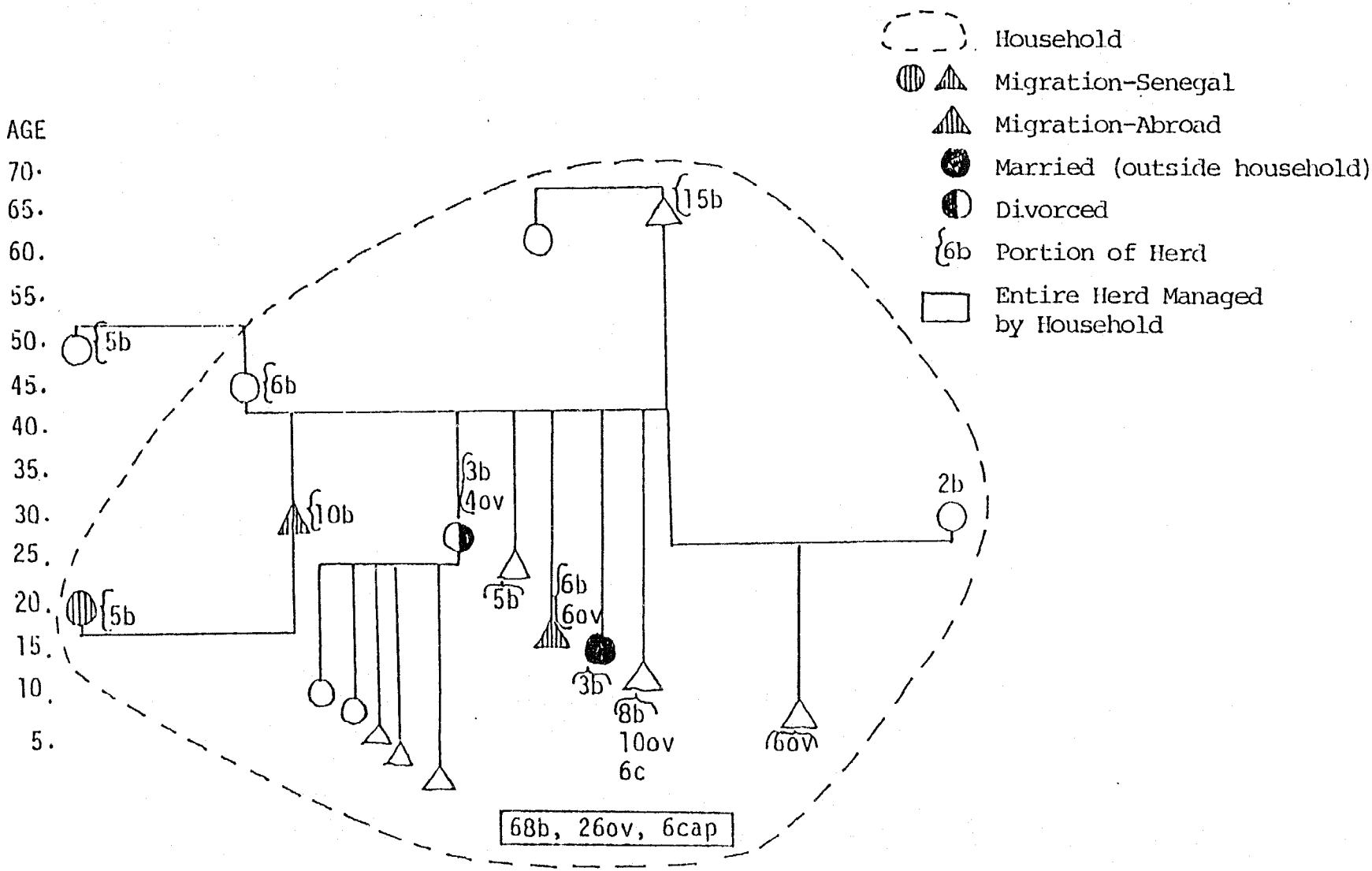


Figure 8.3 Status of the Herd Among the Peul: A Polygamous Household



This situation may be illustrated by the S.S.B. household represented below. The *gorwori* includes 15 cattle, six owned by the first wife and only two owned by the second wife. Corresponding to her position in the household, the first wife (*jeewo*) has access to the milk from the *gorwuuri* and from her personal stock, while the second wife (*lembel*) must content herself with the products from her own two cows. The second wife, when it is her turn, has access to the *gorwori* and her two cows while the first wife makes use of products from her own six cows. The first wife enjoys a privileged position in comparison to her co-wife. In the Lake Guiers region, where the economy of the *Fulbe* households depends more on their herds, this type of organization appears to be more strictly adhered to, since parts of the herd controlled by wives are given special names according to the status of each: *sadaake* for the first wife and *sandareeje* for the second.

The concern for assuring their children's autonomy and their economic independence through preinheritance (Bonfiglioli and Diallo 1988:25-26) is also one of the principal factors of the system underlying the status of *Fulbe* herds.

But the viability of the system seems guaranteed only if it includes a large herd relatively closed to the outside market and to modern logic. If this does not obtain, a number of imperfections will surface:

- If the head of the household does not have a sufficient number of cattle, he cannot adequately provide for the preinheritance of all of this children. The youngest of the children stand to lose the most. Similarly, though he may manage to provide a proper dowry for his first wife, often he will not be able to do the same for the second. This is a source of classic rivalry between co-wives and half brothers in polygamous households.

- If financial needs are high, the head of the household may off-take animals from the *gorwori* first to meet the needs of the household, which may result in serious depletion of the herd. In the latter case, the household ends up depending for its survival on the goods of the wives, who then become more powerful than is usually expected. The margin of maneuverability of the household head is then greatly reduced in terms of the household herd. Development projects concerned with herding would be mistaken in assuming that he is the sole representative.

- The very phenomenon of a reduced *gorwori* should be considered a probable consequence of the method of financing irrigated agriculture in *Fulbe* perimeters such as Saracouro and Diolol. Indeed, herders finance irrigated agriculture mainly through sales of cattle. From the preceding analysis, it is evident that the animals that are sold are taken almost exclusively from the *gorwori*.

- The current context seems to be marked by a perceptible movement of cattle (particularly large animals) from the Valley toward the *ferlo*, whose form and schedule need to be determined. Young men from herding families in the Valley

receive a preinheritance of an insignificant number of cattle and are forced to migrate in order to save money for marriage and the adequate support of their family. In the two cases mentioned, the tendency to migrate is stronger among younger brothers who try to redress the imbalance favoring their older siblings. Knowing that they cannot expect to receive a large inheritance from their father, the *gorwori* already having been exploited, young *Fulbe* herders from Kaawel become herders in towns such as Ourossogui or in distant localities in the Peanut Basin near Sokone, close to the border with Gambia.

- In households where herding activities have been extensively reduced, young people simply distance themselves from the activity and its lifestyle to participate in a process of migration identical in all respects to that practiced in *Toorobbe* and *Sebbe* villages. Currently, dowries appear to be paid increasingly in money rather than in cattle.

- Destitute herders can also find local people who will give them animals under various conditions of management. They may make use of milk and its derivatives, or receive yearly compensation in money or cattle, depending on the size of the herd. A herder who takes care of cattle under these conditions is called a *gaylinké*. Obviously, these individuals are not allowed to make important decisions concerning the welfare of the herd, a situation that sometimes creates problems. For example, the *gaylinké* is forced to pay for diesel at distant boreholes in the *ferlo* where he is obligated to bring large ruminants when the wells are dry near the periphery of the Valley, as was the case this year in the regions of Doumga Rindiaw and Kaawel. Significant cases where a herder cares for a large herd belonging to people settled in large villages or towns in the region who participate in nonagropastoral activities have not yet been identified. This situation would represent an apparent transfer of part of the regional herd from traditional herders to new economic actors.

This analytical sketch of the status of the herd merits more detailed investigation. Herd ownership in *Fulbe* society reveals the difficulties inherent in attempts to better the current situation for pastoralists. Because of a lack of overlap of cattle managers and cattle owners, *Fulbe* herding appears to be compatible only with grazing on unclaimed lands, where the need for labor and inputs is very reduced.

For this reason, we may anticipate a slow improvement in the conditions for herding vis-à-vis traditional agriculture and irrigated agriculture. Using manure for irrigated agriculture would decrease the burden of production fees in the PIVs and would reduce the current rate of offtake. In return, techniques to manufacture better, inexpensive cattle food with the use of local by-products, and to preserve forage harvested in the cuvettes in the *waalo* and in *jeeri* fields, would enable herders to provide better food for their herds during the dry season, a very hard time for regional herds.

8.5.5 Conclusion

Traditional agropastoral activities are prone to precariousness, fragility, and low productivity. Despite these drawbacks, they make use of significant human resources (labor) and land resources in the Valley. The use of labor may be easily justified by the fact that their contribution is essential to fulfilling basic food needs of the population.

During the past few years, an ecological crisis hit the Sahel hard, worsening the state of traditional herding and agricultural practices. The immediate result was an increase in the level of migration.

The level of precipitation as of 1986 appeared to be rising to more normal levels. Hopes were dashed in 1989 when the *jeeri* harvest was practically nonexistent in the regions of Doumga Rindiaw and Kaawel, and negligible in the zone of Boyenadji Roumde. The poor distribution of rain and the infestation of grasshoppers resulted in a severe lack of forage.

Herding activities on the jeeri, on the other hand, increase the chances of survival of bad years. In agricultural households, herding constitutes a discrete and important source of monetary income. Yet the majority of animals in the zone belong to *Fulbe* herders who are severely marginalized from development programs in the Valley. To incorporate herders and herding better into the national development policy, it would be necessary to understand the complex realities of local pastoralism better. Among the questions that demand attention concerning current herding practices is the status of the herd, an issue equivalent in importance to the status of land in the agricultural setting.

8.6 Fisheries

8.6.1 Introduction

Fishing in the Senegal River and the adjacent lateral floodplain is one of the three principal production components of the subsistence-based, regional economy. Historically, farmers, herders, and fishers have interdependently exploited the floodplain's resources. Seasonal changes in the water regime have permitted each group to occupy the plain at a different period in the flood cycle, optimizing the natural potential of the ecosystem. The spatial and temporal compatibility of these different production activities has fostered strong socioeconomic ties among the occupationally diverse groups. Trade of fish, grain, and dairy products has evolved into a set of reciprocal exchange relations that bond the various communities.

In relatively recent times, those bonds have been increasingly threatened by natural and human forces that have disrupted the equilibrium of the floodplain ecosystem. Like farmers and herders, fishers in the river basin have felt the impact of two decades of persistent Sahelian drought. Fishing has declined substantially as a primary subsistence activity, and many fishing households have been forced to abandon their customary practices for such new survival

strategies as wage-labor migration or full-time farming. The drastic drop in fish production has instigated the emergence of a new trade network in which coastal fish trucked in daily from St. Louis have replaced riverine fish as the main protein source in local diets. Women of many fishing caste households (*Subalbe*) have responded to the decline of local fisheries by becoming the primary fish vendors, controlling the coastal fish trade in the river basin.

More recently, construction of the Manantali dam threatens to exacerbate the deterioration—already serious—in fishing conditions in the region. Pre-dam feasibility studies of the impact on the environment warned of a sizable decline in fish populations that rely on seasonal migrations to the fertile floodplain for their spawning grounds (Gannett Flemming 1978). The volume of fish available in any given year depends on the total surface area of the floodplain inundated and the duration of the flood. If annual flooding of the plain is reduced, and water flows from the dam increasingly regularized, the reproductive cycle of freshwater fish will be increasingly threatened.

In light of possible continuing declines in the riverine fish population, the livelihood of an estimated 10,000 fishers[76] throughout the valley is at risk (Grosenick et al. 1990b:110). Proposals to incorporate slowly disenfranchised fishing communities into new agricultural schemes, such as PIVs or intermediate-sized perimeters, may encounter some local resistance. In preliminary interviews many fishers at one of the research field sites in this study expressed strong opposition to the idea of becoming full-time rice farmers if fishing eventually became unviable as a major means of subsistence. Instead, they voiced their desire to begin migrating seasonally to the southern Casamance region where conditions for fishing are good. At present, fishing grounds in the Casamance generate substantial cash revenues for many fishers from the Senegal Valley who are increasingly embarking on seasonal fishing expeditions as conditions continue to decline at home.

8.6.2 Monitoring Fishing Activities

8.6.2.1 Sample Households

By closely monitoring the food consumption patterns of sample households, the SRBMA study has been able to gauge the importance of local fish production in their nutritional regime. An analysis of household budgets in section 10 of this report reveals that in Thiemping, a riverine village, fish imported from St. Louis has replaced local freshwater fish as the main source of protein.[77] Imported fish accounts for 11.1 percent of total food costs while riverine fish accounts for only 1.4 percent. While these figures cover only household spending rather

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[76] Fishing is carried out by men only; women predominate in marketing the catch.

[77] This is based on a biweekly monitoring of 15 households in Thiemping during a twelve-month period from December 1988 to November 1989. A methodological discussion of all field activities undertaken is summarized in an earlier section of this report.

than actual quantities of local fish consumed, the proportion of riverine fish in the local diet can be assumed to be small, as few families continue to fish in the village either full or part time.

For families who do continue to fish regularly, figures from one Thiemping household show that fishing can potentially provide sizable family revenues in some instances. Monitoring the fish catches of the most active, proficient fishing household in the village during the study period reveals a daily income of almost 2,500 FCFA. This revenue alone provided the household with an annual gross income almost twice that of the average for the study sample.

A second site, Thially, ten kilometers upstream, was selected early in 1989 to exemplify a village that depends heavily on both irrigation and fishing. In contrast to Thiemping, Thially landholding in the waalo and falo is located primarily across the river in Mauritania. Thially villagers rely considerably less on these traditional production systems than do those of Thiemping, however. The sociocultural features of the village are divergent as well. Thially is much more homogeneous in its caste composition, made up largely of the Subalbe fishing caste and the Toorobbe maraboutic caste, who reside in separate village quarters.

Four households from the fishing caste were chosen randomly to study fishing strategies. Within several months after these households were selected, hostilities erupted on the river between Senegal and Mauritania, severely curtailing fishing.[78] Those families studied who rely on fishing as their primary occupation became almost totally dependent on family members and the village community at large for their physical and economic survival.

8.6.3 The Seasonal Fishing Cycle

Fishing methods in the Senegal Valley occur in a range of different microenvironments that extend from the main channel of the river to the stagnant ponds that remain in the floodplain during the dry season. Techniques vary from season to season and are well attuned to the annual fluctuations in rainfall and changing hydrological conditions of the river. Fishers migrate seasonally, following the reproductive cycles of the freshwater fish as they move downstream and enter the floodplains to spawn during the height of the rainy season. As the floodwaters recede, fishers follow the return migration of fish in the channels as they swim back to the river.

The fishing cycle is marked by four seasons: *ndungu, kawule, dabbunde,* and *ceedu.* Beginning in mid-to-late June, early rains signal the arrival of the short and unpredictable rainy season known as *ndungu.* Within a few weeks the river may rise considerably, and by July the channels extending laterally into the floodplain begin to fill. The rate at which the various basins are inundated varies according to the morphology of each floodplain. By late July or

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[78] Attempts systematically to follow the fishing strategies of these families were thwarted as a result of the regional conflict. Most fishermen in Thially were forced to abandon their activities on the river, nor did they fish the floodplain during the 1989 rainy season. When asked why, many indicated that the village had no history of fishing in the waalo.

early August, much of the area is flooded and fish from the main river have begun migrating into the floodplain in search of nutrient-rich feeding grounds for spawning. Early on, fishers residing in villages such as Navel, near Matam, situate themselves strategically at the mouths of the major floodplain channels and seine for fish migrating into the channels toward the inner floodplain. This period, known as *uddude* (to close the door), is one of the most active periods of fishing and provides some of the largest fish catches of the flood season.

As the flood approaches its peak, fishers pursue the fish migration by way of the river channels (*cangol*) into the floodplain. They can reach the area either in small dugout canoes (*lana*) or on foot if they live close to the fishing grounds. In the largest floodplain near Thiemping, Cangay Dow Seyji, they arrive by canoe from nearby villages such as Kanel, but they may come also from fishing communities more than 30 kilometers away, like Mbakna, a small fishing caste village just north of Doumga Rindiaw. The most active fishers may remain in the floodplain for several days or weeks depending on fishing conditions, setting up small camps on the higher *foonde* soils of the basin (*toggere*) that have not been flooded. In Thiemping, a woman would arrive occasionally from these small floodplain camps to sell the day's catch in the village market. Several fishers from Thiemping also fished the floodplain at this time, going each evening by foot to set their nets and returning in the early morning hours to take in the catch. Fish harvests on the floodplain continue until the waters recede in late September, when fishers return to the confluence of the channels with the main river to await the return migration of fish as they follow the retreating current downstream.

This marks the arrival of the second season, or *kawule,* when a short hot season returns during the months of October and November. Much of the fishing activity resumes on the river at this time, and it continues into the following cool season, *dabbunde,* which begins in late November and ends by mid- or late-February. Increasingly, fishing becomes concentrated in the deepest depressions of the river (*luggere*) where the richest feeding grounds and the densest fish populations are to be found. It is this geomorphological feature that has determined the historical location of many of the small fishing caste villages on the Senegal River. Thially Subalo and Dolol are two area fishing villages near Thiemping situated near deep depressions in the main bed of the river.

Fishing can begin in the small marsh areas as early as February, depending on the extent of flooding. Dry-season fishing of the pond areas occurs at a time when fish populations have declined in the river as a result of diminished watershed levels emanating from upstream.

Within the fishing communities, institutional mechanisms have evolved locally to protect the various fish populations during this period. As feeding grounds are sparse and fish stocks are low, a communal sanction is enforced to prohibit all fishing of the deep pools (*luggere*) during a three-to-five-month period, depending on the status of fish populations and the general hydrological conditions that have developed during the course of the flood season. This annual "closing" of fishing rights on the river, *cokde,* occurs near the end of the cool, dry *dabbunde* season, usually in January or February. The magnitude and duration of flooding of the waalo area is critical in this respect, since an adequate flood permits an extended period of fishing in

the small residual floodplain ponds that complement the period of closure of fishing rights on the river.

The resumption of fishing on the river occurs during the hot, dry period or *ceedu*. The "opening" of the new fishing season usually begins in March and is marked by an important period of communal fishing of the deep pools known as the *cokte*. Historically, fishers would gather in small groups at the pools (luggere) in years of ample flooding to fish with large nets (*caambal*), which usually require from 10 to 20 men. Fishers will often travel considerable distances by canoe to participate in the *cokte,* migrating from site to site. This festive event has become rare on the river during the past decade as a result of the extended period of low rainfall in the region and the consequent decline in the fish population. The *cokte*, which signals the beginning of the annual fishing cycle, may continue until the arrival of the new rainy season in June or July.

For some fishers, farming may become a subsistence activity well integrated with fishing on the river during the retreat of floodwaters. Many fisher households of Thially Subalo temporarily leave the village to set up seasonal camps on the banks of their river plots or falo gardens near the village. Thially fishers own falo fields on the Mauritanian side of the river that may approach one hectare or more in size. In years of good flooding such as 1988, harvests of corn, squash, melon, tomatoes, and sweet potatoes may be considerable and represent a primary agricultural crop comparable in volume and value to that of the waalo for many other farmers. Unfortunately, much of the falo crop that had been harvested and stored in the fields was abandoned as the fishers were forced to flee the river banks and return to their villages at the outset of border hostilities on the river. Farming the falo is well adapted to the fishing strategies of the fishers in the dry season. Fishing and farming during this time permit many Subalbe households to survive by combining small cash revenues from their daily catches—as the women sell the fish in nearby villages such as Thially and Odobere—with consumption of much of their falo crop. This compatibility between falo cultivation and dry season fishing on the river allows fishing families like those in Thially to hold their other seasonal crops (from rainfed, recession, and irrigation harvests) in reserve in the village to be consumed on their return during the rainy season. This customary complementarity of fishing and farming systems has been severely disrupted by the border conflict, which now poses grave threats to the future well-being of fisher households, such as those from Thially, who no longer have access to their falo fields.

8.6.4 Organization of Labor

Fishing is usually carried out by two or three members of the household unit (*fooyre*) and most often involves the male head and one or two sons. Only on rare occasions such as the *cokte* do fishers organize in larger groups for a particular task. Frequently one man paddles a canoe while the other casts or gathers in the line or fishing net. Many fishing techniques are carried out by a single individual, particularly those using certain kinds of nets. Occasionally villagers construct dams to trap fish; these are made of either clay soils or branches and limbs

from trees. Depending on the size and location of the structure, several fishers from the same village may be needed for the task.

A clear gender division of labor exists in fishing, as women household members are responsible for the preparation, preservation and selling of fish in local village markets, while men fish. Fishing ordinarily occurs during two periods of the day: dawn and dusk. Fishing lines may be set in the morning and checked in the evening or vice versa. Most fish catches are taken early in the day and sold soon after. One woman in the household, frequently the male head's spouse or one of the daughters, will sort the fish species and reserve a part of the catch for the family's needs. In most instances, the subsistence requirements of the household will be met first. Any remaining quantity will then be sold and a portion or all of the cash earnings spent on the family's needs for other food items for the day's main (midday) meal. Imported rice and ingredients for cooking sauces are often the priority purchases.

In Thially, women leave the village early each morning, carrying large bowls of the day's fish catch on their heads to the most populous neighboring village in the area, Odobere. Here, the demand for fish is high and the women vendors are able to obtain prices above those in their own village. Odobere women frequently hurry to reach the vendors at the edge of the village in order to buy fish before it sells out in the local market.

The extent to which men or women control the cash earnings from fish is variable, related to demographic or domestic features unique to households. In several instances, the mother or spouse of the man heading the household determined the manner in which the day's revenue was to be spent. In another household, where revenues were considerable, the male head spent a large portion of the earnings to invest in new equipment and reconstitute the household's small livestock herd.

8.6.5 Fishing Methods

Fishing techniques are numerous and well adapted to their particular hydrological environments. Because capital is scarce, equipment is rudimentary, involving such low-cost materials as wooden, hand-dug canoes, nylon fishing lines, and simple gill nets of several sizes. The techniques employed vary according to the location (river, channels, floodplain, and ponds), the species of fish desired, and the time of year.

The main river is most often fished with a series of up to 3,000 fish hooks attached to a small pole. The hooks or *dolinge,* vary in size according to the species to be fished. Numerous gill nets are used as well, the most common termed the *caambal.* A specific type of *caambal,* the *sakite,* is used in the floodplain and at the entry to the floodplain channels, where it is set in the evening and retrieved the following morning.

Fishing in the ponds and small streams that remain in the floodplain in the dry season frequently involves the use of different netting methods that may easily be carried out by one person. These nets, including the *anja-njaara, duyru,* and *jawli kofe* are attached to small

wooden poles that are held manually and manipulated skillfully and quickly in the shallow waters. While such activities are usually carried out by individuals, nets such as the *jawli kofe* are handled in groups of 20 to 30 fishers who fish the ponds in a large circle, moving slowly inward toward the center.

Fishing is also carried out by constructing dams and trapping fish inside them. A common form of bunding and bailing, known as *wecu beli,* occurs in ponds as they are drying out. Small wattle and daub (*leydi e bakkere*) dams, known as *gambol,* are constructed, and water is then bailed out of the particular area until only the fish remain. This method is especially labor intensive and usually requires two or more individuals. A similar dam-building technique, *parka,* involves the construction of two dams in a small stream in the floodplain, one or two meters apart. Water is bailed out of the area between them; then fish migrating in the stream jump over these small dams into the dry middle area. A final dam technique, *mbargu,* is found in large, deep floodplain channels, such as the Diamel and Diolol in Matam Department. Large tree branches, several meters high, are placed close together in the soil bed of the channel prior to the flooding season. These substantial dams require a significant amount of communal labor to organize and build. Men subsequently fish by canoe around the dam, which prevents some fish from swimming into or out of the floodplain.

9. The Role of Irrigated Agriculture in the Production Systems of the Middle Valley

9.1 Introduction of Irrigated Agriculture to the Middle Valley

The first years of drought gave proof of the extreme precariousness of traditional agricultural production. Climatic irregularities at this latitude can nullify a year of agricultural work. During the late 1960s and early 1970s, the food situation was critical. Even though Sahelian-type crops are adapted to a short growing cycle (three months on average), a ten-day rupture in the pattern of rainfall or a deficit amount of precipitation can still greatly reduce the likelihood of a successful harvest. Faced with dependence on an undependable climate, planners could not count on the improvement of traditional agricultural production methods. Because any amelioration would require, in one way or another, breaking away from meteorological constraints, priority was accorded to irrigation schemes. Thus, the Senegalese government requested help from international development organizations in order to combat the rapid decline in food security through irrigation, especially in the northern part of Senegal.

In the Middle Valley, SAED was given the mission of furnishing the maximum number of families with the means of providing a secure source of food, regardless of climatic variation. Only irrigation from the river would permit local populations to overcome negative climatic variations. SAED was not able to provide, first for financial and then geomorphological reasons, the type of irrigation schemes established in the Delta. What type of scheme could be introduced, then?

SAED, aided by FAO and funding from the UNDP-OMVS "Programme de lutte contre la sècheresse" introduced to Matam the principles of the small perimeter in 1974. In 1976, with the additional support of SATEC (Société d'Assistance Technique et de Coopération, Paris) under FAC funding (Fonds d'Aide et de Coopération, Paris) and CCCE (Caisse Central de Coopération Economique, France) SAED assigned itself a triple objective for the establishment of small Irrigated Village Perimeters (PIV):

- increase revenues in order to limit the rural exodus,
- provide farmers with training in irrigation and new crops,
- establish village organizations capable of insuring the long-term viability of the project (SAED; SATEC 1976).

9.2 The Perimeters in the Present Context of the Après-Barrage

The development of the Village Irrigated Perimeters in the Senegal River Valley during the last fifteen years has been spectacular. In the Department of Matam, for example, the number of small perimeters grew from 3 in 1974-75 to 8 in 1975-76, to 62 by October 1978, and 92 in 1980; in July 1985 the Department counted 176 perimeters, and 215 in October of 1989 (Lautier and Berger 1981; Ministère Français des Relations Extérieures et al. 1982; and

the SAED Délégation, Matam, personal communication). In 1985, 522 small irrigated perimeters on both banks of the Senegal River covered a total surface area of 10,000 hectares and served 35,000 households, or half of the inhabitants of the Senegal River Valley (Diemer and Van der Laan 1987:47).

But now, irrigated agriculture on a wide scale in the Senegal River Valley, and Irrigated Village Perimeters in particular, face problems. We discuss these irrigation problems in a study of recession cultivation because, first, irrigated agriculture has become one of the traits characterizing the physiognomy of the Valley. For many households on both sides of the river, it has become a component of their production systems. These systems would be incomprehensible without information concerning the problems created by irrigation. A unique experimental model of agricultural intensification on a large scale in the Valley, irrigation and the difficulties associated with it provide many useful lessons for the future. If recession agriculture is to be maintained—a desirable goal—the conditions of its practice must be improved. Lessons learned from irrigated agriculture allow us to understand: (1) just how far one can go with intensification that demands increased labor input; (2) to what point modernization that requires the use of agricultural inputs can be tolerated; (3) to what point the dynamics of producer organization and land tenure practices could become either harmful or helpful.

Allegedly requiring very low management costs compared to large- and medium-scale perimeters run by SAED, Village Irrigated Perimeters at first raised high hopes. Several considerations other than financial underlie what some authors have not hesitated to label "a small-scale social revolution" (Schmitz 1986:52). In the first place, the PIVs were expected to promote the emancipation of social strata that are discriminated against by the customary hierarchical land tenure systems. Diemer and Van der Laan (1987:14), in fact, found the same proportions of freemen and slaves on the perimeters they studied as in the village. Next, the PIVs would supposedly help slow the rate of emigration in villages where they are established. Finally, with production at least comparable to that obtained on medium and large-scale perimeters, the PIVs would have the advantage of guaranteeing a large degree of autonomy to their producers who, farming small surface areas (typically averaging .2 to .3 ha), are faced with lower operating costs.

Not only did different specialists in irrigation and in the Senegal River Valley extol the presence of the Village Irrigated Perimeters and general small-scale peasant production, but also peasant societies, which until then had always been suspicious of innovations introduced from the outside, were successfully motivated over a relatively short period of time. What formerly the colonial administration had not achieved over the course of a century, even with the use of force, seemed to have been achieved with ease.

The first generation of PIVs has now been in operation for 15 years. Both infrastructure and equipment (over which there is considerable mastery), and the producer organizations (about which much less is understood) first to plunge into this venture, are beginning to show the effects of time.

During the "golden age" of small irrigation schemes, the ecological conditions were not conducive to other traditional activities: from 1975 to 1986, recorded rainfall at Matam station never exceeded 400 mm. Higher levels have been registered since then. At the same station, the maximum flood reached 7 meters on the limnimetric scale only four times between 1975 and 1987. Since 1988, because of the Manantali Dam, farmers know that they can count on a more regular flood.

Since 1984, Senegal has engaged in a program of economic liberalization that has included the withdrawal of the State and of its interventionist branch, SAED, in the Valley. It is only now that the consequences of this process—as yet incomplete—are becoming clear.

The PIVs, which in comparison to large- and medium-scale perimeters constitute the simplest, most flexible, least constraining, and therefore the most easily "transferable" type of management, are the criteria by which to judge whether irrigated agriculture has been well accepted in the Valley.

The analysis of irrigated agriculture will center on the following issues: (1) land tenure; (2) the immediate causes and effects of the organizational weaknesses of producer groups; (3) sources of funding for irrigation, which will permit an understanding of the reaction of peasants to problems posed by cost increases accompanying the progressive withdrawal of SAED; (4) production levels obtained and yields achieved. They provide the opportunity to measure the concrete impact on households of changes in irrigated agriculture; (5) solutions desirable from the villagers' point of view and feasible from a practical point of view, as well as lessons that may be drawn from the practice of irrigated agriculture for future development plans in the Valley.

During the past two decades has led the Senegalese government to take successive measures to revise irrigation development policy and introduce new strategies that are more compatible with the resource constraints of the population. In particular, intermediate-size perimeters (Casiers Intermédiares) which combine various features from large and small schemes, are now being promoted as the future model for irrigation production in the Valley. Analysis will therefore seek to enhance our understanding of irrigation on a larger scale by focusing attention on the Casier Intermédiaire as well as on the PIV.

9.3 Research Sites

The data are drawn from a representative sample of households participating in small-scale village perimeters, or PIVs, in Doumga Rindiaw, Tiguere Cire, and Thially. The various aspects of production were monitored in these villages for a complete agricultural season. The Doumga study is complemented by a less exhaustive treatment of small-scale production in four neighboring sites: Saracouro Dialloubé, Diolol Diaobé, Mbakna Less, and Mboloyel. The populations of these villages feature a diverse mix of caste groups and thus provide a broader view of the strategies undertaken to finance the high costs of irrigation and the varied nature of land tenure relations within the sites.

A discussion of small-scale perimeters will be followed by an assessment of the first season of production (1989) in the most recently established *casier intermédiare* in the Matam region, a 1,004 ha scheme located at Hamady-Ounaré.

9.4 Analysis of Small-Scale Village Perimeters

Various elements of production in ten village perimeters in the Department of Matam were monitored from October 1988 to April 1990. In Doumga Rindiaw, labor and production data were gathered for six households cultivating seven fields during the 1988 rainy season at Bosséa I, the village's first perimeter, created in 1978. This is supplemented by information gathered on land tenure relations and the capital costs of production on Bosséa I and on a second village perimeter (established in 1982), Bosséa II. These same aspects of irrigation are also examined in four neighboring perimeters for the 1989 wet season (in the aforementioned villages). A third village perimeter, Bosséa III, will begin its first year of wet season rice cultivation in June 1990.

Irrigation activities were also followed in two perimeters at Tiguere Cire. In Tiguere Cire II, rice production was monitored for 16 households during the 1989 wet season. In addition to rice cultivation, many village perimeters in the Matam region engage in irrigated vegetable gardening during the cool, dry season beginning in December or January and extending into the hot season as late as June. This aspect of off-season irrigation provides households with critically needed fresh vegetables during the long hot dry months of the year, and in some instances provides cash revenues from the sale of garden produce. This facet of production is represented by a 1988-89 study of dry-season onion cultivation on 31 field plots in the Tiguere Cire I perimeter. The perimeter members sell onions in the local market to earn revenues sufficient to reinvest in rainy season irrigated rice production.

The final site of small-scale irrigation represented in this study includes two perimeters, Thially I and III, in the village of Thially, approximately 27 km upstream from Matam. Labor time and crop yields were obtained for all PIV members (55 field plots) farming in the two schemes during the 1989 rainy season.

9.4.1 Land Tenure Relations

The study of ownership of land devoted to irrigated agriculture shows which social categories will benefit from the Après-Barrages, at least in the irrigation sector. Since the creation of the 1964 Law of National Domain, Senegalese land reform has not proven to be particularly efficient. It is true that in many rural zones in the country it was established without major obstacles, but this occurred mainly where land is of limited value because of poor soils and inadequate rainfall, resulting in very flexible forms of traditional land tenure.

The Senegal River Valley with its flooded and/or irrigable lands provides a different picture: the soils are among the richest in the country and suffer from fewer constraints associated with lack of water, because of the presence of the flood and irrigation potential. Land

tenure customs are deep rooted. With the recent construction of the two dams on the river, one could say that the Valley is the first large scale test of the viability of the land reform in rural Senegal, and of its capacity to promote agricultural development.

9.4.1.1 The Principle of Democratization of Land

A key position taken in favor of expanding irrigation production at the expense of recession cultivation is the argument that modern agriculture permits a more equitable distribution of land that has been traditionally controlled by ruling elites in a hierarchical, caste-dominated society. A study of the evolution of land access in three village perimeters at one of the principal sites of research investigation, Doumga Rindiaw, suggests that the democratization of land is somewhat illusory, being dictated more by the laws of supply and demand than by a system of equitable land allocation to all members of the community. It depends on the level of development of irrigation, and on the degree to which peasant demand for irrigable plots is being met. Peter Bloch (1987) notes cases in the Bakel region of immediate claims to PIV land by members of the traditional aristocracy. But he does not explain what might have occurred if the supply of irrigated plots exceeded the village demand for them.

The example of Doumga Rindiaw (see Table 9.1 and Figure 9.1) reveals that as long as the supply of PIV parcels is lower than the demand, the social elite will remain the privileged group. The village of Doumga Rindiaw includes approximately 1,400 inhabitants distributed among 163 households who have access to two irrigated perimeters. The first dates from 1978 and the second from 1982. A third scheme is under construction. Each of the 64 households

Table 9.1 Evolution in Caste Access to Irrigated Parcels as Supply Increases; The Case of Doumga Rindiaw

Castes	Villag	% Villa	All PIVs	% PIVs	PIV I	% PIV I	PIV II	% PIV II	PIV III	% PIV III
Tooro	96	59	100	68	47	73	44	69	9	45
Fulbe	10	6	1	1	0	0	1	2	0	0
Jaw/Se	16	10	15	10	8	13	3	5	4	20
Safal	4	2	1	1	1	2	0	0	0	0
Nyeen	5	3	5	3	2	3	2	3	1	5
Maccu	31	19	26	18	6	9	14	22	6	30
Wolof	1	1	0	0	0	0	0	0	0	0
Total	163	100	148	100	64	100	64	100	20	100

forming the first PIV hold .30 ha for rice cultivation. The traditional *Tooroodo* elite clearly dominate the producer group (73 percent, although they comprise only 59 percent of the surveyed households). Descendants of slaves (*Maccube*), who represent nearly a fifth of the village households, control only 9 percent of all plots in the scheme. Despite this, even using

this perimeter as the sole example, irrigated agriculture is more accessible to traditionally disadvantaged social strata than is recession agriculture, because only households belonging to noble castes can hold the right to be master of agriculture for floodable cuvettes in the village.

With the establishment of the second PIV—64 plots of .20 ha each, *Tooroodo* pressure diminished noticeably in favor of an improved representation of the slave caste: 69 and 22 percent of the plots were allocated to *Toorobbe* and *Maccube* households, respectively.

With the proposed third producer group planned for the new PIV—which has vegetated since 1985 but could commence operation in the rainy season of 1990—the same tendency holds. Of the 20 members who presently make up this group, 45 percent are members of the *Tooroodo* caste, and 30 percent are members of the *Maccudo* caste.

On the whole, the distribution of household types in the three PIVs closely parallels that in the villages. The overrepresentation of *Toorobbe* is in contrast with the underrepresentation of the Fulbe, who have demonstrated little interest in irrigated agriculture.

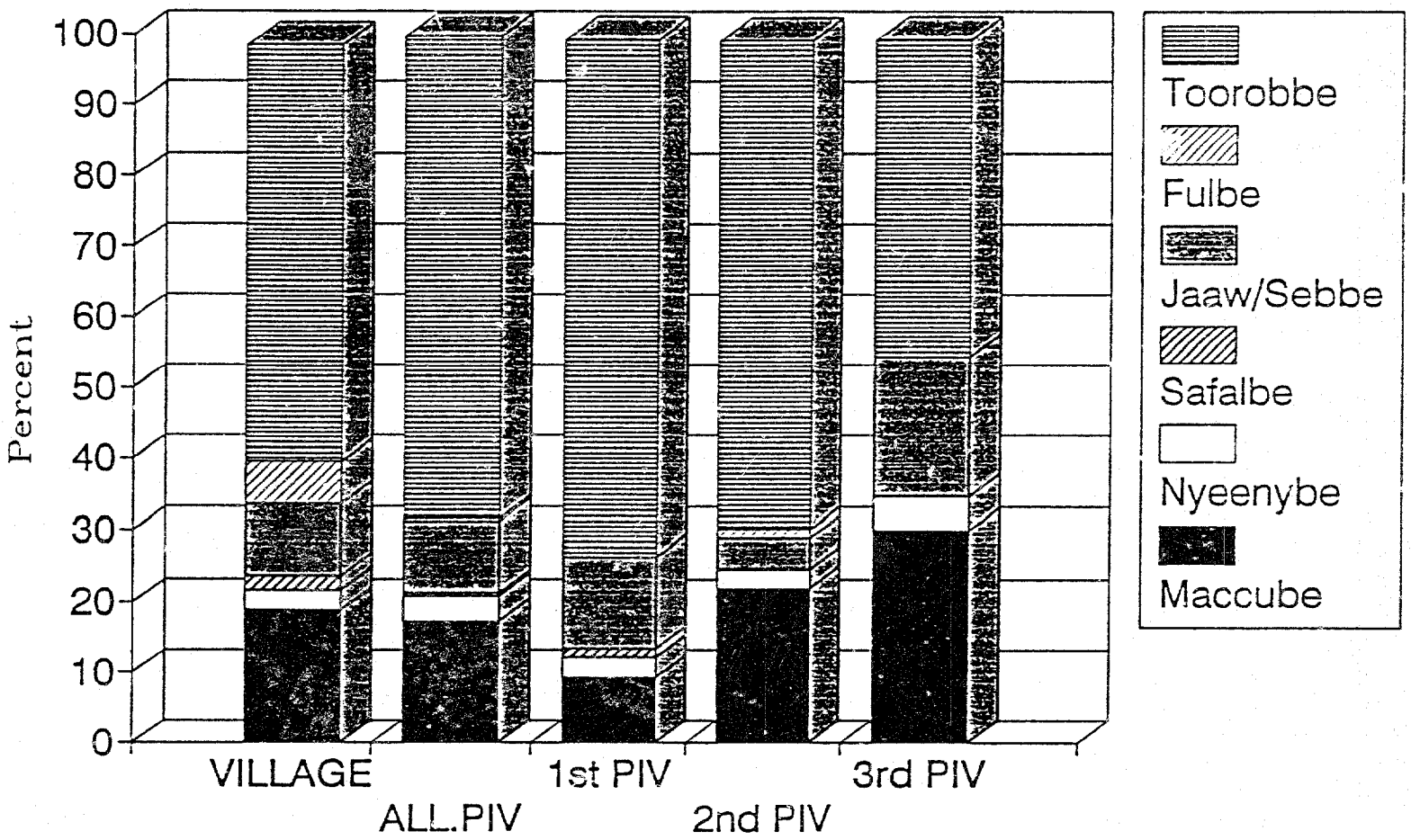
9.4.1.2 Association with *Waalo* Land Tenure

To understand the development of differential access of social categories to irrigated parcels according to the degree of completedness of the perimeters, it is necessary to relate it to the realities of the *Fuuta*. Initially, when the demand is clearly greater than the supply, control of land by the elite is confirmed, even if it is not complete. The principle generally applied to villages has as a goal to serve equitably and progressively all carrés. The oldest members of the carrés are the first to be served. As additional PIVs are established, other married males are allotted plots, often according to rights of seniority.

How can it be explained, then, that the lower castes, such as the *Maccube*, are disadvantaged in the distribution of the plots in the first scheme in Doumga Rindiaw? The answer lies with the fact that in contrast to the *galle*—a unit of residence in which members of the same lineage segment belong to the same caste—the carré is a political unit that has no residential continuity nor caste homogeneity. The carrés of the most influential dignitaries may include not only the members of their *galle*, but their "unfreed" *Maccube* and their families.[79] For this reason, the representation of *Maccube* in the village in terms of *galleeji* or of *pooye* (19 percent) is higher than their representation in terms of the carrés, a certain number among them

[79] The size of a carré often reflects the political influence of its leader. Because of this, the leader becomes an important constituent with the capacity to mobilize a large number of "votes" during tumultuous elections and periodic meetings. Certain carrés may include more than one hundred people. Their leaders are privileged targets of local politicians. Another advantage of being the leader of a large carré is the reception of large portions of distributed foods. This explains the interest in registering in a carré all migrant relatives, even if they reside for the most part outside the village with their families.

Figure 9.1 Access to the PIV for Caste Groups; the Case of Doumga Rindiaw



then being subsumed within the carrés of their "masters." The result is that, whatever their age may be, they can then be among the last to be served in the PIVs. In addition, in certain localities in the Fuuta, the carré "trick" is used by certain dignitaries to gain control of several parcels, by using borrowed names of "slaves" and of permanent migrants, a situation we have not observed in Doumga Rindiaw. In any case, and as was just noted for Doumga Rindiaw, differential access to irrigated land by different social strata lessens as the supply of parcels increases.

Priority rule with respect to seniority rights in the carré seems to have originated in the *joowre* in the *waalo*, where the eldest member of the lineage clearly enjoys favored access to land. In the *waalo*, he not only manages the lands belonging to the lineage, but controls the largest of the fields (*ngesa mangu*). His juniors have access to smaller plots (*ngesa cukka*). If there is not enough land under the jurisdiction of the lineage they may find themselves without land.

In the case of irrigated land, the principle of elders before juniors, "masters" before "servants," men before women—the latter having practically no access to land—constitutes a factor of persistent injustice which, in certain cases, hinders the optimal use of irrigated land. Some of those who are in greatest need of irrigated land and who have access to adequate labor and capital may—in circumstances where there are not many plots available—be excluded from this type of agriculture in favor of individuals who have neither the motivation nor the means to make good use of the land attributed to them.

9.4.2 The Deterioration of the PIVs over Time

When a PIV is established, individuals interested in irrigated agriculture form a producer group and obtain rights to land from the Conseil Rural de la Communauté Rurale within their jurisdiction—an administrative structure established in the region of Saint-Louis in 1980. Subsequently they must consult SAED, which, until its recent withdrawal, provided infrastructure, supplied pumps, presided over the distribution of land by the drawing of lots, and provided technical training to producers. Until 1986, SAED also supplied inputs to producers.

After that, no major obstacles hindered the efficient functioning of the perimeter for the first few years: the producers were generally motivated and present in the villages. Rich or poor, they could count on SAED to pay the heavily subsidized production fees that were reimbursed at the end of each season. The proportion of cultivated land within the managed surface area was therefore very high.

The mass exodus of producers from the PIVs in the Department of Matam seems to mark the end of the period of euphoria. The present situation in the PIVs is problematic, given the low level of production on the perimeters, and, quite bluntly, the large number of abandoned schemes. How did this happen?

Field observations of declining participation in village perimeters at all three research sites—Doumga, Tiguere Cire, and Thially—indicate that irrigation performance is increasingly beset by three major obstacles: (1) rising capital costs of production that exceed the financial capacities of the scheme participants; (2) chronic labor shortages as families continue to opt for off-farm revenues derived from migratory earnings. The extent of this emigration is exceptional in the Valley, especially in the Department of Matam and Bakel (SCET-AGRI 1983:9). And (3) a loss of organizational cohesion in the perimeters as the membership and social composition of scheme cooperatives change over time.

In the perimeters of Doumga, the gap is growing between those with adequate labor and capital to farm the schemes and those who actually possess the fields. Plots that were originally allocated to carré heads who are often of the same age grade (*fedde*), are being inherited by their wives or children at the time of their death. These beneficiaries are frequently unable to participate in the crucial decision-making processes at the village level, and thus the organizational cohesion of the local institutional structures for management of the perimeters begins to disintegrate. Often the beneficiaries do not have the labor or capital to farm the perimeters. Inevitably, then, their fields lie idle or are loaned or rented out to others capable of farming. The result is an increasing disjunction between *de jure* land tenure status and *de facto* land use. In Bosséa I in 1988, only about one-half of all field owners (54 percent) were able to farm their own plots. The remainder rented out their fields on a tenancy basis, covering the capital costs of production and receiving half of the harvest.

In the Thially perimeters as well, one observes a pattern of progressive abandonment or transfer of plots from field owners who are short of capital or labor to those well endowed with these resources. In Thially I, which began operation in 1975, only 4 percent of the field owners (3 out of 72) continue to cultivate their own plots. During the 1989 rainy season, only a quarter of the fields (18 out of 72) were being exploited. The phenomenon of increasing indebtedness of the farmers and their subsequent tendency to drop out of the perimeter to establish new ones, free of debt, is well illustrated in this example. In 1985, 54 percent of the PIV members (39 out of 72) were forced to abandon the perimeter because of outstanding debts to SAED for the loan of fertilizers. Later in 1985, these members created a new perimeter, benefiting from new subsidy inputs from the government. This movement of farmers from one scheme to another after accumulating heavy debts may be described as a strategy of "shifting irrigation" that has been observed elsewhere in Matam Department perimeters (Nuttall 1989). The growing weight of financial responsibility that has shifted from SAED to individual producers since 1986 has led 13 additional members in Thially I to abandon their parcels. Of the 18 plots cultivated in 1989, one-half were exploited by individuals who resided in the village but were not members of the scheme cooperative.

Even a much newer village perimeter in Thially—Thially III—which was established in 1985, has begun to experience a rapid decline in participation of its members since the withdrawal of government support. After just five years, this perimeter has an attrition rate of 50 percent; only 39 of the original 79 field plots remain in production. Of the farmers remaining in 1989, approximately one-half allowed their plots to be loaned or sharecropped,

indicating that membership in this perimeter, as in the older ones, suffers from a shortage of operating capital and/or labor.

In the Tiguere Cire II rice perimeter as well, fewer than one-half of all field owners (16 of 36, or 44 percent) were able to exploit their own plots during the 1989 rainy season. As in the perimeters discussed above, farmers cite the prohibitive production costs that had been previously assumed by SAED. While no cases of sharecropping were observed, 6 of the 16 fields (37.5 percent) were loaned out to other farmers.

The examples presented here show that the Senegalese government's rationale of expanding irrigation in order to democratize access to land is challenged increasingly by the socioeconomic realities of an impoverished population incapable of assuming the financial burden of agriculture that requires high capital input. As farmers become progressively indebted following the recent shift of costs to the producer, a process of "disguised wage labor" as observed in the Doumga and Thially perimeters takes place. Farmers short of capital but with sufficient labor power sharecrop the fields of landholders who find themselves in the opposite situation. Thus, the government-expected democratization of land is not taking place. A decreasing number of rich farmers finance the capital inputs of a growing majority of cash-poor farmers who are no longer able to cultivate their own fields. The long-term product of this polarization may be increasing disparities in access to land and an intensification rather than diminution in the level of socioeconomic stratification among smallholders in irrigation.

9.4.2.1 The Problem from the Farmers' Perspective

A superficial examination of the inadequate performance of village perimeters and the rising dropout rate of PIV participants may easily lead one to attribute the deficiencies to such technical aspects of production as the malfunctioning of irrigation pumps, or poor ground leveling and canal construction during the construction of the perimeter. However, socioeconomic considerations—which are often much more difficult to discern—may explain a large part the decline in perimeter performance in recent years. After the harvest, we distributed a questionnaire to all individuals who had access to plots in Bosséa I and II, whether they had cultivated their land or not, to determine the exact reasons why the plots had been abandoned.

In Doumga Rindiaw, we surveyed 73 participants in the two perimeters to determine why owners abandoned their field plots. At first glance, an inoperative motor pump appeared to be the major problem, but a thorough interrogation of the scheme members revealed that this technical impediment was only a symptom of a more serious underlying problem: a critical scarcity of both labor and capital among the PIV participants. As a result of these resource constraints, the increasing burden of operating costs and the additional physical labor required to maintain and operate the perimeters is progressively assumed by a dwindling number of participants who are able to absorb the increased costs and avoid abandoning their plots.

At Doumga Rindiaw, during the rainy season of 1988, seven plots in the first PIV were left uncultivated by their owners. The second PIV remained officially empty because of a defunct pump. For the last season (rainy season 1989), Bosséa I (the first PIV) had two pumps in use, because the second, which had been broken, was repaired. Bosséa II's pump was also repaired thanks to the attention of SAED. Despite all this, only 34 of the 64 plots at Bosséa I, and only 14 out of 64 at Bosséa II, were cultivated. Unarguably, the problem of irrigation cannot be reduced to the technical factors often offered as an explanation.

Table 9.2, as well as Figure 9.2, depict the frequency of reasons given for the noncultivation of certain fields. The total number of respondents was 47: 21 in Bosséa I and 26 in Bosséa II. Each participant could list several reasons.

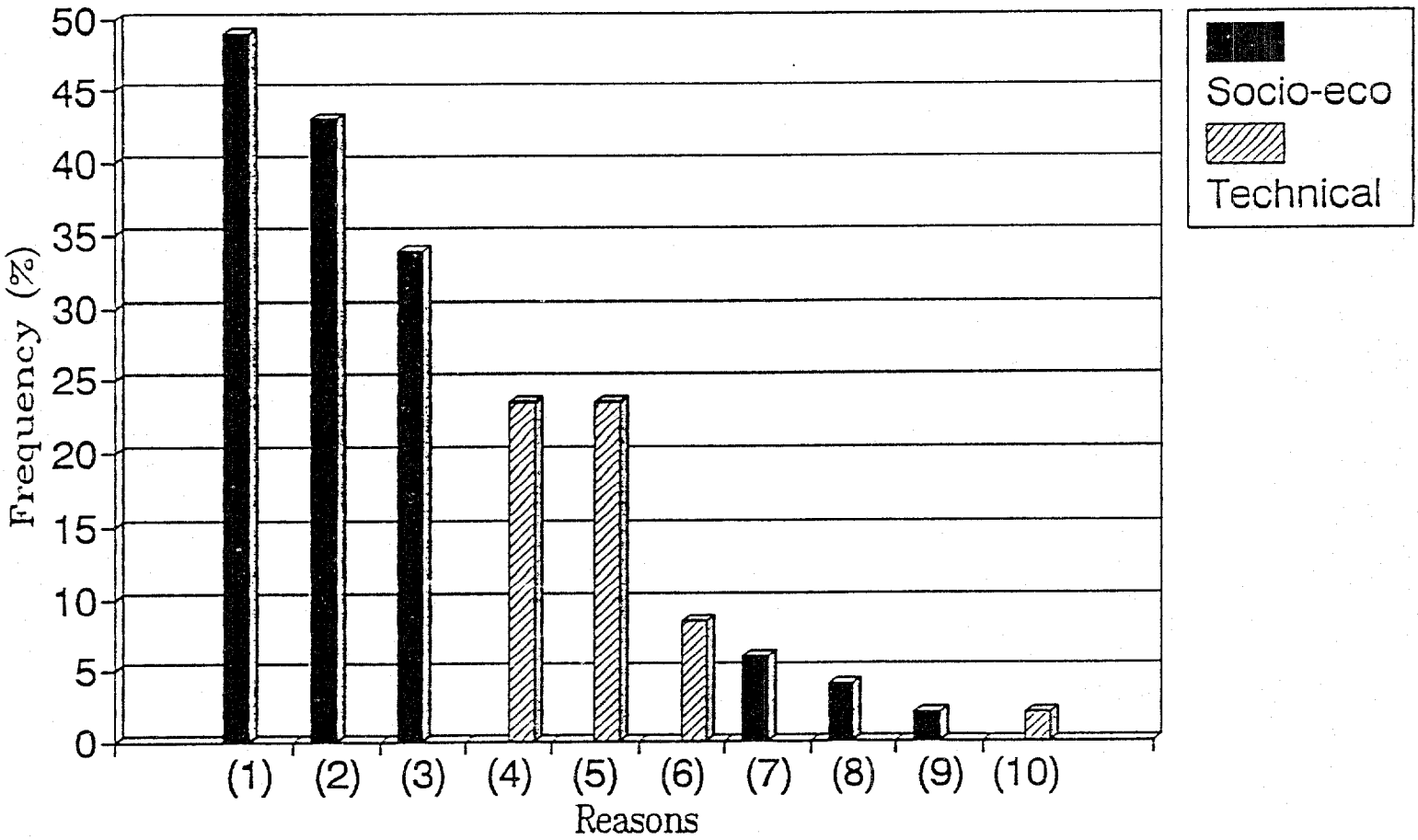
The data impugns the idea that the principal problems associated with the PIVs are tied to infrastructure (canals, topography, soils) and equipment. For example, in 1988, when Bosséa II was out of commission, the reason given by the farmers and SAED alike was that the pump

Table 9.2 Reasons Cited for Not Cultivating PIV Parcels; Bosséa I and II (Doumga Rindiaw rainy season 1989; 21 interviewed from Bosséa I and 26 from Bosséa II)

Reasons Cited	Bosséa I	% Freq I	Bosséa II	% Freq II	Total I-II	% Freq I-II
1) Not enough money	12	57	11	42	23	49
2) Not enough labor	8	38	12	46	20	43
3) Labor working elsewhere	10	48	6	23	16	34
4) Levelling problems	2	10	9	35	11	23
5) Poor canals	1	5	10	38	11	23
6) Soil problems	3	14	1	4	4	9
7) Bad previous experience	3	14	0	0	3	6
8) Preference for waalo/jeeri	1	5	1	4	2	4
9) Dislike of irrigation	0	0	1	4	1	2
10) Poor dikes	1	5	0	0	1	2
Total (respondents)	21		26		47	

was broken. Based on the responses received, it is tempting to conclude that this PIV should be classified among those whose only problems are associated with infrastructure and equipment. For the 1989 season, those justifications no longer held, since the pump had been repaired. Certainly, some people mentioned other technical, training, and topographical constraints, but

Figure 9.2 Reasons Given by Farmers for Not Farming PIV Parcels (Doumga Rindiaw 1989)



for the most part—for example in Bosséa I—people recognized that the problem lay elsewhere, with lack of financial means and labor—which usually results from a preference for another activity. Some people admitted that, in truth, they preferred traditional agriculture. One man affirmed that he didn't like irrigation—yet none of them had thought to relinquish their plots to the producer organization for use by others who were in need!

To recapitulate, two major series of problems can be highlighted: user fees and labor. A third set of serious problems is represented by the diversity of perspectives of producers vis-à-vis irrigation: the loss of cohesion within producer groups, the menace to their viability, and the overall inefficiency of peasant organizational structures for irrigated agriculture.

9.4.3 Funding Irrigated Agriculture

Extended contact with villagers and the high frequency of their complaints concerning the financial burdens posed by irrigated agriculture—which are confirmed by the reasons given for not using certain plots—attracted our attention to funding issues. The questionnaire on irrigation included a section concerning financing irrigated agriculture in Bosséa I in 1988, and in both perimeters in 1989. This section was supplemented by interviews with presidents of producer groups to assess the overall situation of each scheme. All individuals who had financed irrigated agriculture in 1988 and/or 1989 and were available for questioning were interviewed, whether they had directly exploited their plots, financed cultivation as "absentee owners" or cultivated a borrowed plot (*rem bamaa*).

Seventy-five responses were received, 37 from the Bosséa I season in 1988 and 38 for the two PIVs in 1989. In 1988, 57 parcels were cultivated at Bosséa I, which means the response ratio was 37/57, or 65 percent. In 1989, 34 plots and 14 plots, respectively (for a total of 48) were cultivated in the first and second PIV, representing a response ratio of 38/48, or 79 percent. The data have been categorized into three groups (see Table 9.3 and Figure 9.3):

1) Identification according to:

   a) the perimeter (B1 for Bosséa I, B2 for Bosséa II, and B1-2 for the two PIVs);
   b) land tenure (J.G. for *joom ngesa*, or direct exploitation; REM. or *rem bamaa* for borrowing a plot; RENT. for "renting," or having plots sharecropped, a system known locally as *rem peccen*).

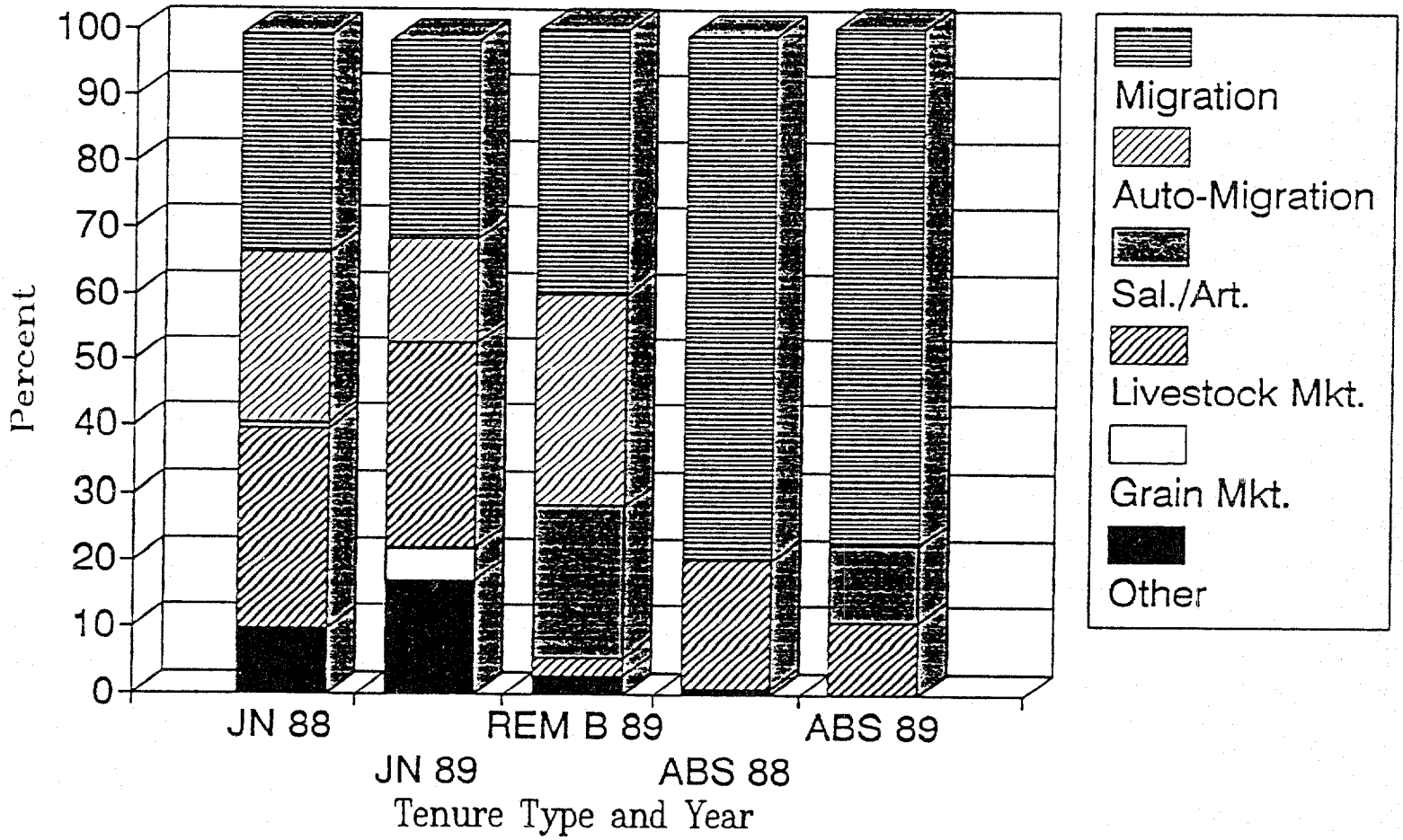
2) User fees, including:

   a) seeds, when they were bought.

Table 9.3 Source of Revenues for Financing Irrigation among Various Landholding Categories. The Case of Two Perimeters in Doumga Rindiaw

PIV/Ten/ Year	Num-ber	Seed	Pump	Fert-ilizer	Other	Total Expense	Remit-tances	Auto	Live-stock	Sal/Pen	Grains
B1 J.G.1988 (Fcfa)	19	7800	199000	169950	0	376750	123300	98200	113850	5600	0
B1 J.G.1988 (% total)	19	2	53	45	0	100	33	26	30	1	0
B1-2 J.G. 1989 (Fcfa)	15	8550	152000	123250	0	283800	84650	45500	88500	0	15600
B1-2 J.G. 1989 (% total)	15	3	54	43	0	100	30	16	31	0	5
B1-2 Sh. 1989 (Fcfa)	10	5425	101000	77900	0	184325	73325	58650	4700	42150	0
B1-2 Sh. 1989 (% total)	10	3	55	42	0	100	40	32	3	23	0
Total J.G.+ Sh. (Fcfa)	44	21775	452000	371100	0	844875	281275	202350	207050	47750	15600
Total J.G.+ Sh. (% total)	44	3	53	44	0	100	33	24	25	6	2
B1 Rent.1988 (Fcfa)	18	7900	186000	178900	5000	377800	298150	0	75650	0	0
B1 Rent.1988 (% total)	18	2	49	47	1	100	79	0	20	0	0
B1-2 Rent.1989 (Fcfa)	13	5350	133000	96600	0	234950	182850	0	24900	27200	0
B1-2 Rent.1989 (% total)	13	2	57	41	0	100	78	0	11	12	0
Total Renters (Fcfa)	31	13250	319000	275500	5000	612750	481000	0	100550	27200	0
Total Renters (% total)	31	2	52	45	1	100	78	0	16	4	0

Figure 9.3 Revenue Sources for Irrigation; the Case of Doumga Rindiaw



b) pumping, including the cost of fuel and lubricants as well as the salary of the pump attendant;[80]
c) the cost of fertilizer.

3) Sources of money for payment of fees.

In cases of multiple sources of funding, an attempt was made to determine from the peasant the exact contribution from each source. Sources included:

a) migrant remittances;
b) "auto-migration," whereby personal funds were obtained through the seasonal migration of cultivators themselves to pay for irrigated agriculture;
c) livestock sales;
d) income generated from salaries (retirement pensions), military pensions, and artisanal income (this concerns the village jeweler only): in sum, all local nonagricultural income.
e) grain sales (from the *waalo* primarily, since at the beginning of the rainy season on the PIV, any grain remaining in the granaries comes from the *waalo*). Only one case of this was noted, but it bears special mention.
f) other sources of funding: loans reimbursable at harvest time, gifts, and money donated by relatives. Included in this category are unspecified sources of funding.

Many observations may be made based on the data gathered. Only the most important are presented in Table 9.3 and Figure 9.3.

9.4.3.1 The Complex Relationship between Irrigation and Migration

Migration maintains a very complex and controversial relationship with irrigation in the Middle Valley because the nature of the relationship is unclear. In effect, migration touches upon the two most sensitive facets of irrigation: labor and capital. It affects the former negatively and the latter positively.

The average number of migrant laborers is higher for households who have access to plots but choose not to cultivate them, "preferring" instead to have them sharecropped. Similarly, households who fund irrigated agriculture as *joom ngesa* or "absentee owners" have the highest rate of absence of the working age population (31 per cent for the former and 42.5 percent for the latter).

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[80] Once the technique of including the costs of fuel, lubricants, and the salary of the pump attendant under the rubric of periodic fees is adopted, collecting information on this complex question is simplified. The gap between producers is smallest at this level.

The survey confirms that these observations are not fortuitous: for both PIVs in the two-year study, remittances from migration—both long-term and seasonal—provided 66 percent of the funding needed for irrigated agriculture.[81] This means that irrigation simultaneously requires a labor force on site as well as abroad to cover the costs on the perimeters. Herein lies the paradox of irrigated agriculture in the small village perimeters of Doumga Rindiaw, and certainly in the Department of Matam, perhaps in the rest of the Fuuta, in Soninke regions, and in the rest of the Valley.

A more precise look at the data from Doumga Rindiaw reveals two forms of migration: seasonal and long-term. The population census that we conducted in September and October 1988 revealed that one out of four "inhabitants" of Doumga Rindiaw lived outside the village. This large community of workers constitutes an important loss of labor for the village, but also an irreplaceable source of monetary income, as will be evidenced by the budget study.

The "absentee owners" in irrigated agriculture rely almost exclusively on income derived from migration of family members established outside the village to finance agricultural production. Nearly 80 percent of their costs in both 1988 and 1989 were paid for by migration. But, given that this migration income was gained at the cost of a reduction in household size, they were able to meet only two of the conditions for irrigation: they had land and capital but insufficient labor, which they obtained—or bought, if you will—through sharecropping. Since there is an inverse relationship between access to migration remittances and involvement in irrigated agriculture, it is logical that actual producers count less—compared to "absentee owners"—on outside sources of funding to finance irrigation. The portion of their fees covered by migration varies from 46 percent for the *joom ngesa* in 1988 to 59 percent for the same in 1989 and 72 percent for individuals borrowing plots in 1989, still a considerable portion. But the real question is how do households acquire both labor power and revenues?

Inhabitants in the Valley have a long tradition of seasonal migration. It continues to be practiced on a large scale, involving primarily young men—most often seen as small-scale merchants and shoe polishers in the large cities in Senegal. Adult men—often heads of families—participate as well, leaving the *Fuuta* during the *jeeri* harvest, which corresponds to the end of the planting and weeding of the *waalo*. Their departure also coincides with the remaining few tasks on the PIVs such as weeding, perhaps a last round of watering, harvesting, and threshing. Heads of households and young men return to the village when rainfed agriculture and the rainy-season on the PIV commence.

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[81] The total cost for the monitored households reached 1,457,625 FCFA, and the sum provided by long-term migration totaled 762,275 FCFA, compared to 202,350 FCFA derived from "auto-migration" (see Table 9.3).

Figure 9.4 below was derived from notes taken from village diaries kept with the help of two research assistants since April 1989 in Kaawel and Doumga Rindiaw. All observed events in village life are mentioned therein, particularly villagers' travel.[82]

It is evident that migration is general and does not spring from the practice of irrigated agriculture only.

In both villages, the extensive return of migrants takes place between June and July, while departures are spread out over time, this year beginning earlier than usual—in September—because then it was realized, both at Kaawel and at Doumga Rindiaw, that the *jeeri* season was a failure. This indicates that traditional forms of agriculture are catalyzing these movements. The village of Kaawel, which has no PIV, witnessed the same type of seasonal migration as the village of Doumga Rindiaw, where irrigation merely exacerbated an already existing problem.

Heads of households practicing irrigated agriculture participate in walkabout trade in Dakar and, above all, in towns in the Peanut Basin (Kaolack, Fatick, Nioro du Rip, Kaffrine, Koungueul, etc. . . in the case of Doumga Rindiaw). The time of their departure south corresponds with the commencement of the peanut trade, when the regional circulation of money intensifies. Money saved during their sojourn in the south serves not only to refill the granaries, but also to pay irrigation fees for producers. Only actual producers employed this method of financing; the contribution from seasonal "auto-migration" represented from 16 to 26 percent of a *joom ngesa*'s total costs from 1988 and 1989, and up to 32 percent for those who borrowed plots in 1989. At the same time, the contribution made by long-term migration constitutes only about a third of their total costs, which seems high in absolute terms but is low when compared to the situation of "absentee owners."

In sum, small-scale village irrigation does not hinder migration. On the contrary, it depends on it.

9.4.3.2 Local Nonagricultural Income

Among those interviewed, income derived from remittances, pensions, and—to a lesser degree—from artisanal production, covered 5 percent of total costs. The proportion was higher for "absentee owners" (12 percent) and for those who borrowed plots (23 percent) in 1989 (see Table 9.3).

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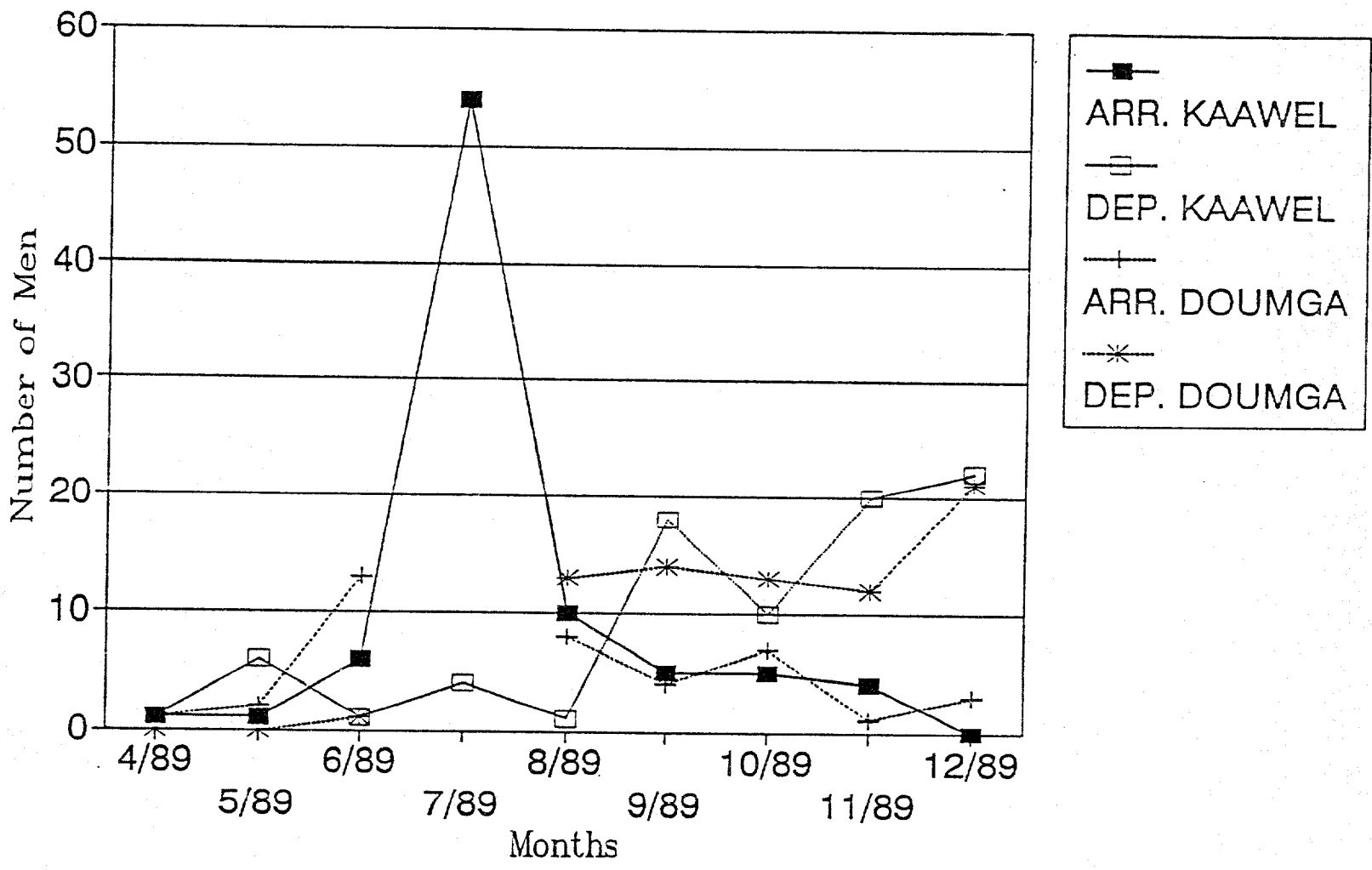
[82] Recording these movements was more systematic in Kaawel than at Doumga Rindiaw, because our assistant was occasionally absent—notably in July—when he left to take his exams. Consequently, some data from this period are missing.

Figure 9.4 Migration Patterns in Doumga Rindiaw and Kaawel from April to December 1989



9.4.3.3 Decapitalization

A fundamental characteristic of methods of financing irrigation is heavy dependence on small-scale animal husbandry. All of the study groups sold livestock to pay production costs incurred in the PIV, whatever the type of land tenure. On the whole, income derived from the sale of livestock covered 21 percent of the fees for the irrigation season.

Decapitalization of the livestock sector to fund irrigated agriculture is more noticeable in households practicing direct exploitation, 30 percent of which is covered by the sale of livestock. For this reason, they seem to pay the highest price for participation in irrigated agriculture. It remains to be determined whether this high rate of off-take from relatively small herds will enable producers to engage in irrigation on a long-term basis. Did households that had already sold a part of their *waalo* reserves then begin to sell their livestock? Did those who are indebted locally once own herds of animals? Might not the extensive sale of livestock be initiating a spiral of progressive impoverishment in households practicing small-scale village irrigation?

9.4.3.4 The Consequences of Heavy Production Costs

The reputation of the PIVs as a low-cost system of agriculture is inaccurate when viewed from the peasants' perspective. Methods employed to finance irrigation and the widespread withdrawal of plot holders proves this. The most serious consequences of this situation for the future of the PIVs and, by extension, for irrigation in general in the Valley are the following:

"Absentee owners" finance irrigation through migration. This type of income thus constitutes a renewable resource whose use has no long-term negative effects on their economic status. On the other hand, producers forced to reduce their capital reserves in order to cultivate their plots are often ruined in the process, with no recourse but to sharecrop.[83] The relationship of "absentee owners" to sharecroppers reveals a disguised paid agricultural work force resulting from increasing economic differentiation in the villages.

The fact that rice farmers participate in seasonal migration in order to finance irrigated agriculture explains why annual double-cropping is not feasible for most PIV producers.

Farmers are now bending over backward to meet the increase in input costs following the withdrawal of SAED and the removal of subsidies as part of the New Agricultural Policy and the Structural Adjustment Program. In order to do this they cut back on the quality as well as the quantity of inputs, often to the detriment of productivity. In extreme cases, they abandon irrigation completely. The example of fertilizer illustrates this nicely.

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[83] The case is worth mentioning of a producer who, incapable of financing irrigation himself, cultivated his own plot as a sharecropper to the profit of a local "donor."

Currently, only nitrogen is being used on PIVs in the Department of Matam. Since water fees are more or less fixed within certain bounds, farmers cut costs by diminishing nitrogen doses according to the revenues at their disposal. Of the total quantity of 100 to 150 kilograms recommended for a plot of .30 ha—for Doumga Rindiaw, for example—it is common to buy no more than a sack of 50 kg, whose price varies from between 4,500 and 5,000 FCFA. Some poor producers buy fertilizer in small quantities from retailers. Small-scale trade of nitrogen was initiated this year at Doumga Rindiaw, where a woman bought 50 kg sacks that she subsequently sold for 500 FCFA per *muud*, a local measure corresponding to approximately 4 kg.

These and other similar practices have an obvious impact on production: widespread lower yields. The SAED delegation in Matam have observed a continuous drop in yields since the 1986 rainy season, when real prices for inputs and SAED's withdrawal of credit services were first put into effect. Since 1986, average yields estimated by SAED for the Department of Matam dropped from 6 tons/ha to 5.7 in 1987, and to 4.8 in 1989.[84] After each season when peasants who have used low doses of fertilizer see the poor results—harvesting less than they invested—they abandon irrigated agriculture.

The reduction in the number of producers has another consequence for those remaining. If a PIV is designed for the participation of 64 households and only 30, or 10, households actually participate, the latter find themselves facing the problem of an oversized perimeter. This logically translates into a larger share per holding of costs in labor, in maintenance of infrastructure (canal repair, for example, which constitutes a labor carried out collectively by only families who are actually producing), and also in production outlays (since fees per producer rise as the number of participants drops—for example in the case of a broken pump). Presumably, water costs per user are higher as well, because water losses are risks shared by all producers on the scheme. This means that at a certain level of nonparticipation on the PIV, even those who are most interested in irrigated agriculture will be forced to follow suit.

9.4.3.5 Funding in Other Contexts

Subsequent to the examination of Doumga Rindiaw, the framework of the study was expanded to include certain villages in the immediate area. The objective of this expansion was to verify observations made locally that might not have been applicable within a broader context. The other villages in this study are Saracouro Dialloubé, Diolol Diaobé, Mbakna Less, and Mboloyel.

Saracouro Dialloubé and Diolol Diaobé lie in the *jeeri* near Doumga and are populated primarily by *Fulbe*. Of the 60 members of the group who use the PIV of Bokidiawé I from 1979 on, 22 are *Fulbe* from Saracoura Dialloubé, 17 of whom were interviewed. The village

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[84] Actual yields are likely to be much lower than the figures provided by SAED. Significant to our study is the evidence for the widespread, continuous drop in yields.

of Saracoura Dialloubé, about one kilometer away in the nearby *jeeri* of Doumga Rindiaw, has been diminishing in size during the course of the past few years as its inhabitants move to Bokidiawé to settle, establishing their own separate neighborhood. They have maintained their political and administrative ties with their native village. Some, recognized as traditional landowners in the zone where the first PIV of Bokidiawé was to be built, have participated in the scheme. This represents an initiative on the part of the *Toorobbe* of Bokidiawé, and participation by the households of Saracouro Dialloubé was motivated primarily by the desire to maintain ties to the traditional land patrimony.

The village of Diolol Diaobé is located 500 meters to the southeast of Saracouro Dialloubé. Like the latter village, most of its inhabitants are *Fulbe*, but there is also a fairly large community of *Maccube*. Livestock seem to be much more important there than in Saracouro Dialloubé. In fact, the progressive absorption of this latter village by Bokidiawé seems to be a consequence of the progressive abandonment of herding. The political and administrative village of Diolol Diaobé is also subdivided into several settlements spread out across the *waalo* between Diamel and the principal branch of the river. These residences are in fact former dry season camps (*seedaano*), while the *jeeri* village at that time was utilized only as a rainy season camp (*rumaano*). Over fifteen years ago, the *waalo* camps became permanent settlements for two major reasons. The succession of dry years led many farmers to abandon rainfed agriculture. Therefore, even this year, only 24 households among the 64 members of the producer group practiced this form of agriculture. The second reason is that the very same drought decimated a large number of cattle in the village, and villagers were left to raise sheep and goats that can be fed in the *waalo* with the by-products of recession agriculture and in the *foonde* with grass and forage.

A PIV in the village of Diolol Diaobé was set up in 1988 and used for the first time this year. The perimeter is 15 kilometers from the village *jeeri* and fed by the waters from a swamp flooded by the Diamel called the Balel.

Mbakhna Less is a fishing village established on the bank of the Diamel, approximately 7 kilometers from Doumga Rindiaw. The inhabitants of Mbakhna Less participate actively in fishing on the Diamel and the main branch of the river. Women enjoy a quasi-monopoly of the sale of freshwater fish in the nearby villages of the *jeejegol* and the *jeeri*. They provide a significant percentage of the supply of saltwater fish (which they buy along the national highway) to the villages on the banks of the river—Nguidjilone, Sadel, and Dondou. The inhabitants of Mbakhna (Less and Dow) also use most of the *falo* of Doumga Rindiaw. The village lacks rainfed lands. The small sandy *foonde* on which this agriculture takes place is utilized by the inhabitants of Mbakhna Dow. Neither Mbakhna controls much land. Except for a few households, they participate only in recession agriculture under sharecropping or loan contracts in the cuvettes in neighboring villages of Doumga Rindiaw, Doumga Ouro Thierno and above all, Kaawel.

The inhabitants of Mbakhna Less became involved very early in irrigated agriculture, their scheme dating from 1978. Both Doumga Rindiaw and Doumga Ouro Thierno who, in the

same year, created their own PIV with the intention of arresting the infringement of *Subalbe* villages upon their lands. These villages claimed even the land where the PIV of Mbakhna Less is located.

Mboloyel is a *jeejegol* village situated less than a kilometer from Doumga. It is headed by *Toorobbe*, but includes a large community of *Soninke*, largely of the blacksmith caste. Mboloyel was established fairly recently, which explains why the village has no control over *jeeri or waalo* lands. It managed to find a site for its PIV, which was created in 1984, between the *waalo* of Doumga Rindiaw and the Diamel. But later the village was obligated to grant plots to traditional owners from Doumga Rindiaw and Bokidiawé.

In Mbakhna and in Mboloyel the PIVs facilitated access to land and agriculture for populations historically ill-served in this domain. In Saracouro Dialloubé, Diolol Diaobé, and Doumga Rindiaw, they represented most importantly a method for defending and protecting a patrimonial heritage that appeared to be under siege by outsiders.[85]

Each village has its characteristic pattern of financing irrigated agriculture, whether through migration, animal husbandry, local nonagropastoral activities, and, if one considers each producer group, agricultural credit. In the predominantly *Fulbe* producer groups of Saracouro Dialloubé and of Diolol Diaobé, selling cattle is the most common method of financing irrigated agriculture: 61 percent in Saracouro Dialloubé and 74 percent in Diolol Diaobé. In Mboloyel, long-term and seasonal migration underwrite more than 80 percent of the cost of irrigated agriculture. Mbakhna Less provides a completely different scenario. Local nonagricultural income provides for up to 72 percent of the cost of irrigated agriculture, not including, of course, agricultural credit. This income derives for the most part from fishing on the river, the Diamel, and associated lowlands.

Of all the producer groups, only Mbakhna Less presents a viable situation. Funding agriculture by means of a second local activity such as fishing, whose resources are not easily depleted as long as the flood is maintained, does not induce progressive impoverishment. Above all, the labor force required by irrigation is available locally. The sale of livestock, on the other hand, cannot finance irrigated agriculture over the long term. Because of its high labor requirements, irrigated agriculture—if it is to remain viable—cannot depend heavily on income from migration, which depopulates households slated to participate in irrigation.

In conclusion, (see Table 9.4) the behavior of the various castes regarding the type of funding employed to irrigate are somewhat dictated by the limits imposed by traditional professional specializations. *Toorobbe* farmers and other free men (except for *Subalbe* fishermen) have recourse to no sources of income other than from migration to cover the costs of irrigated agriculture. The Fulbe rely almost exclusively on their livestock, and fishermen on

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[85] Kaawel is planning to establish a PIV in the triangular area between Doumga Rindiaw, Doumga Ouro Thierno, and Mbakhna, to legalize its traditional rights over land in this zone.

fish. The *Maccube*—the only caste with no professional restrictions—enjoy the most diversified and well-balanced sources of funding: migration, herding, and nonagropastoral activities (crafts, sale of wood, masonry, etc.). Members of the artisanal castes in the groups under study had their fields sharecropped.

Table 9.4 Mode of Financing Irrigation by Statutory Groups and Landholding Profiles (in percentages)

Caste	Number	Grains	Remitt	Livest.	Non-ag. Act.	Automigrat	Others
Owner-Cultivators, Sharecroppers, and Lessees							
Toorobbe	6	0.0	58.4	0.0	0.0	41.6	0.0
Fulbe	43	1.6	7.6	85.2	0.0	2.6	3.0
Subalbe	51	5.6	16.4	1.2	72.8	1.5	2.5
Other Rimbe	4	0.0	80.6	12.3	7.1	0.0	0.0
Maccube	22	4.1	32.4	22.6	36.9	4.0	0.0
Renters : 22 Fulbe. 3 Toorobbe. 2 Other Rimbe. 6 Nyeenybe and 3 Maccube							
All	36	1.7	38.0	49.4	6.9	3.1	0.9

9.4.4 Production on the PIVs

The analysis presented here is based on observation of the 1988/89 rainy season rice culture on the first PIV of Doumga Rindiaw, the 1989/90 rainy season on the two PIVs of Thially, 1989/90 rainy season rice culture in the PIV of Tiguere Cire II, and onion raising in the 1988/89 dry off-season at Tiguere Cire I. During these periods, comparative data, especially concerning labor inputs, were collected from sample households.[86] Discussion will concentrate on understanding the intense labor and capital demands of irrigated agriculture.

[86] In Doumga Rindiaw, certain information was gathered after the fact, since the sample was chosen definitively only at the end of October. A breakdown of labor inputs was possible only for harvest and post-harvest activities. For the rest, the people in the sample noted for each agricultural season individuals who worked for them, or for whom they worked, the length of the work day (from what time to what time), and the kin relations and/or the conditions under which they either received or contributed work. Using the data from the previously conducted village census, we employed household demographic figures to determine for each household in the sample the sex and the age of individuals having worked on the PIV plots.

9.4.4.1 Labor

Rice production comprises a series of field tasks that require a high degree of physical exertion and intensity easily surpassing the labor requirements characteristic of traditional rainfed and recession agriculture. Comparative analyses of modern and traditional agriculture are quite frequently biased in their understanding of the performance and productive capacity of each system because they place a high priority on agricultural yields, which are almost always assessed in terms of yields per unit land. Since average yields of irrigated rice paddy per hectare invariably surpass the yields of traditional crops such as sorghum and millet, development experts and government officials are inclined to favor irrigation in their planning decisions. A more objective and economically rational approach would be to adopt a broader analytic perspective by establishing a multiple set of production criteria that takes into account the costs of both labor and capital.

The objective of the following section is to highlight the manner in which labor is mobilized in the perimeters and to describe various tasks in the production cycle that are differentiated according to age and type.

9.4.4.1.1 The Agricultural Production Cycle

The agricultural calendar of rice production extends over a five-month period beginning soon after the first rains in June and continuing until mid- to late December. Pumping delays, which result from occasional minor repairs, may slow the process. The agricultural tasks undertaken involve varying degrees of physical exertion, allowing for brief intervals of rest. In general, however, most families recognize that the irrigation season is an exhausting exercise in which physical health is often taxed to its limit as individuals pass long grueling hours working the hard clay soils in the hot Sahelian sun. Thus farmers are quick to respond that rice cultivation fills a critical gap in their struggle to feed their families but at an extremely high price in terms of their physical health and well-being.

The chronology of production entails a series of activities: some overlap and extend throughout the major portion of the production cycle; others are quite short, involving only a single or a few days of labor. We noted at least 15 distinct field tasks. The heavier field activities are generally carried out by men, who tend to work the fields on a daily basis and often take a full day to complete these tasks. Many women undertake certain tasks during shorter periods of time, or alternate their field schedules with other women in the household, enabling at least one to remain behind to prepare the midday meal and carry out other household chores. Nonetheless, women do engage in extremely heavy physical labor, and near the end of the season, at harvest time, they are in the fields more often than men. As will be demonstrated below, in one of the two perimeters studied women overall contribute more labor time than men.

Most field tasks are undertaken by the household alone, although intensive, difficult tasks that must be carried out over a relatively short period of time often are performed by small work groups that may be involved in reciprocal exchange. The nature of these work parties and the

prestations given resemble those found in traditional agriculture and will be briefly described later. The chronology of field activities and the gender-based division of labor are summarized in Table 9.5. The tasks most frequently performed by each group and those most frequently carried out in work groups are indicated as well.

Table 9.5 Agricultural Labor Cycle in Rice Perimeters

Task	Labor Period	Gender	Cooperative Labor
Field clearing	mid June	m	
Canal repair	mid July	m	
Nursery			
fencing	mid July	m	
bed preparation	mid July	m	
irrigation	mid July	m	
seeding	late July	m	
Field hoeing	August	m	
Irrigation	Aug-Oct	m	
Fertilizers	late Aug-early Sept	m, f	
Transplanting	late Aug-early Sept	m, f	doftal
Weeding	Sept-Nov	m, f	doftal
Guarding	early Nov-mid Dec	m, f	
Harvesting	mid Dec	m, f	doftal
Threshing	mid Dec	m, f	doftal
Transporting	mid-late Dec	m	

A major portion of the irrigation season overlaps with rainfed cultivation in the *jeeri* fields. Thus, families must attempt to organize their time skillfully between the two production activities. Often, labor input will be divided among family members early on, certain individuals working the *jeeri* while others begin preparing the rice plots. The most arduous tasks in the perimeter, transplanting and weeding, occur naturally in the production cycle after completion of the most demanding period of field preparation and planting in the *jeeri*, so the demands of the two systems for labor do not conflict during those periods. Moreover, the *jeeri* harvest occurs in mid- to late November, falling conveniently during the slack time for irrigation, when field guarding against birds, usually by young boys and girls, is the principal activity on the perimeter. Bottlenecks between the two systems are thereby avoided.

The agricultural season starts with field clearing, termed *duggitaade*, during which crop residues and dried grasses from the previous season are burnt off. This may begin as early as mid- or late June—soon after the first rains—depending on the time available to the farmer, who at this point is usually occupied with preparation of his rainfed *jeeri* fields. Soon after, a thorn

fence is constructed around the nursery perimeter and general rehabilitation of the major canals begins. All members of the scheme carry out these activities collectively. As fencing is completed, they prepare nursery beds by turning the soil manually (called *gabaade*). Subsequently, the first irrigation of the perimeter begins and farmers plant their rice seed in the beds. At this time, they begin working their own fields, *gabaade ngesa*, hoeing and turning the soil and constructing small dikes in the interior in order to direct water efficiently to all areas of their plots. Field irrigation begins next; three to five fields receive water each day. A full irrigation cycle may require from ten to twenty days, depending on the efficiency of pumping and the number of participants in the perimeter. Diesel fuel, usually purchased on credit, is often not sufficient for the entire season and members have to contribute additional funds to receive water in the latter part of the year. Farmers who are short of cash for additional fuel sometimes do not receive an adequate supply of water.

Tasks carried out jointly by men and women begin with the application of nitrogen and phosphate fertilizers. The most time-consuming and crucial task during the year, transplanting the rice, or *lorngo*, must be undertaken over the course of several days and requires a massive labor effort by all. This is the first major task involving large work parties of both nonreciprocal (*doftal*), and reciprocal (*ballotiral*) labor. An important circulation of labor, consisting mostly of young males—many from families that do not cultivate rice—occurs at this time. The most labor-intensive activities besides transplanting are weeding, harvesting, and threshing, which require cooperative work parties of both men and women. Transport is most often an activity reserved for men using horse-drawn carts.

Several months after harvest, rice paddy is weighed and sold to SAED; the cash receipts are used to repay agricultural loans by individuals who obtained credit at the beginning of the season.

9.4.4.1.2 Labor Inputs: Differentiation of Tasks by Age and Sex

The massive exodus of adult male migrants from the Senegal River Valley leads one to hypothesize that the resulting void in agricultural production is filled by women and children who remain behind in the villages. This hypothesis is validated in two of the three research sites, Doumga Rindiaw and Thially. At the third site, Tiguere Cire II, women and children participate in rice production to a lesser extent. As the following discussion suggests, the more important role of adult men in the Tiguere perimeter may be a function of the failed rainfed *jeeri* crop, which freed many men for participation in rice production.

In a study of task-specific divisions of labor by age and sex in the Bosséa I perimeter at Doumga Rindiaw for the 1988 rainy season, children and young adults between the ages of 5 and 15 contribute approximately 50 percent of total labor input. The contribution of women, only 18 percent, was significantly lower than expected. A similar study of labor input for the 1989 rainy season on the two Thially perimeters indicates the key role of women on some rice perimeters. Women accounted for 55.9 percent of total labor inputs in Thially I and 40.5 percent in Thially III. Women also provide the bulk of labor in irrigated dry-season vegetable

gardening. On the Tiguere Cire I perimeter, they accounted for 59.2 percent of total labor during the 1988-89 cool dry season. (In the season of rice production at Tiguere Cire II, as in Doumga Rindiaw, women participated only marginally on the scheme, contributing only 11.2 percent of the total labor input.)

The level of participation of women on the perimeters of Thially is high, especially in light of the fact that only 26 percent of all men aged 16 to 64 participate in migration. Women participate above all in weeding, planting, guarding, harvesting, and threshing. In the case of planting, they provide on average 17 percent of the total work input for the two PIVs. Women, and above all, young girls, contribute significantly to the task of guarding (5.8 percent).

On the perimeter of Doumga Rindiaw, women's contribution to the various tasks is much lower than men's. Their presence is most noticeable during transplanting (6.8 percent) and threshing (8.8 percent), while they are almost entirely absent for other tasks. However, as the following discussion will reveal, the dominant role of men in the perimeter of Doumga Rindiaw is primarily a function of the presence of young men 5 to 14 years of age.

Women work little on Tiguere Cire II. They take part in specific tasks on four different occasions. The first two are nursery planting, and transplanting young rice plants. This work must be performed rapidly, when the field is completely flooded. A surface area of .37 ha must be finished within a day. Since there are not enough men to complete the task, women are called upon to help. The situation is exactly the same for weeding and harvesting, which include cutting the sheaths of rice, drying them, threshing, sifting, and putting the rice in sacks. These long and arduous tasks require a certain endurance that cannot be undertaken alone by men. For these tasks also, women are called upon to help. Weeding, plowing, and leveling, also demanding and difficult work in terms of labor, are undertaken by men alone, since this work can be spread out over time.

The proportion of time allotted to each task varies somewhat among the three research sites (see Table 9.6). In general, the most labor-intensive tasks are harvesting, transplanting, and weeding. The least time-consuming tasks are fertilizing, guarding, and transport of the harvest.[87] Transplanting is the most time-consuming task in the Thially PIVs, accounting for

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[87] To arrive at a uniform classification among the three sites, we incorporated one or more additional tasks under broader headings, as follows:

1) Field hoeing - includes ridging or mounding the rice plots and turning the soil prior to irrigation.

2) Nursery - includes all aspects of seedbed preparation and planting, as well as fencing and weeding the nursery.

3) Irrigation - includes all preparation and repair of canals.

almost one-third of total labor input (32.5 percent), while time required for harvesting was high at all three sites, most notably Tiguere Cire (54.5 percent). For men, transplanting required the most time (15.7 percent) in Thially, while harvesting (22 percent) and field hoeing (17.8 percent) required substantial inputs at Doumga Rindiaw. The data on gender-based task differentiation indicate that for the most part, men perform the most difficult physical tasks such as field hoeing, irrigation and canal repair, nursery bed preparation, and weeding, while women most frequently participate in fertilizing, harvesting, and transplanting.

Table 9.6 compares the labor profiles at the three research sites and provides a global view of gender roles for all perimeters.

Dry-season vegetable gardening entails a slightly less differentiated series of field tasks than that required for irrigation (see Table 9.7). On Tiguere Cire I, onion cultivation, carried out primarily by women, requires more hand watering of the onion beds than extensive mechanical irrigation. The result is a high labor input, largely from women (26.1 percent), to hand water plots. Could women, who are responsible for carrying out almost 60 percent of the total work, be said to control a new type of agriculture, considered secondary in the eyes of men? Many women are directly responsible for their plots, but the village producer group is open only to men.

Certain explanations surface after closer scrutiny of the sexual division of labor. Even though women dominate fieldwork in irrigated vegetable gardens, specific tasks are reserved for men, including dike placement and the construction of ridges (14.1 percent of the total time). This tiring work falls on men's shoulders, but it can be carried out over a period of several days if outside constraints do not hinder the work. Such is not the case for planting or harvesting, which must be undertaken at one time if at all possible. These difficult tasks are carried out primarily by women. In fact, because of the high rate of male migration, not enough men are present to undertake everything that needs to be accomplished in a short period of time. For this reason women participate extensively.

The higher representation of women than men does not necessarily imply a shift of power, but rather a punctual and circumstantial response to a deficit of male labor. Watering fields (requiring 26.1 percent of the labor) is largely the responsibility of women.

An analysis of the sexual division of labor by age group in the Doumga and Thially perimeters illustrates the crucial role of children, adolescents, and young adults between 5 and 24 in providing the bulk of the labor in rice production (see Table 9.8). In Doumga, youths aged 5 to 14 provide almost 50 percent of the total labor. In Thially, the contribution from the same age group is somewhat lower, approximately 30 percent. If the age groups from 5 to 24 are combined, the contribution at both village sites is markedly high: 81.5 percent at Doumga

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4) Harvest - includes threshing and winnowing of rice.

Table 9.6 Task Differentiation by Gender in Doumga Rindiaw, Thially, and Tiguere Cire Perimeters

Task	Percentage Labor Time by Gender								
	Doumga (Bosséa I)			Thially I, III			Tiguere Cire II		
	Women	Men	Total	Women	Men	Total	Women	Men	Total
Fertilizer	-	1.3	1.3	0.4	0.9	1.3			0.5
Field hoeing	-	17.8	17.8	0.4	6.4	6.8			9.4
Guarding	-	1.1	1.1	5.8	2.6	8.4			-
Harvesting	10.8	22.0	32.8	10.4	9.6	20.0			54.5
Irrigation	-	11.6	11.6	-	2.8	2.8			4.2
Nursery	0.2	10.4	10.6	0.3	12.5	12.8			2.2
Transplanting	6.3	6.1	12.4	16.8	15.7	32.5			21.3
Transporting	0.3	1.5	1.8	-	0.4	0.4			0.2
Weeding	1.4	9.6	11.0	7.3	7.3	14.6			7.5
Total	18.7	81.3	100.0	41.8	58.2	100.0	11.2	88.8	100.0

Table 9.7 Task Differentiation by Gender on Tiguere Cire during the Dry Gardening Season

Task	Percentage Labor Time by Gender		
	Tiguere Cire I		
	Women	Men	Total
Harvesting	11.7	9.2	20.9
Nursery	1.9	1.1	3.0
Ridging	2.5	14.1	16.6
Transplanting	11.7	6.3	18.0
Watering	26.1	4.4	30.5
Weeding	5.3	5.7	11.0
Total	59.2	40.8	100.0

Rindiaw and 63 percent at Thially. This reflects largely the demographic structure of the villages, wherein the youngest members of the community comprise the largest percentage of the total population. In Doumga Rindiaw, youths aged 5 to 14 are strongly represented in the perimeter with respect to their representation in the study sample (42 percent). Conversely, in the age range from 35 to 74 years, 24 percent of the sample population contributes less than 10 percent of the total labor in the PIV.

Table 9.8 Labor Inputs by Age and Gender in Doumga and Thially Perimeters

Age	Percentage Labor Time								
	Doumga (Bosséa I)			Thially I, III			Tiguere Cire II		
	Women	Men	Total	Women	Men	Total	Women	Men	Total
5-14	6.7	42.0	48.7	14.6	14.9	29.5			6.7
15-24	7.4	25.4	32.8	17.0	16.5	33.5			34.6
25-34	2.0	6.9	8.9	4.0	9.2	13.2			
35-44	1.5	4.1	5.6	4.3	5.7	10.0			
45-54	0.1	-	0.1	1.7	5.2	6.9			51.5
55-64	0.5	2.7	3.2	0.1	4.8	4.9			7.2
65-74	0.5	0.2	0.7	0.1	2.5	2.6			
Total	18.7	81.3	100.0	41.8	58.8	100.0	11.2	88.8	100.0

The activity of men between 25 and 74 is more noticeable in the Thially perimeters than in Doumga Rindiaw. This may be explained by the fact noted earlier that relatively few men in Thially participate in migration.

The analysis shows that in Doumga Rindiaw, young men circulate from one household to another to perform work. The labor demands for irrigation, thus, appear to have been met so far despite a high rate of migration, keeping in mind the potential of female labor—as yet underutilized in the PIV—as a resource to fall back on. This situation could change with the establishment of a second PIV planned for the 1990 rainy season.

At Tiguere Cire, youths under 15 contribute only 6.7 percent of the total labor input, compared to 48.7 percent at Doumga Rindiaw and 29.5 percent at Thially. Adult male heads of households are most often called upon to work, as well as men between 16 and 25. The latter take part above all in tasks preceding the scholastic or administrative year. In other words, vacationers upon their return to the village are asked to work in irrigated fields before leaving again. It is clear that this age group participates only marginally in the harvest—which takes place during the month of January and requires a large labor force—because the men have departed to urban areas. Adults aged 26-55 are represented in much larger numbers than those reported at Doumga Rindiaw (14.6 percent) and Thially (30.1 percent). One explanation offered is that the rainfed crop on the *fonde* at Tiguere Cire failed this year, freeing up more labor power than usual. We noted that the most advanced age groups always appear to invest their labor force first in traditional forms of agriculture and only then in more modern forms such as irrigation. In cases where labor was absolutely necessary on the perimeters, women and children who were not otherwise occupied in other fields and had no previous work obligations were sent first. This year, older men were available to work in the fields. Thus, our detailed hypothesis was not in contradiction to data gathered in the other research sites.

For the onion crop at Tiguere Cire, young people under 25 years of age do not constitute a majority of the total labor force, contrary to what had been noted for traditional recession agriculture (see Table 9.9). Instead, the absolute majority for labor was represented by the 25-54 year age group, 79.2 percent of them women. Only 20.8 percent of the labor force was represented by men from the same age group. This confirms the hypothesis that women are called upon to work in the place of male migrants. All of these tasks, except for watering and the harvest, could not easily be entrusted to younger workers. Similarly, the oldest age groups (8.7 percent) are rarely called upon to work as older people have probably not adapted to this new type of agriculture.

Table 9.9 Task Differentiation by Age Group on Tiguere Cire during Dry Season Gardening

Tasks	Percentage Contribution of Age Classes			
	5-14	15-24	25-54	>55
Nursery	0.3	0.5	1.5	0.2
Watering	2.0	7.3	17.9	0.7
First weeding	0.7	1.3	2.4	0.8
Burning	0.1	0.4	1.0	0.3
Dike construction	0.7	2.2	2.9	3.0
Ridging	1.0	2.8	3.6	1.0
Transplanting	2.2	5.7	7.2	1.0
Second weeding	0.4	1.0	3.2	0.4
Harvesting	3.2	8.2	11.6	1.3
Total	10.6	29.4	51.3	8.7

Although it is premature to draw any firm conclusions about the role that age- or gender-specific groups play in replacing the most productive segment of the adult population, the data from these studies suggest that women and children have become increasingly important in meeting household subsistence needs through their participation in irrigated agriculture. A geographically broader sample of case studies on labor differentiation by age and gender is in order before concluding that these age groups are absorbing the responsibilities of absentee migrant workers.

9.4.4.1.3 The Circulation of Labor

The Doumga Rindiaw and Tiguere Cire studies reveal a significant circulation of labor. In Doumga Rindiaw, despite the fact that only six out of sixteen households included in the sample took part in the PIV, 14 provided labor, as is indicated in Table 9.10. This indicates that irrigation engages even those who may not have received and/or exploited plots, and it points to the rule of intense interhousehold exchange relations that obtain in the village. Perhaps

this represents a means of resolving the thorny problem of labor; households with an insufficient labor force may benefit from help provided by their larger neighbors.

Table 9.10 Labor Inputs on the PIV by Sample Households (as a % of the total)

Households Codes	Parcels		
	1	2	Indefinite[a]
1.3			0.38
13.1	8.13		
15.1			0.69
19.3			1.03
24.1	13.10		
35.1	9.22		
46.1			0.34
54.4			0.63
57.1	25.82	14.22	
62.1			1.13
77.1	13.19		
78.1			0.50
81.1	10.82		
84.1			0.80
TOTAL	80.28	14.22	5.50

[a] This group includes those households that did not cultivate an irrigated parcel, but which assisted those who did.

We can compare by volume and destination (or type of beneficiary) the labor mobilized for irrigated agriculture within the sample. The extent of the labor force put into circulation is significant. Households in the sample participating in irrigated agriculture benefited from 15 percent of the total available labor force. Households not personally involved in the PIV contributed 5 percent of the mobilized labor force.[88] It is no less true, however, that households can really count only on their own labor force—which represents more than 3/4 of the total volume recorded.

The analysis of the circulation of manpower on Tiguere Cire II during rice production reveals two types of labor: family labor (45 percent) and labor received in *doftal* (54.4 percent) (see Table 9.11). Because there are not enough family members to supply the necessary labor

[88] The imbalance between work provided and work received may certainly be explained by the fact that our sample of 16 households, cultivating 7 plots in the PIV, surpasses by far the village average: only 57 out of a total of 163 households cultivated 64 plots this year.

for all tasks, the head of the family makes use of reciprocal labor from his network of friends or his *fedde* (age grade). This labor is not paid per task or by day as it might be for an agricultural worker. At the end of the harvest, the household head redistributes a certain quantity of rice in thanks for work performed. This compensation is relatively light: although they provide 54.4 percent of the labor needed, members of the *doftal* receive only 18.2 percent of the harvest. Perhaps this situation reflects a form of solidarity, providing rice to individuals without the financial wherewithal to produce their own.

Table 9.11 Movement of farm labor in the production of rice and vegetables/legumes on Tiguere Cire

Labor Category	Percentage	
	Tiguere Cire I (onion)	Tiguere Cire II (rice)
Household head	12.1	7.9
Household family member	68.9	35.6
Extended family	9.7	1.5
Slaves	0.3	-
Clientele	2.7	-
Neighbors	2.1	-
Talibe	0.7	0.5
Agricultural laborers	3.5	-
Doftal	-	54.4
Total	100.0	100.0

Labor availability does not appear to be a limiting factor at the present time. On the other hand, if all households in Tiguere Cire had the means to cultivate, who then would be able to provide the *doftal*, and what would be the methods of recruitment and the means of payment for this form of labor that is indispensable to an agricultural system dependent on manual labor? Developers must take this into consideration.

The analysis of labor circulation in the garden perimeter of Tiguere Cire reveals that labor provided by compounds is almost double (81 percent) that furnished by single families cultivating rice (43.5 percent) (see Table 9.11). Heads of compounds are rarely seen in the PIV (12.1 percent), because of the presence of female workers, and because the man responsible for the cultivated plot relies heavily upon families who belong to the lineage but live outside the concession (9.7 percent). Irrigated garden culture is therefore largely a family affair (90.7 percent of total labor), wherein labor is exchanged among households according to rules of the *ballotiral* (reciprocal help), of the *doftal* (nonreciprocated help), or of the *caatal* (gifts in kind, equivalent here to 14.4 percent of the total harvest).

In certain cases where the available labor is insufficient—when men are not present or free to work, for example—a salaried work force may be called upon (2.7 percent) largely to construct dikes and ridges (58.6 percent and 34.9 percent, respectively, of the work carried out by these laborers). The base pay of this salaried work force is 295 FCFA per half-day. Women may also be recruited for planting and harvesting, both of which require a large labor force.

Patron-client relationships represent an additional contribution (2.7 percent of the labor). They are not always immediately compensated.

Some of the remaining labor (2.1 percent) is supplied by neighbors whose work will be reciprocated later (*ballongiral*). Former captives are no longer socially obligated to donate much labor (*doftal*). On the contrary, they appear to be more often employed as manual laborers (3.5 percent of the cases).

9.4.4.1.4 Falling Yields and Natural Selection

If the statistics from SAED are reliable, the drop in yields, while continuous, has not yet reached a critical level: average yields of more than 4.5 tons of paddy per hectare are quite acceptable. But in light of the actual data gathered at the research sites, there is reason to doubt the accuracy of the figures provided by SAED. The recorded yields of rice are in every case below the 4 tons/ha reported by SAED. Only in the irrigated perimeter of Tiguere Cire II does the average yield of 3.7 tons/ha even approach the desired level.

SAED tends to overestimate yields because agricultural advisors responsible for the estimates content themselves with data derived from sampling plots belonging to producer group presidents. These presidents owe their positions to their commitment to irrigation and to their above-average level of motivation compared to the other members of the producer group. Their yields in no way reflect the overall production on the PIV.

An assessment of yields from the perimeter of Bosséa I in 1988 and 1989 invites two remarks (see Figure 9.5 below):

- The overall yield falls far short of the estimates made by SAED. In 1988, the average yield in the 51 plots whose production is known was 1.514 kg of paddy per hectare, varying from 0 to 5 tons/ha. Only three plots yielded more than 4 tons/ha and 7 plots more than 3 tons/ha. In 1989, the situation clearly improved for reasons that will be discussed. The average yield for the 31 plots whose production is known was 3.516 kg/ha. Of these, 12 yielded more than 4 tons per hectare, and 4 of them yielded more than 5 tons/ha.

- Several reasons account for the increase in yields from 1988 to 1989: (1) a large number of producers who were incapable of financing irrigation, and had used minimal doses of fertilizer in 1988, withdrew in 1989. An important observation from the following graph is that there were few plots cultivated in 1989 with

yields lower than one ton/ha in 1988. A sort of economic "natural selection" operates here. Given the financial suffering of certain families this year in their attempts to maintain irrigated fields, the process is likely to continue: (2) when rainfed agriculture failed, the peasants cultivating on the PIV invested all their energy into irrigated agriculture,[89] which makes irrigation appear as a safety strategy more than a basic component of production; (3) with the massive withdrawal in 1989, producers with time and the means encroached upon empty neighboring plots with the result that their production was attributed to the official size of their original plot (.30 ha), exaggerating the true harvest per unit area.[90]

9.5 Analysis of Intermediate Schemes

The Irrigated Village Perimeters represent only one transitional solution in a zone characterized by drought and climatic variation. However, because they are accessible only to a fraction of the population, most often located closest to the river, and because they provide only a small surface area per household, (.2 to .35 ha), they contribute to production for subsistence rather than for sale. The PIVs are not sufficient in themselves to compensate for the grain deficit resulting from the inhospitable climate and for declining *waalo* yields.

It was therefore decided to establish larger hydro-agricultural schemes. Without recreating the social, technical, and agronomic problems experienced with the large perimeters in the Delta, problems amply documented elsewhere (Reboul 1984; Dumont and Motin 1982; Seck 1986), a compromise was found between the too-small PIVs—limited to an increasingly crowded space—and the large perimeters farmers in the Valley find difficult to manage. The establishment of "intermediate" schemes would seem to represent a means to increase and secure the gross income of the local population. They combine the advantages of the PIVs with the surface area of the large schemes.

An extensive project called MATAM PHASE III was proposed, involving 4 of the 49 cuvettes in the Department of Matam. Such schemes appear necessary in the present circumstances, but they are not without their problems.

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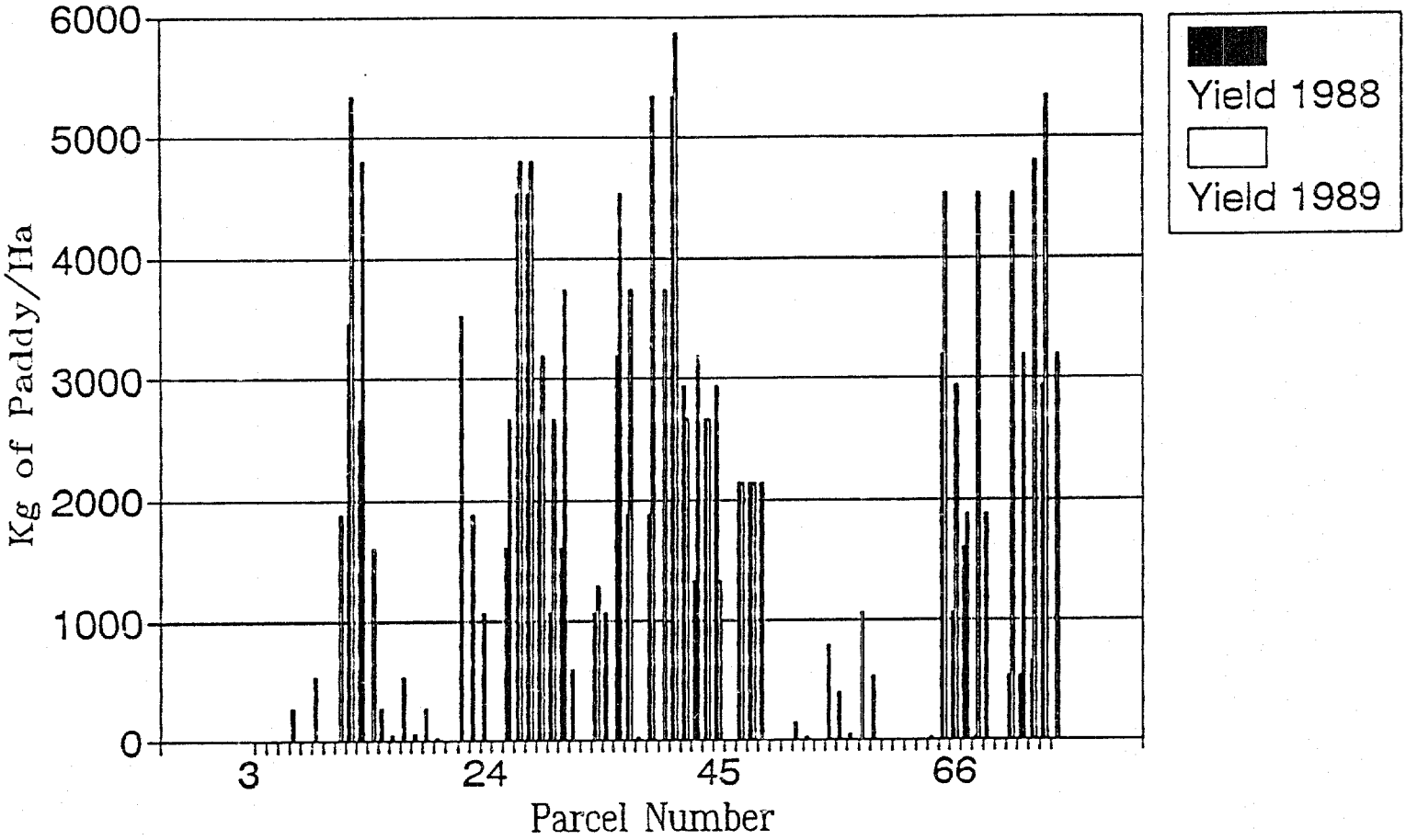
[89] In September, a respected marabout from Ndouloumadji Dembé, located about ten kilometers from Doumga Rindiaw, made his recommendations known in all the neighboring villages. He claimed that it was futile to replant in the *jeeri*, that the "rejection" of the *jeeri* should be interpreted as a divine verdict, and that all energy should be redirected toward *waalo* agriculture and irrigation.

[90] Precise measurements of the various cultivated plots were undertaken, and the collected data will be presented later.

Figure 9.5 Yields on Bosséa I in 1988 and 1989



9.5.1 Characteristics of the Schemes

The intermediate schemes, considered by OMVS to be the training ground for irrigated agriculture, will be established in 49 autonomous sites in the Department of Matam, for a total of 22,000 ha between Waoundé and Thilogne. Over the long run, they are expected to compensate for the decline of recession agriculture, generate revenue, pay off investments, pay for labor, and build up savings.

According to the SCET AGRI (1983), these schemes are based on Autonomous Irrigation Units (UAI) located within the large perimeters. These are small schemes of from 15 to 20 hectares (the same size as current PIVs) whose management has been somewhat improved by grouping several UAI's in Autonomous Units of Management (UAG). In other words, a UAG is a cluster of PIVs benefiting from a common infrastructure.

Each UAG will have its own pumping station, machine garage, credit system, water management, etc. In truth, UAGs might be considered small agricultural cooperatives in the image of CUMAs (Agricultural Equipment Users Cooperatives) that have operated for a long time in the Guédé Perimeter, downstream in the Department of Podor. Lastly, each UAI will comprise approximately thirty 0.8 ha fields cultivated by households averaging ten members each.

9.5.2 The Establishment of the Hamady-Ounaré Scheme

The project proposal dates from 1984, and the scheme was established beginning in 1987-88. It was scheduled to begin operation in September 1989 and in fact the first season did begin then. The Hamady-Ounaré scheme includes two perimeters, one totaling 622 hectares (413.6 ha net) and the other totaling 342 hectares (263.2 ha net).

Both perimeters were constructed in a former cuvette of approximately 100 hectares whose production was not particularly good, according to the peasants. The transformation of this area did not meet any notable resistance or even hostility. The same cannot be said, however, when a pond, reputedly to be rich in fish, was drained. Every year, inhabitants from five or six neighboring villages came during the dry season to harvest their quota of fish. The pond must have been valuable, for it was guarded up until the opening of the fishing season, and supplied fresh fish to the local population for several months.

Nevertheless, we did detect a certain enthusiasm concerning the schemes. Even the air of resignation dissipated quickly in view of the good harvests. Ndouloumadji-Dembé and Founébé have been the site of a real battle between peripheral villages over the next perimeter, each side desiring the largest possible surface area for irrigated agriculture.

Schemes A and B of Hamady-Ounaré were established on land belonging traditionally to the villages of Hamady-Ounaré and Dendoury. While scheme A had initially been reserved

for the population of Hamady-Ounaré (135 individual allotments planned for 4,700 inhabitants) and Dendoly (140 for 2,600 inhabitants) and scheme B for the villages of Dendoly (2 UAIs), Banadji (3 UAIs: 75 plots for 1,500 inhabitants), Fora-Diawara (2 UAIs: 30 plots for 300 people), Sinthiou-Bamanbé (5 UAIs: 133 allotments for 5,300 inhabitants) and Daiba (1 UAI: 35 allotments for 250 people), only Dendoly, Hamady-Ounaré and Daiba are actually represented in scheme B.

It is quite surprising that the ratio of allotments/inhabitants is not the same for all villages. We were not able to figure out clearly how they were calculated. At first glance, the system does not appear particularly democratic: Dendoly is clearly advantaged, perhaps because of its traditional land base.

That the inhabitants of Fora-Diawara would have abandoned independently the idea of cultivating on the perimeters is understandable, since the direct routes to the scheme were impassable during the rainy season. They would have had to walk more than 15 kilometers to reach the perimeter. On the other hand, we find it less understandable why the producer group in Sinthiou-Bamanbé, headquarters of the Rural Community and hometown of the president, had only 14 representatives in one UAI (B8), which, in addition, had not been created for it. The inhabitants of Sinthiou-Bamanbé acknowledge their tardiness in claiming their plots: they felt that the plots hadn't been sufficiently well constructed and they had been informed of their existence fairly late. Finally, when they did decide to take possession of their plots (in light of the very disappointing results of rainfed agriculture), they discovered that the plots were already being cultivated by the inhabitants of Dendory. It is surprising that the same reasons (withdrawal of the members of UAI A1) did not elicit the same responses: A1 had not been redistributed to another producer group even though many farmers whose crops failed did not receive replacement plots.

Concerning individual allotments, the "injustices" appear less obvious. Nevertheless, dignitaries, elders, and other important persons were served first, and therefore benefited from the best UAI. Inversely, caste groups and other people in peripheral villages (Daiba) had to content themselves with UAIs whose soils weren't always conducive to rice cultivation: B12 for Daiba, A16 for only the *Maabube* (weavers).

The only resistance we noticed was a quasi boycott effected by peasant leaders who complained that the construction of the plots was not adequate especially in terms of field leveling. These complaints indicate that some have noticed differences in the conception of the perimeters in the Department of Matam.

On the one hand, there is the Matam Project Phase III, to which Hamady-Ounaré belongs, in cooperative operation with SAED. The project was paid for by the Senegalese government with a loan from the French Caisse Centrale de la Coopération Economique, and the Abou Dhabi Foundation, which advocates maximum participation and responsibility on the part of the beneficiaries. Thus, it was planned that the basic structural framework of the scheme (canals and initial leveling) would be undertaken by a construction firm, while dikes and

secondary leveling of the fields would be undertaken by the peasants themselves. Furthermore, mechanization would be kept to a minimum, with the introduction of animal traction. Initially, the peasants were supposed to buy their own pump, with 15 percent of the cost from their own pockets and the rest in credit from the CNCAS (Senegalese National Bank of Credit). Under these conditions, a plot of .8 ha would be allotted to each household head.

On the other hand, we have the Italian project—presented as a gift by the Italian government—a highly mechanized scheme to be delivered in its finished state. The beneficiaries are to be allotted 1.4 ha per household of 10 working members.

Under these conditions, it is not surprising to hear grumbling among the peasant populations. All the same, the discontent surrounding Hamady-Ounaré seems political in nature. In fact, it cannot be denied that the political dimension was, aside from local and high-level concerns, an important catalyst for the discussion of the philosophical framework of the irrigation schemes in the Après-Barrages. Ultimately, the inhabitants quickly rallied around their primary direct interests, which were to make use of their plots despite the imperfections.

The many imperfections are are associated primarily with hydrology. A complicated pumping system, costly over the long term, was put into place. The original idea had been to pump water from the Diolol (a distributary of the Senegal River as large as the Diamel) from a pumping station and discharge the water upstream in a primary canal that would service a network of secondary canals. The UAIs, each of which has a small pump, would pump what they need into their canals. The pumped water would then flow into canals belonging to the UAI and flood fields by gravity flow. UAI members manage their pump independently. The principal pumping station is controlled by SAED but will eventually, in principle, be transferred to a Collective Interest group representing all the UAIs in the scheme. Therefore, there are two levels of pumping.

This does not take into account the drying up of the Diolol at the end of the season, in spite of several discharges of water from Manantali upon request to OMVS. After 15 days without irrigation in the scheme, which in certain areas caused the crops to fail, an emergency solution was implemented. A group of small pumps were positioned at the head of the tributary, some 25 kilometers upstream from the scheme at the level of the Senegal River, in order to recharge the Diolol and allow the water to be pumped to rice fields still needing water. There was therefore a third, improvised level of pumping.

Despite the absorption of the excess cost by the CCCE, this raises the problem of the economic dimension of such a concept within the domain of irrigation scheme development. The whole idea of the Après-Barrages is questionable as well. Will Manantali be able to provide a flow throughout the year sufficient to meet the demands of dual season rice production along the entire Senegal River network? Are we perhaps only in the preparatory phase of the normal situation that will prevail in the Après-Barrages?

9.5.3 Outline of the 1989-1990 Rice-growing Season at Hamady-Ounaré

Despite the late start following the tardy establishment of the UAIs and the lengthy interruption in irrigation at the end of the season prompted by the drying up of the Diolol, the results were reassuring, even satisfactory.

9.5.3.1 Surface Area Cultivated and Types of Crops

Of the 30 UAIs, whose surface area totals 644.2 ha, only 16 cultivated rice (356 ha, or 55.2 percent of the total area). Three UAIs were devoted to corn (90.4 ha, or 14.1 percent of the total area), and 11 were not harvested at all because the farmers refused to cultivate or the crop failed (197.8 ha, or 30.7 percent). We will discuss only rice cultivation here for several reasons:

- during our presence, the plots of corn had not yet been harvested;
- to grow corn was often a last-minute decision, when it was too late for the farmers to plant rice. It was not their first choice for a crop;
- farmers who grew corn did not need credit through the CNCAS. The cost/benefit analysis associated with this cultivation was therefore much more difficult to follow.

9.5.3.2. Labor

Labor techniques on the intermediate schemes are similar to those described for the PIVs, but with several differences:

- In contrast to the PIVs of Tiguere Cire and Doumga Rindiaw, labor is very well distributed among men and women, 57.8 and 42.2 percent respectively, of time devoted to work. As on Thially's PIV, women replace absent men in the fields.
- Since much of the work is carried out by women, fewer young children are called upon to work. Outlined below is the work distribution:

The Irrigated Rice Scheme at Hamady-Ounaré

Age groups	%
5-14 years	15.5
15-24 years	43.2
25-54 years	37.8
> 55 years	3.4

Thus, in contrast to the small-scale perimeters, children 5-14 years old and people older than 55 years participate less than at Doumga Rindiaw and Thially. Their absence is compensated for largely by women in the 15-54 age range.

- The labor force does not include a high percentage of family members, as did that of the PIV in Tiguere Cire. Neighbors are heavily relied upon. One explanation already offered for the PIVs was the lack of direct access to irrigated agriculture for all village households. Neighbors of an "owner" contribute their labor, acquiring in the process the means to obtain rice. Here, this is not the case, since all households have access to at least one plot in a UAI. The heavy participation of neighbors represents less a means for them to gain access to irrigated agriculture than it does a way of dealing with labor-intensive tasks that need doing in short periods of time. Thus, labor is evened out among the different plots.

Labor Category	%
Head galle	11.2
Galle members	46.7
Members outside the galle	2.3
Total (intra-familial)	60.2
Captives	-
Clientele	1.5
Neighbors	35.4
Talibe	.8
Paid labor	2.1
Total (extra familial)	39.8
	100.0

- The various tasks, even though they are the same for a plot on a PIV and one on an intermediate scheme, do not require the same proportion of labor. Thus, the entire harvest (cutting, threshing, winnowing, sacking, and transport) represents 79.9 percent of the total work time. For the other tasks, we have the following percentages:

Task	%
Clearing	3.1
Preparation	6.0
Working the soil	1.6
Planting	1.0
Transplanting	2.6
Spreading manure	.5
Weeding	3.6
Irrigation	1.7
Harvest	79.9
	100.0

The sum of these tasks totals an average of 4.014 hours per hectare. At first glance, irrigated agriculture on midsize schemes as on PIVs appears to require a great deal of effort and thus seems to compete poorly with concurrent recession agriculture, and even with rainfed agriculture. However, while much work must be done at the end of the season that can, ultimately, hinder the beginning of a second season following immediately afterwards—notably between the irrigated off-season and the rainy season—the selective mechanization of irrigated agriculture can alleviate the work burden associated with harvesting. Mechanization could take the form of threshers controlled privately and rented out. Some farmers have the experience, the willingness, and the means for this venture. Furthermore, this type of mechanization appears to be working successfully in the Podor zone on the Italian projects. This potential solution would attenuate the difficulties posed by labor shortages and migration.

9.5.3.3 Yields

Yields of rice average 6.075 tons/ha (6.2 on scheme A and 5.9 on scheme B). These figures are fairly high, in light of the difficulties encountered by the farmers, but they were obtained using sampling squares, and we believe they were overestimated. Our own surveys revealed only 4.920 tons/ha. We are well aware, however, that because we were working with SAED (whom we thank for its helpful collaboration), a number of farmers purposefully declared only a fraction of their harvest. Most likely, the true figures fall somewhere in between. In order to compare yields, we painstakingly calculated the gross production for a UAI, A2, which, generalized for the total area cultivated, gives a yield of 6.4 tons/ha, in contrast to the 7.2 tons/ha calculated by SAED from the sampling squares. We believe that the figures representing "SAED yields" should be reduced by 10 percent. In addition, all of our subsequent calculations were based upon figures provided by agricultural advisors who admitted having weighed rice before it had completely dried.

9.5.3.4 Cost Analysis

For the 16 UAIs cultivating rice, total costs were 36,529,650 FCFA (20,067,553 for the 9 UAIs in scheme A and 16,462,097 for the 7 UAIs in scheme B). The costs can be broken down thus:

	Input	%
•	seed	13.0
•	fertilizer (nitrogen: 18% and 18-5-46: 10%)	28.0
•	diesel	27.5
•	pump attendant	1.0
•	maintenance and spare parts	2.0
•	fees, membership fees, loan advancement through CNCAS	10.0
•	pump depreciation	11.5
•	loan interest	7.0
		100.0

The diesel mentioned here includes only the amount used for the UAI pump and not the amount used for the pumping station. SAED-CCCE has absorbed the costs up until now, but it is discussing passing on the costs to the producers. For stations A and B, the costs total 31,124,000 FCFA, 22,124,000 for diesel, 3,000,000 for labor, and 6,000,000 for depreciation of the pumps, which have been heavily used, especially when the Diolol at Waounde was refilled.

For the 356 hectares under rice production, fuel costs total 19,250,000 FCFA, or 54,073 FCFA/ha. In the discussion that follows, two figures for Gross Production Revenue (GPR) will be presented, the one experienced by farmers, and the real figure, indicated in parentheses, using the unsubsidized inputs that were predicted at the beginning of the season.

At 85 CFA/kilogram as paid by SAED, the commercial value of rice was 173,904,815 FCFA for 2,046 tons produced on the 356 hectares at Hamady-Ounaré. Of course, not all the rice was necessarily sold, nor at this price.

The Gross Production Revenue was calculated at 137,375,165 FCFA (118,125,165), which represents the equivalent of 8,585,948 FCFA per UAI (7,382,812). For the UAIs in scheme A, the total came to 9,036,824 FCFA, and for scheme B, 8,006,250, for a difference of one million FCFA which can be explained by the more numerous technical failures experienced by scheme B.

The Gross Production Revenue calculated at the producer level averaged 330,918 FCFA (286,918). Calculated per hectare it comes to 419,706 FCFA (364,706). At the level of scheme A the GPR/ha is 425,166 FCFA as compared to 412,686 for B, for a difference of 3 percent.

Recapitulated in Table 9.12 for all the UAIs in schemes A and B are the characteristics of the 1989-1990 season.

9.5.4 Conclusion

The intermediate schemes as currently conceived by the SAED and the CCCE appear to be less troubled in the final analysis than at first glance. These schemes do not preclude recession agriculture, but do hinder rainfed agriculture as a result of the superposition of different production schedules. Indeed, many individuals abandon rainfed agriculture because the returns to labor are not sufficient.

At the end of the first trial season, the schemes enjoy an enthusiastic following. Several migrants have already returned to Hamady-Ounaré to invest in rice hullers. If the conditions for maintenance and training can be maintained at current levels, it is a safe bet that a certain number of activities upstream and downstream of the project could be developed, but it is too early to be talking of overall success or failure. A span of at least five years is required before an overall assessment can be made. The skepticism expressed at the beginning has already

lifted, however, and the initial results are encouraging, compared to the small irrigated perimeters, whose limiting factor has been insufficient surface area cultivated per capita.

If the rate of return is 4.76, the margin of flexibility within the system remains very narrow. The rate of return is 3.1 if the costs at station A and B are taken into account, which are not insignificant, but acceptable if you take the following rule into consideration: 1/3 of the harvest is devoted to paying production costs, 1/3 is earmarked for monetary needs, and the remaining third for consumption. On the other hand, this precludes any error and imposes a high level of labor since it demands a minimum yield of 5 tons/ha, which as the UAIs age, could become difficult to achieve.

9.6 Conclusions and Outlines for Solutions

The problems generated by the combination of the internal dynamics of households who have access to plots, economic liberalization, and current improvements of rainfall and hydrological conditions are varied. Among the examples:

On Doumga Rindiaw's PIV, socioeconomic problems and their manifestation in the control of plots augmented quite noticeably between 1988 and 1989. On the PIV of the *Fulbe* village of Katoté, in the Rural Community of Bokidiawé, sharecropping is more significant than at Doumga Rindiaw, and furthermore, four plots were sold to individuals from other villages.

In another village, a well-endowed individual covers the cost of the production fees on the PIV and is repaid by the beneficiaries in paddy at the end of the season, at a price well below that offered by SAED.

Here and there, farmers are trying by any means possible to reduce their production costs by minimizing the amount of nitrogen, phosphate, and water (by counting on rainfall as a replacement), by not replacing their seed stocks, etc. Such practices bring on a fall in yields as has been witnessed in the Department of Matam, where yields have been decreasing since 1986.

Speaking more generally, in the same department, of the 215 established PIVs, only 121 were utilized in their entirety or partially during the 1989-90 rainy season. The other perimeters confronted diverse problems classified into three categories by SAED: construction difficulties (34 PIVs), broken pumps (34 PIVs), and "social problems" (26 PIVs). According to the delegation of Matam, this last category involves, above all, "old" PIVs.[91]

When all is considered, the Village Perimeter is witnessing an accumulation of what SAED has called "social problems," which manifest themselves in the deteriorating process of

[91] Personal communication from the Delegation of SAED-Matam.

Table 9.12 Summary of the Performance of the UAI. Casiers A and B

UAI	Mem-bers	Area (ha)	Rice Maize	Costs (KF)	Tons/ Ha	Tons (rice)	Value (KF)	GRH/UAI (KF)	GRH/ Member (KF)
A.1	28	22.0	NOT CULTIVATED						
A.2	31	24.8	rice	2 713	7.2	179.8	15 283	12 570	405.5
A.3	22	17.6	rice	1 850	5.2	91.7	7 791	5 941	270.0
A.4	34	27.2	rice	2 700	5.6	151.4	12 869	10 169	299.1
A.5	28	NOT CULTIVATED							
A.6	26	16.5	rice	2 042	6.3	109.9	9 344	7 303	280.9
A.7	34	24.0	rice	2 839	6.8	163.6	13 907	11 517	338.7
A.8	26	20.8	rice	2 130	6.4	133.1	11 315	9 185	353.3
A.9	33	25.4	rice	2 418	6.9	175.3	14 897	12 480	378.2
A.10	23	16.2	rice	2 060	6.5	105.3	8 950	6 891	299.6
A.11	25	23.2	NOT CULTIVATED						
A.12	37	29.6	maize	98					
A.13	25	30.0	NOT CULTIVATED						
A.14	38	29.0	NOT CULTIVATED						
A.15	21	16.1	rice	2 382	5.1	82.8	7 042	4 660	221.9
A.16	37	29.0	NOT CULTIVATED						
A.17	24	19.0	NOT CULTIVATED						

Casier B

UAI	Mem-bers	Area (ha)	Rice Maize	Costs (KF)	Tons/ Ha	Tons (rice)	Value (KF)	GRH/UAI KF	GRH/ Member (KF)
B.1	27	21.6	rice	2 343	4.7	102.1	8 599	6 256	231.7
B.2	20	21.0	rice	1 460	6.0	125.6	10 680	9 220	461.0
B.3	27	21.6	rice	2 393	6.7	144.0	12 240	9 847	364.7
B.4	25	20.0	rice	2 304	5.4	107.0	9 102	6 798	271.9
B.5	20	16.0	rice	2 212	5.9	94.4	8 024	5 812	290.6
B.6	25	20.0	NOT CULTIVATED						
B.7	20	15.2	rice	CROP FAILURE					
B.8	14	12.8	maize	219					
B.9	25	20.0	rice	3 417	6.6	132.6	11 271	7 854	314.2
B.10	18	14.4	rice	2 333	5.9	85.2	7 242	4 909	272.7
B.11	29	23.2	maize	55					
B.12	31	24.8	NOT CULTIVATED						
B.13	33	26.4	NOT CULTIVATED						

the democratization of access to land, and in the progressive disorganization of producer groups. The initially relatively democratic system of land tenure seems to be changing progressively into a system no less inegalitarian than that of traditional land tenure.

Over the last decade, important demographic changes have taken place within households involved in agriculture on the PIVs. The profile of these households will continue to change, and it is impossible to counteract this turn of events. Irrigated land will fall less and less often into the hands of those who have the labor capacity to work it themselves. Such phenomena, which hinder the productive use of fairly costly infrastructure, cannot be sustained over the long term. The only possible solution, which consists of a periodic redistribution of plots, is plagued with economic difficulties. There are practically no producer groups who are not indebted to SAED and/or, recently, the Senegal Central Bank of Agricultural Credit (CNCAS). With the reform of the Cooperative Movement of 1983, the cohesion of the producer group has served as a credit guaranty. Will it be necessary with each redistribution then, to annul accumulated debts of individual producers? Will the new plot owners agree to reimburse debts that they have not incurred? Will peasants who have had their lands expropriated be held accountable for their debts? Such decisions are neither easy to make nor to implement.

A controlled flood from Manantali will make recession cultivation possible, at least during the next decade, on substantial areas of the *waalo*. This fact, combined with the improvement in the rainfall in the *jeeri*, risks reorienting the economic strategies of the inhabitants in the Valley toward traditional agriculture rather than toward costly, labor-intensive irrigation schemes. In this case, one can only agree with DGIS' claim that at best, "irrigation will continue to be only one of many sources of family income. Farmers are always required to prioritize their strategies. . . As a result, irrigated agriculture risks becoming a punctual activity, and the long-term development of the system as a whole will be uncertain" (Directorat Général de la Coopération International 1988:3).

In the Department of Matam, a third of the perimeters that were not functioning during the 1989 rainy season had difficulties with pumps. This situation was entirely predictable, given that the depreciation accounts for the pumps were not in the black for any of the PIVs. The ingenuity of the mechanics at SAED is not sufficient to make pumps over ten years old (12 years old for Bosséa I) operational, since their life expectancy stands at 5 years. What will happen if SAED no longer contributes to the maintenance of equipment? Or if it no longer rehabilitates schemes?[92] And if the state no longer guarantees a price for the rice, or starts charging for

[92] Once rehabilitation of a PIV is necessary, it has already accumulated such a plethora of social problems that bringing heavy equipment onto the site is not sufficient to put things in order. Similarly, a broken pump or defective infrastructure often masks the disorganization of the associated producer group. For example, when the pump in Boyenadji Roumdé was pushed by the flood to Mbakhna, twenty kilometers or so downstream, the producer group in this first village made no effort to retrieve it. In fact, the group appeared relieved.

water use? If there is no change in the political orientation of the state—which is likely—in view of the present situation of the PIVs, it is not known how the peasants will manage to survive.

Changes affecting producer households, levels of precipitation, favorable hydrological conditions, and the withdrawal of the state combine and add to the classic problems associated with irrigation in the Valley. The manner in which irrigated agriculture is financed demonstrates perfectly the narrowness of the margin offered to developers interested in intensification paid for by peasants.

In contrast to land devoted to traditional agriculture, land destined for irrigated agriculture is sold (approximately 25,000 FCFA per .30 ha plot currently). Because it is illegal, this practice remains secret, and is probably kept in check by the presence of SAED. What will happen if SAED becomes less visible, and private interests wishing to benefit from the presence of the schemes offer higher prices that could supply prospective migrants with a ticket out of the Valley?

The rapid proliferation of irrigated perimeters can be attributed neither to a generalized infatuation with irrigation, as SAED believed, nor to a fad. Individuals who have abandoned their plots can create a new PIV after forming a new producer group. They then benefit from new schemes and new equipment. Moreover, faced with oversized perimeters following the massive withdrawal of plot users, it is in the interest of those still farming on them to regroup to create a new PIV.

As has been mentioned earlier, if those who have access to adequate labor do not have the means to pay production costs, nothing prevents the possibility of future irrigation being financed on a sharecropping basis by privileged villagers (migrants, for example), or by individuals from outside the village or the Valley. Such a case has been noted at Mbilor, in the Department of Dagana, and the intervention of administrative and political authorities from this department became necessary in order to terminate a contract involving a businessman—from the Opposition—established in Dakar but whose native village was located in this region. And if he had been a member of the Majority, or of the party in power?

The Rural Council that allocates land may only give it officially to members of the Rural Community, which disempowers potential colonizers of the Valley. This is why, when the Rural Council allocated 400 hectares to the Rural Community of Ndiayène Pendao to a Mouride marabout, a local cry of indignation forced it to retract its decision. Businessmen and marabouts from the peanut basin who look for a loophole in the system will find one in sharecropping arrangements encouraged by the tacit and interested complicity of villagers too poor to finance irrigated agriculture themselves.

9.6.1 Avenues of Exploration

A technical approach still dominates irrigation programs in the Senegal River Valley. Though the system cannot be said to be totally bankrupt, the situation seems to have arrived at

an impasse no longer easily hidden by the high rate of scheme development, with an implementation rate still moderate, but significant, in the eyes of public powers. As a specialist on the subject has noted, "it seems . . . crucial for all irrigation programs . . . to emphasize not the soils, the topography, or the hydrology. In the end, these factors are secondary as compared to social criteria which are the veritable guarantors of long-term success of schemes" (Guinard 1988:23).

The current problems experienced by Village Irrigated Perimeters confirm this hypothesis. Indeed, the PIVs appear to be suffering from a case of early senility. Over time, coincidental with the aging of the equipment and infrastructure, producer groups in PIVs become embroiled in delicate "social problems." The unavoidable change in membership and in the priorities of producer group members affect the group's cohesion, threatening the principles of democracy and social justice that underlie the original system of land tenure. This system seems inevitably to be evolving toward a tenure system similar to the traditional system respected in the zones of agricultural recession, a system particularly inappropriate for irrigation. Withdrawals, sales, loans of fields, and sharecropping increase proportionally with the age of the perimeter. Persons continuing to cultivate their plots must come to terms with the higher individual costs of equipment maintenance and the upkeep of infrastructure, which must be added to already very high user fees resulting from SAED's withdrawal and from unsubsidized prices of agricultural inputs. The land tenure arrangements on the PIVs show new possibilities of direct or indirect access to land for anyone capable of financing irrigated agriculture. Already, a disguised agricultural wage labor force of poor farmers working as sharecroppers for "absentee owners" is emerging.

The withdrawal of SAED and of the State, as well as the improvement in the local rainfall and hydrological conditions, accelerate the observed tendencies and precipitate the general decline of the PIVs. With no noticeable change of conditions on the PIVS predicted for the short term, the golden age of the PIVs appears to have come to an end, but because the cases documented here may be specific to the area or to the period of reference, the same phenomenon must be studied on a larger scale and longitudinally before drawing any general conclusions.

The future of irrigation in the Valley may lie elsewhere, with intermediary schemes that would allow for the production of marketable surpluses and the generation of income necessary for financing irrigated agriculture. This would mitigate some of the present problems, but not eliminate them over the long term, because plots can always be passed on to households with an inadequate labor force for this type of agriculture. In other words, it is crucial to study in more detail the social and land tenure aspects of irrigation. Otherwise, the farmers in the Valley will not benefit from the Après-Barrages.

Among the most urgent problems to be resolved is the lack of monetary revenue at the local level. Attempts to resolve this problem must not sacrifice food security, which must remain a priority since it is a *sine qua non* to any grassroots development. Improvements in recession agriculture could play a key role within this framework. Agricultural diversification on the PIVs and the promotion of gardening, accompanied by improved market networks and

a greater involvement of women, are avenues to be explored in the search for adequate local income. Small animal husbandry needs to be seriously investigated in this regard. For many households on the edge, animal husbandry represents the only source of monetary revenue, but for this reason and in light of increasing market penetration, it is threatened. However, domestic livestock rearing could benefit more from the by-products of recession, rainfed, and irrigated agriculture if a simple and low-cost technique were developed to produce high-quality feed from local products.

The collective organization of agricultural production on the PIVs needs fundamental revision. Villages are not homogeneous entities unaffected by changes taking place in the rest of the country. They are undergoing a process of increasing economic differentiation. At the lineage and village levels forms of solidarity continue to operate. The first conclusion to draw from this is that the size of irrigated plots must be adapted according to the physical and economic capacity of the associated households. The second conclusion is that the producer group must reflect real, and not supposed, solidarity, which can be achieved often only through a reduction in group size.

The legal status of land in irrigated agriculture needs to be more clearly defined in the sense that greater land security can serve as collateral for credit. This delicate problem concerns the entire national land tenure policy. It must now have been realized that the law of the National Domain has not benefited rural development. It has not proven useful anywhere where land is valued—not in the Niayes, nor in the Valley at present. On the contrary, it often avoids or dodges problems rather than addressing and attempting to resolve them. This law, instead of protecting the weak, encourages "the law of the jungle." Admittedly, nothing concerned with land is simple, but the courage must be found to reflect more deeply on this issue while there is still time.

10. Household Budgets and Granary Stocks

10.1 Introduction

Previous findings in this report have demonstrated that families experience chronic shortages of both labor and capital as they strive to maintain a minimal level of food security. Labor scarcity occurs as households recognize the economic advantage of sending the most productive adult members off-farm as wage-earners. They generally assume that the opportunity cost of retaining adult labor in the village will be high compared to the potential revenues that may be gained from off-farm wage or trade opportunities. The Senegal government is presently confronted with the problem of a growing rural-to-urban migration, as rural inhabitants increasingly seek income off-farm because current village production activities fail to meet families' basic living costs. Government plans for developing the agricultural sector must, to mitigate that problem, incorporate a policy responsive to the resource limitations facing rural households in the Senegal Valley.

The nature and magnitude of resource scarcity, with respect to capital in particular, is reflected in a study of family budgets that was undertaken during a twelve-month period at the principal research sites.[93] This survey illustrates the degree to which the scarcity of capital constrains farmers in their desire to invest in productive on-farm activities such as agriculture, herding, or fishing. Furthermore, by identifying the periodicity or seasonal fluctuation of household cash flows, the survey makes it possible to identify critical peak periods of demand. This has direct implications for planning appropriate development interventions so as not to impose capital demands on the producer at a time when household maintenance requirements are at their highest.

The examination of household budgets is followed by an analysis of the nature of granary stocks throughout the year. The period of demand for capital expenditures in rainfed, recession, and irrigation agriculture coincides with a period of significant drawdown of household granary stocks, when scanty cash revenues must be spent on cereal crops (*jiggoore*) in order to replenish grain reserves. Thus, competing demands for cash occur during the months of millet, sorghum,

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[93] The study sample includes a total of 45 households in Doumga Rindiaw, Boyenadji Roumde, Mbanane, Tiéhel, Tiguere Cire, Mogo YalaBé, and Thiemping that were followed on a biweekly basis from December 1988 to December 1989. One household from Thiemping has been eliminated in the analysis here because it showed unusually high cash revenues and expenditures that skew the findings. Were his household included, this individual, a wealthy migrant, would account for some 40 percent of all revenues in the 15-household Thiemping sample. Only 44 households are therefore analyzed in this section. All flows in cash and kind were systematically recorded during this period, and both structured and informal interviews with household members were undertaken to understand the context in which the household economy functions. The findings discussed in this section concentrate primarily on cash flows rather than those occurring in kind.

and rice production—June through October—a period that corresponds with the lean period between waalo and jeeri harvests when the food supply is critically low and must be restocked. Smallholders, hard-pressed to come up with enough cash to meet both demands, rely increasingly on off-farm migratory incomes during this period, and migrant family members feel the growing tensions and strains.

Before discussing in detail the findings of the budget surveys, we describe the field methodology employed and the problem of obtaining accurate and reliable data.

10.2 Methodology

We devised a series of structured questionnaires to encompass on- and off-farm production and other income-generating activities as well as all major categories of cash and noncash expenditures. The objectives of the survey were to identify and follow the flow of all goods and cash in and out of the household during a one-year period and to understand the degree to which both local production systems and off-farm activities meet the consumption needs of rural families.

Five structured surveys were administered to observe flows in cash and kind in the following areas:

1. Household revenue sources
2. Household expenditures
3. Livestock production
4. Fishing
5. Food consumption

The limitations in undertaking and interpreting the quantitative data in a survey of this nature are well recognized by anthropologists, rural economists, and other social scientists. Initial reluctance by survey participants to disclose sensitive and personal information about family budgets declined over time, as mutual trust and confidence between the field team and participants grew. Overall, the household budgetary information is relatively reliable and reflects accurately the general patterns to be discerned in revenue sources and spending. At all sites, data show that participants were more willing to reveal their expenditures than their revenues. This is evident in the budget figures presented in this section, where spending exceeds revenues at all three research sites. In the Doumga Rindiaw sample, 6 of the 15 households followed have been eliminated from Table 10.1 on Sources of Household Expenditure because of extreme budget discrepancies between revenues and expenditures. If noncash as well as cash flows are taken into account, spending exceeds income by 11 percent for the entire Doumga Rindiaw sample. In Boyenadji Roumde this figure is higher, at 26 percent. Only cash flows were compared in Thiemping, where spending exceeded revenues by 11 percent.

Household revenues were approached by dividing all economic transactions into on-farm and off-farm activities. Expenditures are broadly divided into the agricultural sector and the

nonagricultural sector, with a separate third category for purchases of food, to allow analysis of the extent to which food self-sufficiency is attained. All revenue and expense categories discussed in the data analysis to follow are summarized here.

A. Source of Household Revenues

1. On-Farm

   a. Artisanry—income from artisanal products (pottery, cloth, woodwork, jewelry and smithing, etc.)
   b. Commerce—income from selling imported market items (fish, grain, tea, sugar, etc.), and a wide array of commercial village activities, from shopkeeping and flour mill sales to hair braiding and fuelwood sales
   c. Credit—cash borrowed or received as reimbursement for loans
   d. Crops/Forage—income from sales of farm crops (grains, vegetables, legumes); their by-products as fodder; and other forage and gathered materials (nutritious plant leaves, gum arabic, etc.)
   e. Fishing—income from riverine fish sales
   f. Labor—income from all farm-related activities, such as crop transport fees, flour mill operations, and village-herder fees
   g. Livestock—income from livestock and dairy sales
   h. Social—all cash gifts received from outside the household

2. Off-Farm

   a. Migration—cash remittances and postal money orders
   b. Pension—military and retirement funds

B. Purpose of Household Expenditures

1. Agricultural Sector

   a. Agriculture—costs of such inputs as seed, fertilizer, tools, and, for irrigation pumps, costs of fuel, parts, and maintenance
   b. Fishing—purchase of fishing equipment
   c. Livestock—purchase of animals, and maintenance costs (fodder, veterinary care)

2. Nonagricultural Sector

   a. Artisanry—purchase of locally made artisanal products
   b. Commerce—purchase of small goods and food items for resale
   c. Credit—cash given on loan, or money repaid on an outstanding loan

d. Labor—cash payments for on-farm services such as herding, and fees for transporting harvests
e. Personal—includes a wide range of household needs such as personal hygiene, clothing, house furnishings, leisure items, energy costs, taxes, and education
f. Social—cash expenses for gifts and prestations for social and religious ceremonies
g. Transport—passenger transportation fees

3. Food Purchases—includes all cash purchases of local and imported food items

10.3 Analysis of Household Budgets

10.3.1 Source of Household Revenues[94]

The budget data show that families diversify to some extent the sources of their household earnings (Table 10.1). Incomes are derived from a mix of off- and on-farm activities, of which off-farm sources provide the largest portion in Doumga Rindiaw and Thiemping. (Boyenadji Roumde's large on-farm revenues are explained below.) This finding confirms observations from other studies concerning the primary role of migration in generating family revenues in the Senegal Valley (Boutillier et al. 1962; Diop 1965; Lericollais 1975; Minvielle 1985; Weigel 1982).

Smallholders' reliance on off-farm earnings may be partially explained by the fact that farm-sector activities, such as agriculture, herding, and fishing, are undertaken primarily for their subsistence rather than their commercial value. At all three village sites, revenues from agropastoral and fish production account for less than one-quarter of all household revenues. The dominant production strategies are a reflection of the geographical location of each village. In Doumga Rindiaw, which has close linkages with the transhumant pastoral communities to the south, livestock sales make up the largest portion of farm sector revenues at 12.8 percent. In a riverine village such as Thiemping, on the other hand, revenues from fishing constitute a vital

[94] In Table 10.1 household revenue is based on figures for gross rather than net income for each activity. Determining net income is extremely difficult for such on-farm activities as artisanry, commerce, crop production, fishing, and livestock, because estimates of the costs are not always available. For example, in the case of livestock, animals are frequently born on the farm rather than purchased, and later sold. The costs of maintaining such animals (food and labor) must be taken into account if net revenue from their sale is to be determined. As these and similar measures were not accessible, an accurate reporting of net income is not feasible.

Table 10.1 Source of Household Revenues in Doumga Rindiaw, Boyenadji Roumde and Thiemping

Outside Revenues	Doumga Rindiaw		Boyenadji Roumde		Thiemping	
	%	FCFA	%	FCFA	%	FCFA
Migration	39.1	1,772,090	18.6	2,318,750	62.1	5,061,500
Pensions	22.3*	1,010,680*	8.7	1,083,050	2.9	232,250
Subtotal	61.4	2,782,770	27.3	3,401,800	65.0	5,293,750
Local Revenues						
Artisanry	2.5	113,305	3.0	374,575	0.4	33,200
Commerce	6.0	271,932	48.3	6,004,360	10.8	882,445
Credit	5.9	267,400	6.3	785,530	1.1	91,500
Farming/Foraging	10.0	453,220	8.9	1,107,305	1.5	119,300
Fishing	0	0	0	3,700	13.7	1,112,870
Farm labor	0	0	0	0	1.5	125,100
Livestock	12.8	580,122	4.8	601,400	3.1	249,500
Social	1.4	63,451	1.4	155,990	2.9	238,600
Subtotal	38.6	1,749,430	72.7	9,032,860	35.0	2,852,515
Total	100.0	4,532,200	100.0	12,434,660	100.0	8,146,265

component of the local farm economy.[95] The sale of agricultural crops and forage by-products (sorghum and maize stalks, cowpea vines) at Doumga Rindiaw and Boyenadji Roumde represents an important element of the farm economy as well.[96] Nonetheless, when crop revenues are viewed in relation to gross household cash incomes, it becomes apparent that agriculture is undertaken largely for subsistence.

The subsistence orientation of the local farm economy is also reflected in the fact that on-farm wage-earning opportunities are rare. As indicated earlier, farm-sector production, with the exception of irrigated rice, involves low capital investment. A general scarcity of capital does not allow for extensive on-farm wage-labor at present. Only such arduous field tasks as weeding

[95] The figure on revenues derived from fishing in Thiemping (13.7 percent) probably overrepresents to a slight extent the actual commercial importance of fishing in the village because the single most active fishing household in the village was randomly selected in the study sample.

[96] In the Boyenadji sample, the Crops/Forage category includes the sale of gum arabic, which generates sizable revenues for households located in the jeeri.

and fence construction are occasionally remunerated, at a daily wage rate of 1,000 FCFA. Before the border conflict between Senegal and Mauritania, this labor was often provided by a black, ex-slave caste (*haratine*) Mauritanian population that would migrate seasonally to the riverine villages in Senegal in search of temporary employment.

The most frequent wage arrangement was observed at the village sites during the waalo harvest period, when individuals with horse-drawn carts were paid in either cash or kind for each cart of sorghum transported. A wage arrangement for pastoral activities also exists in most villages. A resident herder or *gaynako* is paid in cash or grain for each animal guarded.[97]

The influence of geographical location on the pattern of household earnings is especially evident in Boyenadji Roumde, where commercial sale of farm products makes up almost one-half of gross revenues. This unusually high figure reflects the particular location of the village, which is close to both Matam and Ourossogui, the region's principal commercial centers. Many women in Boyenadji purchase food items in bulk for resale in their village.[98]

In two of the three research sites, Doumga Rindiaw and Thiemping, revenue profiles are similar despite the locational differences. In both cases, off-farm revenue comprises nearly two-thirds of total gross income. In Thiemping, migratory wages are particularly high (62.1 percent).

Household revenues also help quantify the economic differentiation that is to be found within (as well as among) villages. While rural communities may appear to be characterized by populations that are relatively homogeneous in economic terms, annual per capita incomes are actually highly stratified. For example, in Doumga Rindiaw, per capita incomes varied between 11,000 FCFA and 110,000 FCFA in the households studied. The relative economic status and degree of differentiation between villages is evident in a comparison of either household or per capita incomes in Thiemping and Doumga Rindiaw. In Thiemping, average gross annual income per household was 581,876 FCFA, or 65,930 FCFA per capita. In Doumga, household and per

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[97] The village herder appears in the Thiemping sample but was not randomly selected in the Doumga Rindiaw and Boyenadji Roumde samples, therefore Table 10.1 shows no labor revenue for those two villages. Other wage-earning activities were observed in the villages studied (although not in the household-budget samples), but these instances are quite rare. For example, at one site a young man was employed to operate and maintain a diesel-powered flour mill for a women's cooperative. In the same village, two men were hired as full-time laborers and watchmen in a private irrigated perimeter producing vegetables.

[98] The contribution of commercial activities to overall household revenues in Boyenadji is reported as gross as opposed to net revenue. Once the costs of doing commerce are factored in (e.g., bulk purchases) net earnings are about 27 percent of total household revenues.

capita incomes were substantially less, at 390,000 and 49,000 FCFA respectively.[99] The differences in average cash incomes in these two villages may be attributed primarily to the greater value of migratory remittances in Thiemping.

Economic stratification in the villages is more pronounced than might have been expected given the relative importance of the local subsistence economy. These inequalities would be less pronounced if agricultural activities had remained the principal source of income. As already mentioned, inequality stems from the large and growing role of local off-farm revenues, and above all outside income derived from migration, salaries, and pensions. These circumstances have resulted in, on the one hand, a deteriorating situation for those who have access only to agricultural income, and on the other hand, the emergence of relatively well-off strata who depend for the most part—if not exclusively—on outside off-farm income. When members of the privileged strata become involved in farming, it is most often as "absentee landowners" in irrigated agriculture.

10.3.2 Patterns of Household Expenditures

Where families must survive on very low incomes, it is not surprising that a large portion of the household budget be devoted to food. The proportion of revenues allocated for food may be given as an approximation of the general state of poverty or affluence within a society. Many families in European countries currently spend about a fourth of their incomes on food consumption, while the figure is only about 13 percent in the United States. In contrast, cash spending for food in the villages studied ranges from about 50 to 80 percent of the average family budget (Table 10.2). These figures indirectly support the earlier observation on household revenues that family incomes are low in the Middle Valley, allowing little cash for investment in the farm sector.

Imported food items, particularly rice and coastal fish from St. Louis, account for the largest portion of expenditures in the family budgets. At all three sites, close to 50 percent (more at Thiemping) of total revenues is spent on imported foods. Proximity to the Senegal River does not necessarily produce a preference for riverine fish. At Thiemping, ocean fish represents an important element in the local diet, accounting for 11 percent of total spending.

Second in importance to food is the array of nonagricultural expenses, of which personal household goods are the most important. A broad range of items fall under this category, including clothing, house furnishings, energy (fuelwood and kerosene), personal hygiene, taxes, and education. Transportation accounts for a slightly larger portion of total spending in Doumga and Boyenadji than in Thiemping primarily because of the relative isolation of Thiemping; the other two sites are advantageously located near the national highway.

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[99] In both villages per capita incomes are considerably below the national figure for Senegal of 100,000 FCFA.

Table 10.2 Patterns of Household Expenditures in Doumga Rindiaw, Boyenadji Roumde and Thiemping

Agricultural Sector	Doumga Rindiaw		Boyenadji Roumde		Thiemping	
	%	FCFA	%	FCFA	%	FCFA
Agriculture*	3.0	140,150	0.2	45,500	1.1	103,100
Fishing	0	0	0	0	0.5	45,500
Livestock*	0	0	1.2	217,525	4.4	419,050
Subtotal	3.0	140,150	1.4	263,025	6.0	567,650
Nonagricultural Sector						
Artisanry	0	0	5.0	942,090	0	0
Commerce	0	0	20.7	3,903,505	1.1	103,475
Credit	3.8	178,750	2.4	453,240	0.4	41,000
Labor	0	0	1.4	262,500	1.1	106,150
Personal	7.1	336,330	8.9	1,680,225	5.3	506,605
Social/Health	4.2	196,855	4.8	893,848	3.0	286,285
Transport	4.3	201,200	4.3	809,673	1.1	104,450
Subtotal	19.4	913,135	47.5	8,945,081	12.0	1,147,965
Food Purchased						
Imported	51.2	2,413,333	44.8	8,429,325	76.0	7,271,385
Local produce	26.4	1,245,882	6.3	1,191,270	6.0	576,225
Subtotal	77.6	3,659,215	51.1	9,620,595	82.0	7,847,610
Total	100.0	4,712,500	100.0	18,828,701	100.0	9,563,225

*In recording the household expenditure data, livestock purchases in Doumga Rindiaw were reported together with capital inputs in agriculture and are here combined under the agriculture category.

Just as opportunities for earning cash through farm labor activities are limited, so too are the amounts of cash spent to hire field labor or pay for herding services. The figures here again reveal the extent to which farm production is carried out with rather low cash inputs.

Because of the need to ensure food security, little money is available for investment in productive farm activities. Smallholders on average spend very little of their family earnings on capital costs of on-farm activities. Customary forms of production have generally required low capital investment, and initiatives to improve the system through modest increments of capital have been rare, understandably in light of the monetary constraints that farmers face. Planners who aim to boost production of these indigenous systems must take into account the scarcity of capital in the region.

10.3.3 The Commercial Value of Local Farm Production

The analysis of household budgets has shown that incomes are targeted primarily for food purchases to maintain the nutritional well-being of family members. The large proportion of earnings required to feed the family implies that on-farm production systems are incapable of meeting all the household's food requirements. Nonetheless, local production is essential to the nutritional needs of the community; its commercial value has been seriously underestimated and rarely if ever measured in the Middle Valley. In order to understand the significance of local production for reducing food purchases, household dietary patterns were recorded on a biweekly basis during the twelve-month research period. By asking about the sources of food supplies and tracking their market prices, we have been able to estimate the commercial value of both local and imported food items.

All local produce that was consumed has been assigned a market value that reflects the going purchase price of the item in the village market at the time it was consumed. The cost of all purchased foods, both local and imported, were recorded at the time of the interviews. Local produce includes all locally grown grains such as sorghum, millet, and corn; vegetables and legumes; riverine fish; and meat and related dairy products.

A comparison of the cost of purchased food items and the market value of local produce indicates that on-farm systems (Local Produce plus Food Grown) provide from a quarter to a half of the total value of food consumed (Table 10.3). In both Doumga and Boyenadji the contribution of local production is higher than in Thiemping. This may be a result of the absence of irrigated agriculture and the very small size of rainfed jeeri fields in Thiemping. By measuring the economic value of on-farm production, it is possible to show that local systems do play an essential role in meeting the consumption requirements of rural households.

Table 10.3 The Commercial Value of Local and Imported Foods Consumed in Doumga Rindiaw, Boyenadji Roumde, and Thiemping

	Doumga Rindiaw		Boyenadji Roumde		Thiemping	
	%	FCFA	%	FCFA	%	FCFA
Food Purchased Imported	48.6	2,413,333	67.4	8,429,325	76.2	7,271,385
Food Purchased Local Produce	25.1	1,245,882	9.5	1,191,270	6.0	576,225
Food Grown	26.3	1,303,210	23.1	2,894,445	17.8	1,701,707
Total	100.0	4,962,425	100.0	12,515,040	100.0	9,549,317

10.4 Monitoring Granary Stocks

Middle Valley residents manage to achieve food security only by supplementing their household cash earnings with harvests from an array of production systems that have been the object of detailed analysis in this report. Budget data above have shown that local crops, livestock, and fish contribute significantly to household dietary needs. Each local production system contributes to the overall volume of household food stocks and the fluctuations in those stocks that occur during the course of the year.

We closely monitored granary supplies throughout the agricultural cycle, observing the months when reserves exceed current consumption requirements and when they fall short. While there are differences among the three village sites and the data are specific to a single year, it is clear that no household can sustain itself from the production of only one of the system's agricultural components: rainfed farming, recession cultivation, or irrigation. Every household required contributions from at least two of the three components, and many depended on all three to provide food sufficient to maintain themselves throughout the year.

Fluctuations in granary stocks were recorded from October 1988 to August 1989. In addition to grains produced by their own members, households secured foods from land rent fees collected at harvest time, from gifts, labor services involving crop payments, crop purchases, loan reimbursements in the form of grain, and barter. Granaries are depleted mainly through household consumption, with this use ranging between 64.2 and 76.7 percent in Thiemping and reaching 89.2 percent in Boyenadji Roumde. The remainder of the drawdown is for land rent fees, gifts, labor services, animal feed, barter, and sale.

Granaries are restocked mainly in October, January, and March, corresponding to jeeri, PIV, and waalo harvests. In Doumga Rindiaw, across the 1988-89 season, 46.5 percent of total grain supplies came from flood recession fields, 34.5 percent from rainfed agriculture, and 15.5 percent from irrigated perimeters. The remaining 3.5 percent was made up of purchased imported grains. Thiemping had no irrigated agriculture in 1988-1989. Waalo sorghum production accounted for 57.8 percent of grain (slightly more than 6.6 percent of this came from river bank or falo fields), and 42.2 percent was rainfed millet.

Boyenadji Roumde had a poor 1988-89 flood-recession season, and only about a third of the 99.1-hectare waalo was actually farmed. Many farmers said that the bulk of their field had been insufficiently flooded to provide a harvest, and many complained of losses from locust incursions. Severe weed infestations and labor shortages were also mentioned. Average waalo yields were actually lower than either PIV or jeeri yields, an unusual situation.

In anticipation of household grain shortages later in the cycle, merchants often buy grain as an investment immediately after the rainfed and recession harvests, when quantities are high and prices low. Farmers then repurchase their own grains from these merchants between April and September, when stocks are lowest and prices are high. As granary reserves decrease through the season, spending on grains as well as other food commodities increases. The rising

cash demand for food purchases competes with the increasing need for buying inputs that are required during the peak months of agricultural activity (June-October). In particular, the need to purchase inputs for a capital-intensive irrigation sector overlaps with increased spending on food budgets during this period.

Within each research site, the status of granaries varies by household caste affiliation and access to land, labor, and capital. In Thiemping, the Maccube, of captive origins, have greater grain reserves than any of the other five castes present. Maccube households also have the greatest consumption demands, however, so their larger stocks need not imply a capacity to accumulate a surplus. Moreover, Maccube are not landowners, and they need grain to pay land rents and to make gifts to the maraboutic Toorobbe. The specialist shepherding caste in Thiemping, the Fulbe, earn approximately two-thirds of their grain in exchange for herding village livestock, while landowning Sebbe and Subalbe receive grain as rent, and Toorobbe confirm their clerical status by receiving grain as religious tithes. The artisanal Nyeenybe also receive gifts of grain, but in response to a form of institutionalized begging, the gifts reinforcing their low social status.

In Boyenadji Roumde, Fulbe are almost entirely self-sufficient in cereals from their own fields, whereas Subalbe and Nyeenybe are more dependent on purchased grains, supplemented for the latter by begging, as in Thiemping. Again, Maccube produce most of their own grain requirements on rented fields.

In addition to caste affiliation, households have been classified according to their relative degrees of security in grain supply throughout the year. Three distinct classes of food security emerge:

(1) Households with surplus grain stocks, who have reserves of grain during the month of September—typically the hungriest month—in excess of what is needed to carry them to the following jeeri or rainfed millet harvest.

(2) Households with stable stocks, who have grain just sufficient to cover consumption demands until the jeeri harvest.

(3) Households with deficit stocks, who exhaust domestic grain reserves early, sometimes as early as April, six months before the next harvest.

A preliminary examination of granary stock flow data do indicate that a diversified production strategy, especially the combination of rainfed and recession cultivation (yielding mainly millet and sorghum, respectively), provides food security for the largest number of households. The capital input requirements of both are modest and the two do not compete between them for labor. Both labor and capital costs are high on the PIVs, rendering their net returns problematic, and PIVs tend to compete with rainfed farming for labor.

10.5 Conclusions

This study of household budgets and flows of grain stocks reveals the permanence of two major phenomena: the general overall poverty of the local populations, and everpresent migration. This means that villages continue to be considered "rejection" sites of local populations while the outside world presents "attraction poles" that are more tempting than ever. As long as this situation remains unchanged, no development plans in the valley will succeed, because all the plans that could be implemented require labor.

Local systems of agriculture, which represent the pillars of the production systems for the majority of households, all respond to a logic of subsistence whose rationality is being strongly compromised by market logic and by the rural populations' increased need for money. Farmers without access to money, often externally generated, are the most strongly affected by the present course of events. They are caught up in a progressive spiral of impoverishment that manifests itself in the decapitalization of the herding sector and in the emergence, de facto, of agricultural laborers on the PIVs, whose costs of production they cannot afford. The systems of production that remain open to them are unpredictable. On the other hand, a small number of households almost exclusively dependent on income derived from migration remittances seem to be managing quite well. Development in the valley makes sense only if it is geared toward the wider population by creating new local opportunities that will halt the cycle of poverty, assure food security, and create new sources of monetary revenue.

Of all these objectives, the most urgent is food security, which cannot be achieved in the near future without rehabilitating the irrigated perimeters, maintaining and improving recession agriculture, increasing protection against predators in rainfed agriculture, and improving herder productivity.

11. The Agricultural Sector and Rural-Urban Dynamics in the Department of Matam[100]

11.1 Introduction

The development of towns and their attendant exchanges with surrounding rural areas maintain and enhance a dynamic regional economy. When these exchanges are well established, the rural sector provides agricultural produce for urban centers and the agricultural income of its population creates a demand for the goods and services supplied by towns or cities. This demand encourages the growth of services and enterprises and, thus, new employment opportunities, increased income, and improved living standards for regional households.[101] Small urban centers thus contribute to rural development by providing—among other things—health and education services; distribution, storage, credit and financial services; and transportation and communication services that link rural areas to larger cities and other regions.

Growth in rural income initially stimulates demand in the rural sector for goods and services supplied by the towns. In the Senegal river basin, rural income derives from on-farm production activities (recession farming, irrigation, fishing, and herding), and from off-farm activities, principally migration and petty commerce. As Appleby (1988:5) emphasizes, "it is the ensemble of all these activities that determines the level of rural incomes, and hence the extent of market town and regional development."

This section presents some findings on the relationship of the flood-dependent diversified rural production system to regional employment and farm household income generation. It first outlines the existing pattern of rural-urban relationships in the Senegal river basin, demonstrating that migration revenues are at the heart of the commercial activity that articulates rural areas with the towns. The part played by the agricultural sector in employment and income generation is considered next. It is argued that diversification within the agricultural sector provides numerous on-farm employment opportunities to households of different social and economic standing, as well as to individuals within households internally differentiated by age, gender, personal affluence, etc. A diversified agricultural sector that is not intensive in the use of capital and labor, moreover, indirectly contributes to increased household income by limiting risk and freeing labor for participation in potentially more remunerative off-farm activities. The section concludes with comments on how the large-scale development of irrigation is likely to affect on- and off-farm employment.

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[100] This section is based heavily on Lericollais et al. (1990) "Les relations villes-campagnes dans le département de Matam."

[101] The feedback is not always a positive one. Where urban centers are electrified, have paved roads, secure water systems, etc., they may be competing for and consuming funds that might otherwise (in theory) be directed to rural areas.

11.2 Rural-Urban Dynamics

Within the last half century, a number of conflicting forces have shaped the region's rural areas and towns, as well as the mutual relationship of these two sectors. The devastating drought of 1968-1974 and 1983-1984 severely crippled villagers' principal source of livelihood, agricultural production, at a time when population growth rates were steady (ca. 3.4 percent annually), and it forced many young men to migrate in search of employment (Lericollais et al. 1990:13). The crisis in agriculture was mitigated somewhat by a new and more intensive form of cultivation, irrigation, and by the heavy inflow of migration remittances.

The Middle Valley, then, deviates somewhat from the pattern of rural-urban exchange outlined above. Production levels in the agricultural sector have not kept pace with regional food needs, and, at the same time, employment has largely been sought outside the region. Still, commercial interaction between villages and towns has been strong. The region's dense population, its weak agricultural sector, and the important influx of migration revenues have combined to create a sizable market in the Middle Valley for imported food and other items as well as for numerous services (schools, health, banking, agricultural processing facilities, etc.).

11.2.1 Population Growth Rate Patterns

In the Middle Valley, growth in population between 1971 and 1990 has not been evenly distributed. Figure 11.1 shows that in certain areas population growth has leveled off, while in others it has been quite strong. Most riverine and waalo villages in the Middle Valley (notably, Oudourou, Tiguere Cire, Diamel, Thiemping, Bow, and Padalal) have shown medium and high population growth rates,[102] notwithstanding termination of river navigation[103] and the rather isolated location of these villages. An important exception is Matam, whose population did not

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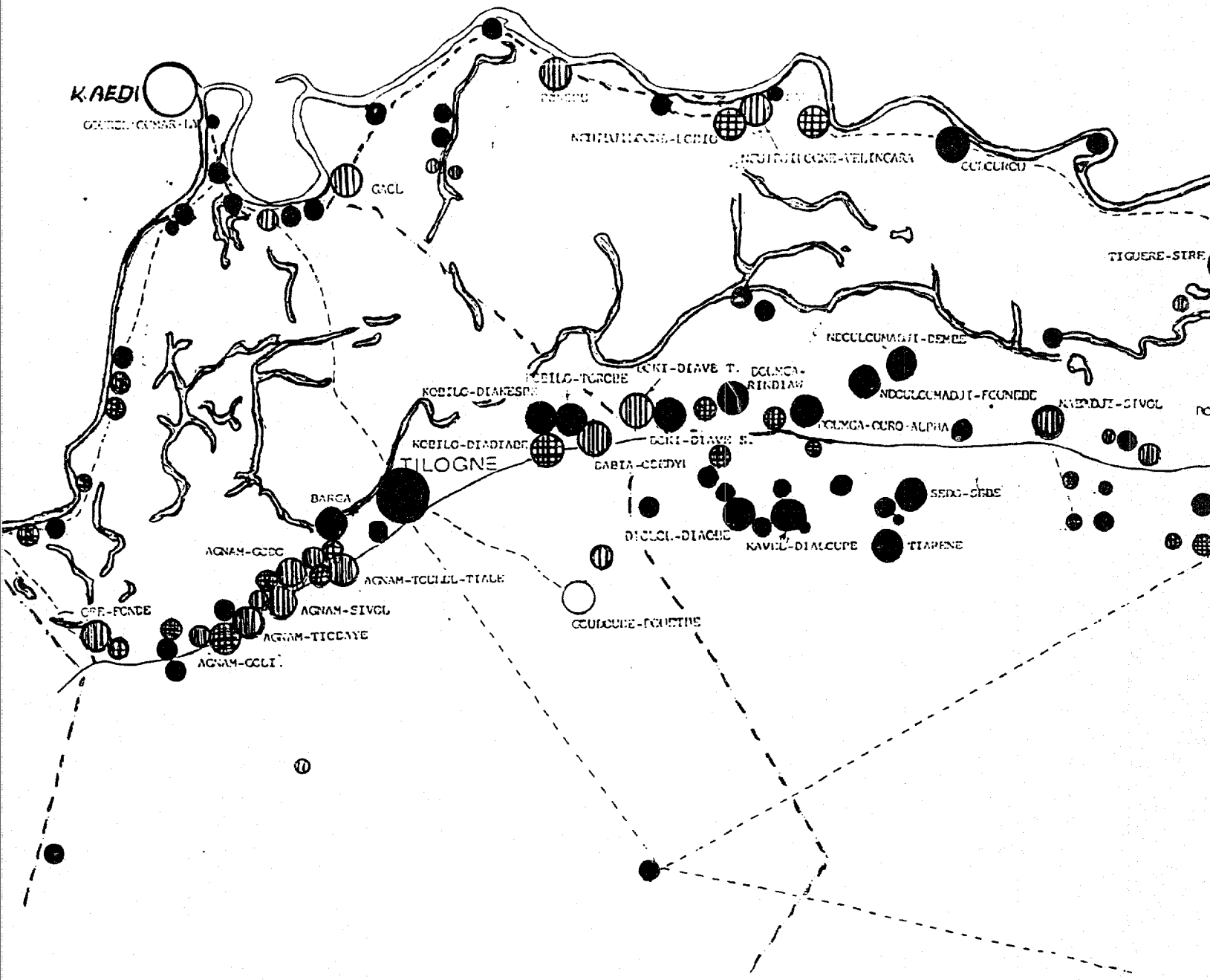
[102] Population growth rates were calculated for the period 1971-1990 using figures obtained from the government tax rosters and the 1977 and 1988 censuses. Growth rates during the 1971-1990 period were grouped into four categories: stagnant (an increase in population of less than 25 percent), weak growth (an increase in population between 25 and 75 percent), moderate growth (an increase between 75 and 100 percent), and heavy growth (an increase greater than 100 percent). We believe that the categories accurately reflect the variation in growth rates throughout the department of Matam, though the actual figures should be treated with some caution.

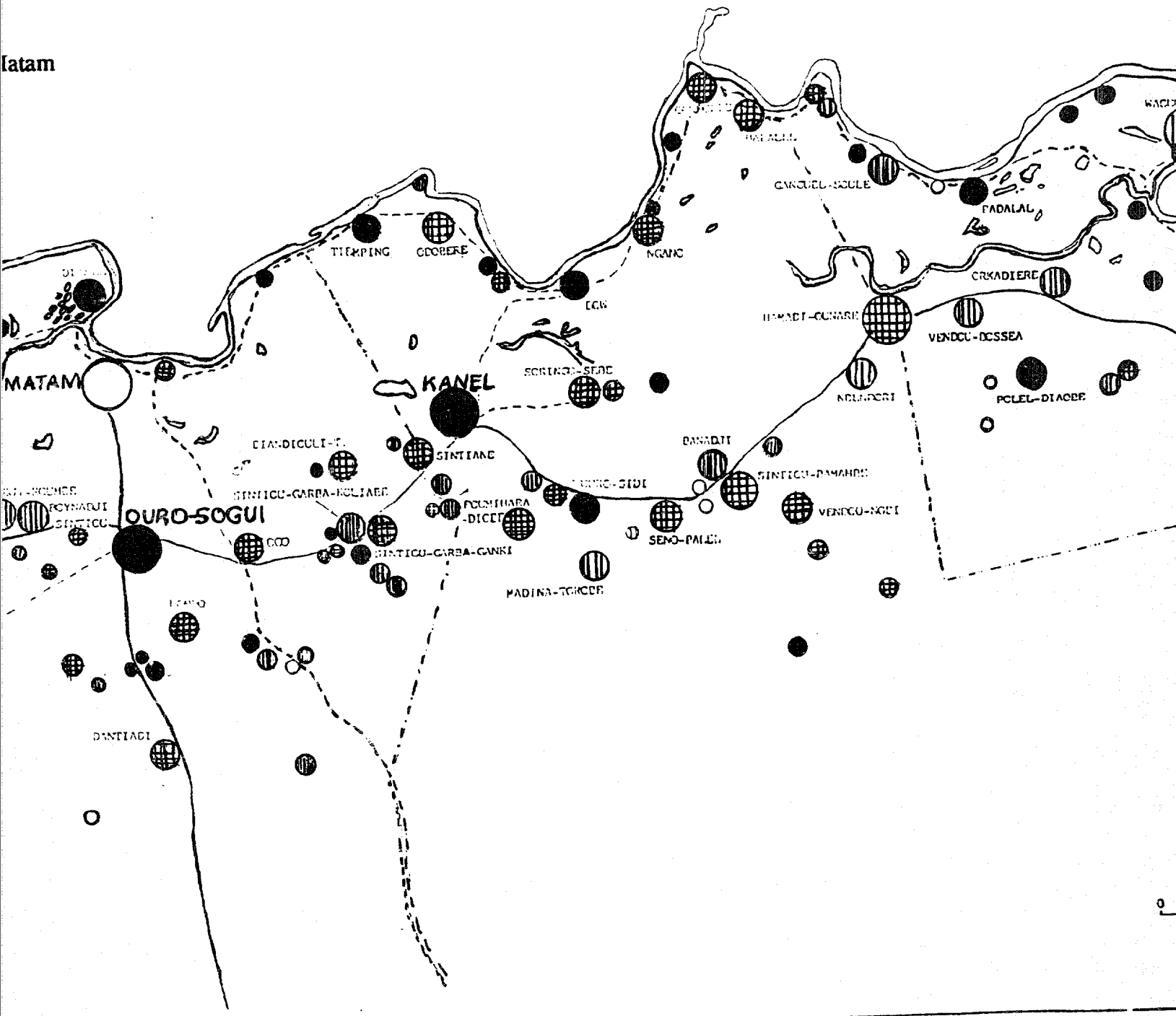
[103] Between the two world wars, the creation of the Thiès-Bamako railway and the improvement of land routes connecting the Middle Valley with St. Louis, Linguère, Touba, and Kayes effectively marginalized river transport.

Figure 11.1 Population in the Department c



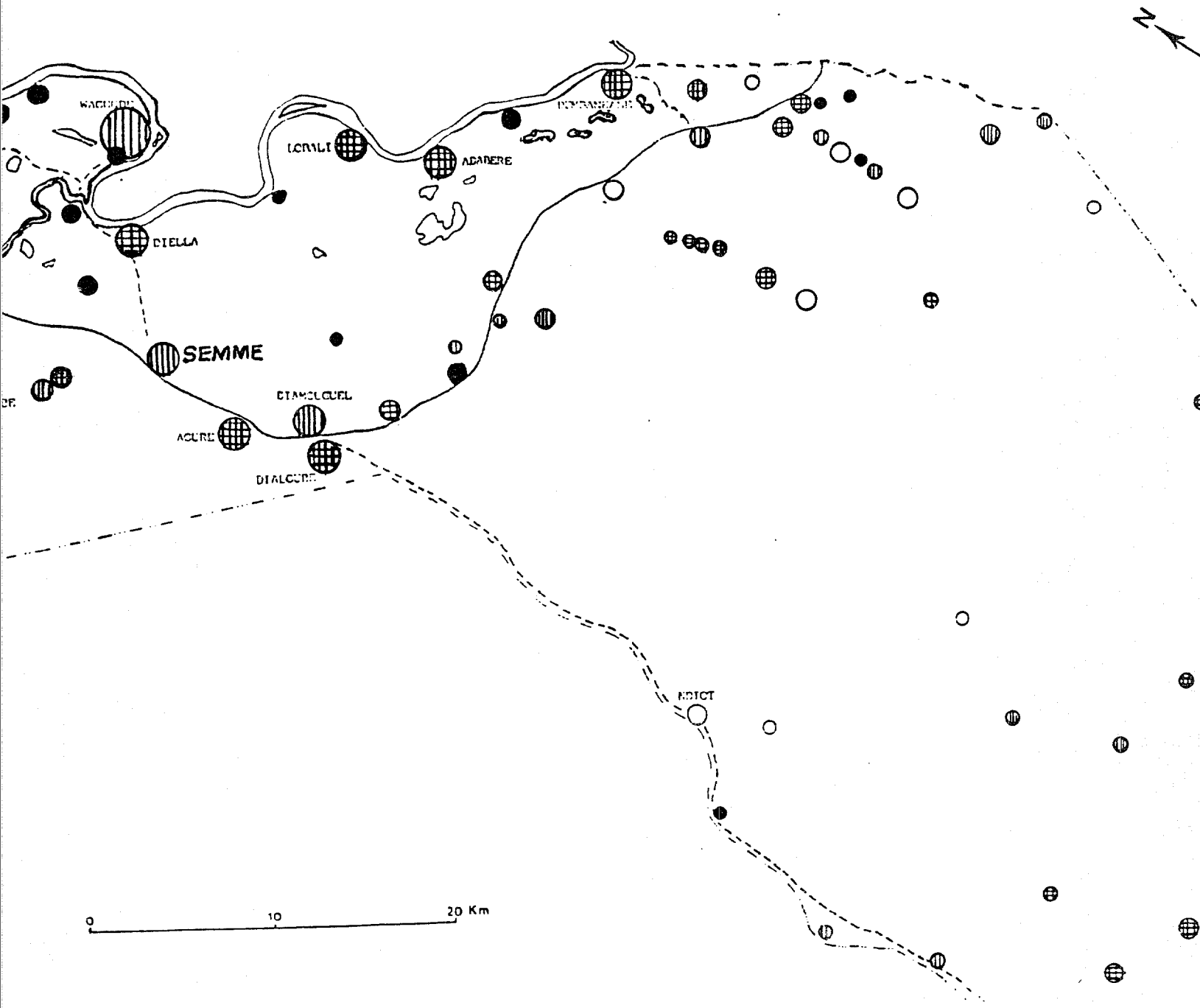
Prepared by A. Lericollais - Design: T. Sene

Matam



Population growth 1971 - 1990

- Strong growth
- Medium growth
- Weak growth
- Stagnation



1990	Size of villages
	0 - 250
	250 - 1000
	1000 - 4000
	> 4000

grow during this same period.[104] More variation occurs in the jeejegol[105] and the jeeri. For certain large centers in the jeeri, growth has been strong, principally in Thilogne, Ourossogui, Kanel, and in the Doumga sector. But within the arrondissement of Thilogne, the Agnam sector rates have been moderate, even weak (Lericollais et al. 1990:15).

The different agricultural and migration options available to villages throughout the drought period help to explain the variation in population growth rates within the Middle Valley. Along the river, the Soninke and Subalbe (fisher caste) villages, heavily involved in overseas migration and with access to irrigated perimeters and gardens, were able to withstand the drought. The rice perimeters and gardens contributed to household food stocks, and the sale of produce provided additional revenues to complement those from migration. Conversely, Toorobbe (maraboutic caste) and Sebbe (warrior caste) villages dependent on rainfed and flood recession cultivation and without access to irrigation saw entire households displaced to Dakar. This is most evident in the Agnam sector of the arrondissement of Thilogne (Lericollais et al. 1990:33).

The rapid expansion of the larger villages (Ourossogui, Thilogne, Kanel, and Bokidiawe) along the national highway is explained by the recent increase in commercial activity there. All four villages are well situated for trade: Ourossogui is at the crossroads of the national highway and the Linguère route, and it is connected to Matam; Thilogne has relatively easy access to villages along the river and also to Kaedi; Bokidiawe is close to the passageway across the Diamel at Ranoa and, thus, its trading area extends to the riverine villages; and Kanel is situated near the road leading to and bordering the Senegal river.

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[104] During the colonial period, much of the commercial and administrative activity in the Middle Valley revolved around Matam. Because of Matam's position both on gum-arabic trade routes and at the center of a vast flood recession and rainfed agricultural zone extending from Orefonde to Semme, its growth and development were closely linked to intensive merchant trading involving the export of locally produced goods—notably, gum arabic, millet, sorghum, and livestock—and the import of manufactured items. Since independence, much of the commercial activity has shifted to the large villages along the national highway. Matam's preeminent economic position in the Middle Valley has been eroded and it no longer exerts an important attractive force on the population in the department.

Recent studies have shown a dramatic increase in Matam's population in the 1960s. This sharp rise reflects the inclusion of the populations of Diamel and Navel, two nearby villages, in Matam's census count. In fact, both villages are independent of Matam.

[105] *Jeejegol* refers to the transitional zone between the *waalo* and the *jeeri*.

11.2.2 Agricultural Production

The constraints imposed on the agricultural sector by a variable climate are reflected in the figures presented in Table 11.1.

Table 11.1 Area and Production Figures for Flood Recession Sorghum, Department of Matam (1975-1982)

Year	Ourossogui		Semme		Kanel		Tilogne		Total	
	Ha.	Tons	Ha.	Tons	Ha.	Tons	Ha.	Tons	Ha.	Tons
1975	1262	120	864	90	866	110	150	170	3142	490
1976										
1977										
1978	3300	660	2450	617	2100	420	1900	285	9750	1982
1979	1700	850	950	522	1050	525	1200	720	4900	2617
1980	2760	1244	1676	670	1734	867	1674	837	7844	3618
1981	2073	1036	1256	628	1301	715	1256	753	5886	3132
1982	1382	694	837	418	867	390	837	460	3923	1962

Lericollais et al. 1990:19.

In 1970-1971, just before the onset of the drought, flood recession cultivation was an important component of the agropastoral production system. In the department of Matam, the area under flood recession cultivation was close to 25,000 ha. Yields averaged 400kg/ha., thus allowing a gross harvest of approximately 10,000 tons. Since then, however, production on that scale has not been possible. The area cultivated in flood recession sorghum has consistently been smaller than that in 1970-1971. In the driest years (1972-73 and 1983-84), only several hundred hectares were farmed in the Matam department. During the drought years, moreover, yields were low, averaging below 300kg/ha., and even as little as 200kg/ha in some years (Lericollais et al. 1990:19). Although the rice perimeters helped to lessen the harsh impact of the drought, their performance during this period was not much better. Data from SAED for the period 1978-86 reveal that in all years the rate of intensification for irrigated rice in the department of Matam was under 0.65. See Table 11.2.

Environmental factors are not solely responsible for the poor performance of agriculture in the Middle Valley. Part of the responsibility rests with an agricultural extension service that has virtually ignored flood recession and rainfed farming, even though yields in both could increase substantially. In 1963, cereal production and livestock rearing on rainfed lands in the Senegal river basin were relegated traditional status by the government. Extension services to improve land and labor productivity for peanut and millet cultivation were limited to central and southern Senegal. In the latter part of the eighties (1985-1987), however, agronomic research did target cowpeas, which are grown widely in the river region. Traditional varieties were improved and new varieties introduced.

Table 11.2 Rate of Intensification for Irrigated Rice in Department of Matam

Year	Hectares Cultivated in Rice (a)	Hectares Prepared for Irrigation (b)	(a)/(b)
1978	299	1,095	.27
1979	504	1,191	.42
1980	1,097	1,692	.64
1981	1,140	1,903	.59
1982	921	2,133	.43
1983	1,142	2,591	.44
1984	1,408	3,147	.44
1985	1,658	4,105	.40
1986	1,740	4,997	.35

Data from SAED/Matam.

State agricultural development agencies, too, have proven ineffective. At the sous-prefecture level, the activities of the CER (Centre d'Expansion Rurale), charged with promoting "integrated rural development," are largely disregarded by many villages (Lericollais et al. 1990:50). Agriculture, forestry, livestock, and rural-water-supply extension agents are responsible for diffusing information on modern techniques and equipment, enforcing firewood collection and fishing regulations, and warning farmers and herders of impending risks. Few of these tasks are accomplished satisfactorily.

As a result, many small development projects are implemented by nongovernment agencies, and in recent years local organizations that take responsibility for grassroots development actions have proliferated in the Middle Valley. There now exist *Associations Villageois de Developpement* (AVD), youth groups, women's gardening groups, herder groups, and *Groupements d'Intérêt Economique* (GIE).

During informal interviews in 1989, farmers voiced an interest in investing in agriculture. They cited capital and water as their principal constraints. The CNCAS (*Caisse Nationale de Crédit Agricole Sénégalais*) provides loans to GIEs and individuals for agricultural and livestock projects, equipment purchases, and commerce. The terms of the loans, however, are inhibiting. Credit must be repaid within a six-month period and at an interest rate of 15 percent. These terms may be feasible for the purchase of inputs, but they are considerably less so for the purchase of more costly and fixed items such as motorpumps. A GIE in Ourossogui, for example, obtained a 10-hectare parcel from the Rural Community in 1989 and was prepared to level the land and to prepare the canals for irrigation. The group lacked a motorpump and could not accept the terms of a loan from the CNCAS. At the time of the interview, they were contacting NGOs in the hope of receiving a grant for a pump.

11.2.3 Migration Incidence

Migration has long been practiced by the *Haal Pulaar* of the Middle Valley. Numerous factors during the past several centuries have been responsible for these movements: political crises, religious proselytism, famine, the slave trade. More recently, the high incidence of migration from the Middle Valley reflects the inability of the agricultural sector to support the entire population, as well as the greater employment and income-earning opportunities outside the region (in Dakar, other Central and West African cities, and Europe). Migration statistics (1988) for the villages of Thiemping, Boyenadji Roumde, and Doumga Rindiaw are presented here. For Thiemping, the percentage of migrant men within each of the caste groups (freemen, artisans, and former slaves) is close to, or above, 50 percent. In Boyenadji Roumde, the proportion of men between the ages of 15 and 65 who have migrated in search of wage-labor approaches 55 percent. At 40 percent, Doumga Rindiaw has the lowest proportion of wage-labor migrants.[106]

The number of Haal Pulaar in Dakar has increased steadily since the 1940s, and migration from the Middle Valley has contributed substantially to the growth of the city. Indeed, by the 1960s, one third of Fuutanke were living in the Cap-Vert region, some households establishing themselves permanently in the urban area. For the most part, those migrating were pursuing income.

We did not analyze in detail the relationship of river basin households to their urban counterparts. It is clear, however, that migration revenues figure strongly in household budgets. In 1989 in Thiemping, remittances accounted for 62 percent of the disposable income of sample households. In Doumga Rindiaw and Boyenadji Roumde the figure was lower at 39 and 19 percent, respectively.[107] The movement of family members back and forth between the village and the city, moreover, is steady, and established social and economic networks between Dakar residents and those of the Middle Valley facilitate access to education, medical care, and employment. Children are more often sent to Dakar than to St. Louis to pursue secondary education because they can lodge with family members there. Middle Valley households send grains to Dakar at harvest time as recompense to those who have housed their children during the school year.

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[106] The percentage of migrants for each village reflects the proportion of the village population absent at the time of SRBMA's village census in September 1988.

[107] The figures for Boyenadji Roumde indicate a relatively high rate of outmigration, but a relatively low proportion of household revenues derived from migration. This is because petty commerce, especially among women, is particularly strong in Boyenadji Roumde. At 18.9 percent, the proportion of revenues derived from commerce diminishes the weight of migration earnings in household budgets.

Finding remunerative employment is not the only incentive to leave the valley. Some migrants, especially those engaged in seasonal work in Dakar, have to leave the region to reduce consumptive demands on household granaries.

11.2.4 Trade and Commerce

Today, as in the past, the seasonal movement of farmers, herders, and fishing groups facilitates the exchange of produce and contributes to the commercial activity of regional towns. Households in the jeeri (for example, the Fulbe of Kirire, Kavel, and Goudoube) who cultivate on the waalo move transversely toward the Senegal river, and fishing groups move longitudinally along the river and the Diamel effluent. These households stop at the villages en route and exchange produce there.

Migration revenues further encourage and promote both the purchase of imported items and the purchase and sale of locally produced agricultural products. Indirectly, therefore, these revenues foster the articulation of rural areas with the towns. Table 11.3 presents a count of vendors in 12 market towns that have benefited in trade from their location on the national highway. It lists the total number of vendors in each market and the number who come from villages other than the market town noted. The table does not include a count of village shops. The figures indicate the size of the different markets as well as the magnetic force each market has over surrounding area sellers and the rural population in general. Ourossogui is by far the most important market town, in terms both of size of its market and the pull it has on area vendors.

Table 11.3 Middle Valley Market Towns

Market Town	Total Market Vendors	Vendors from Other Towns/Villages	
		Number	Percent
Orefonde	61	9	14.7
Agnam-Civol	84	53	63.0
Thilogne	84	14	16.6
Bokidiawe	74	54	73.0
Nabadji-Civol	36	10	28.0
Ourossogui	162	96	59.0
Kanel	98	24	24.5
Matam	98	46	47.0
Sinthiou Bamambe	29	4	13.8
Hamadi Ounare	46	9	19.5
Orkadiere	46	2	4.3
Semme	21	7	33.3

In the markets, the items sold are both locally produced in the Middle Valley and imported from outside the region, principally from Dakar. Table 11.4 lists the items most frequently encountered in the markets during the survey period. Each of the twelve markets noted in Table 11.3 was visited once during the months of December and January 1989/1990. Each vendor in the markets was asked her name and caste/ethnicity, her village of origin, the products she had to sell, the amount of each good for sale on the day of the interview, whether the goods were purchased or produced directly by the vendor's household, where the products were purchased, and their price.[108] The items are in three groups: items produced in the Middle Valley, items imported from outside the region, and items that could either be locally produced or imported. The sale of local produce is an important source of income for market women.

Village shops or boutiques also handle both locally produced and imported items. Important quantities of millet, sorghum, paddy, and cowpeas are exchanged beyond the open markets in village shops that purchase, stock, and resell the grains, as well as bulk and transport them. Table 11.5 summarizes information on the amounts of PIV paddy, flood-recession sorghum, and cowpeas traded in 1989 and 1990 by an opportunity sample of village boutiques. This table is the product of a questionnaire administered to an opportunity sample of shop owners in the market towns noted above. The questionnaires provided data on the volume of grains and legumes (principally flood recession sorghum, paddy, and rainfed and flood recession cowpeas) handled by these small entrepreneurs, purchase and sale prices, and the origin of grains and their final destinations.[109] Because 1989 witnessed particularly poor rainfed harvests, most shop owners reported no trade in millet. See Table 11.5.

Figure 11.2 is a spatial representation of the commercial area of influence of the markets and boutiques in the various towns and villages along the national highway. The arrows show the movement of buyers and sellers from the smaller more remote villages to the larger towns, and indicate the commercial activity that integrates the region. Without remittances, commercial exchange in the river basin would not be as pronounced.

11.2.4.1 Cereals

Trade in cowpeas and cereals—*souna* millet, *samme*, *nyendiko*, and *fela* sorghum, maize, and rice—is active, notwithstanding the low levels of production of the past two decades. The production and marketing of cowpeas, in particular, have increased considerably during this

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[108] The important market centers of Dembankane and Waounde were not visited.

[109] The decision to focus on the trading practices of these small entrepreneurs was taken because they handle sizable stocks for sale locally and outside the region. Numerous attempts to talk with important traders in Matam and Ourossogui proved futile.

Table 11.4 Local versus Imported Market Items

Locally Produced Goods	Frequency of Vendors Selling the Item
Sorghum	28
Cowpeas	48
Cowpea leaves	56
Maize	30
Millet	39
Hibiscus	66
Melon seeds	16
Gumbo	40
Paddy	33
Bitter tomato	42
Total	398
Locally Produced/Imported	
Peanuts	29
Fresh fish	71
Gourds	92
Yams	24
Cabbage	77
Fresh pimento	58
Dried fish	67
Total	418
Imported Goods	
Dried pimento	47
Pepper	55
Maggi cubes	40
Onions	46
Powdered milk	35
Lemon	24
Dye powder	25
Baobab fruit	21
Total	307

Table 11.5 Small Shop Volume of Trade in Grains (1989, 1990)

Year	Village	Paddy	Sorghum	Cowpea
1989	Thilogne	16 T (1)*	23 T (2)	13 T (2)
1989	Bokidiawe	4-5 T (1)	-	5-6 T (1)
1989	Orefonde	-	-	3/4 T (2)
1989	Civol	-	1 T (1)	2T200 (2)
1990	Hamady Ounare	4 T (2)	5 T (2)	400kg (1)
1989	Orkadiere	-	200kg (1)	250kg (2)
1989	Nabadji Civol	6 T (1)	4 T (1)	-
1989	Sinthiou Bamambe	-	-	-
1989	Semme	-	-	150kg (1)

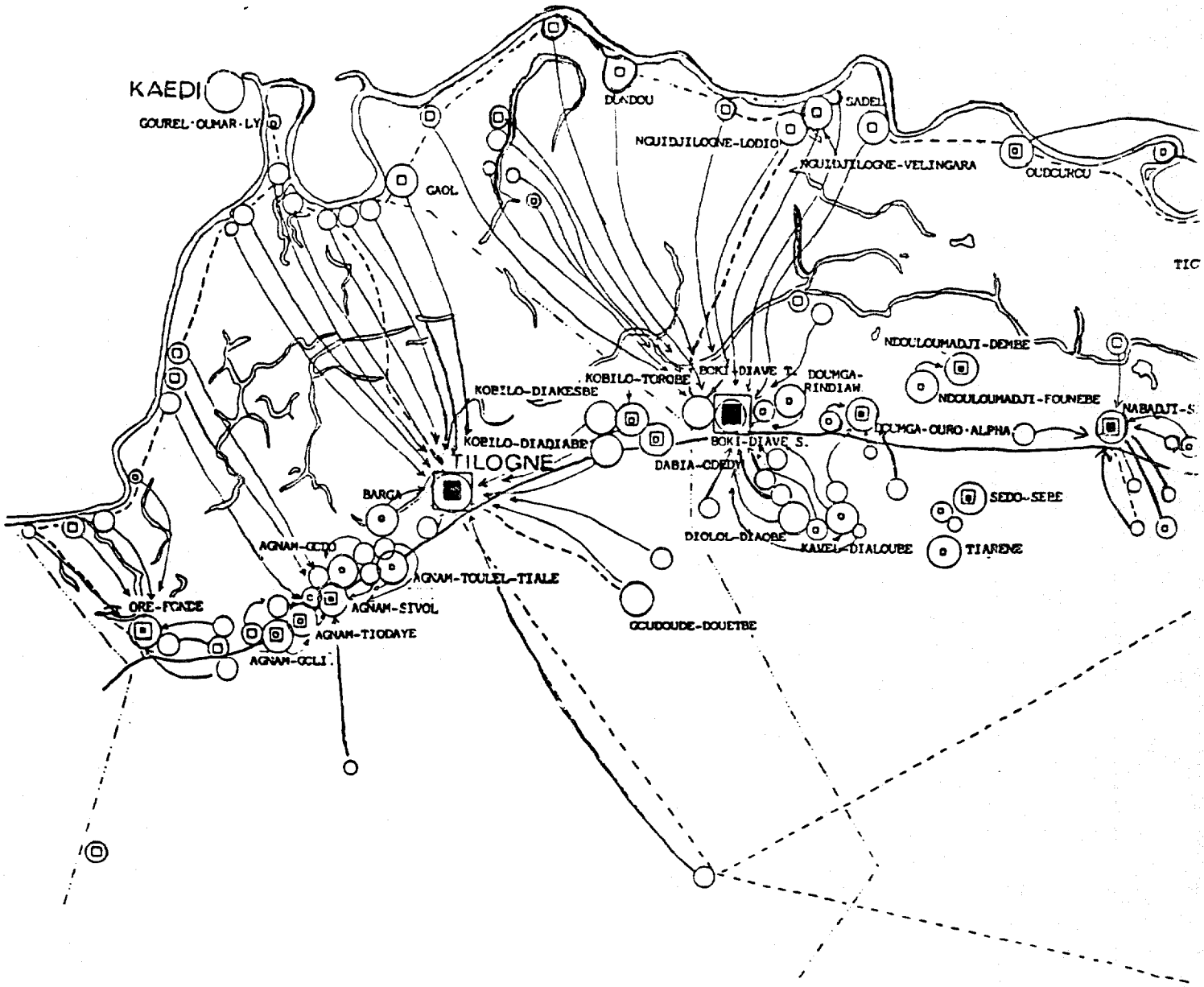
* The numbers in parentheses refer to the number of boutique owners interviewed that traded in each commodity.

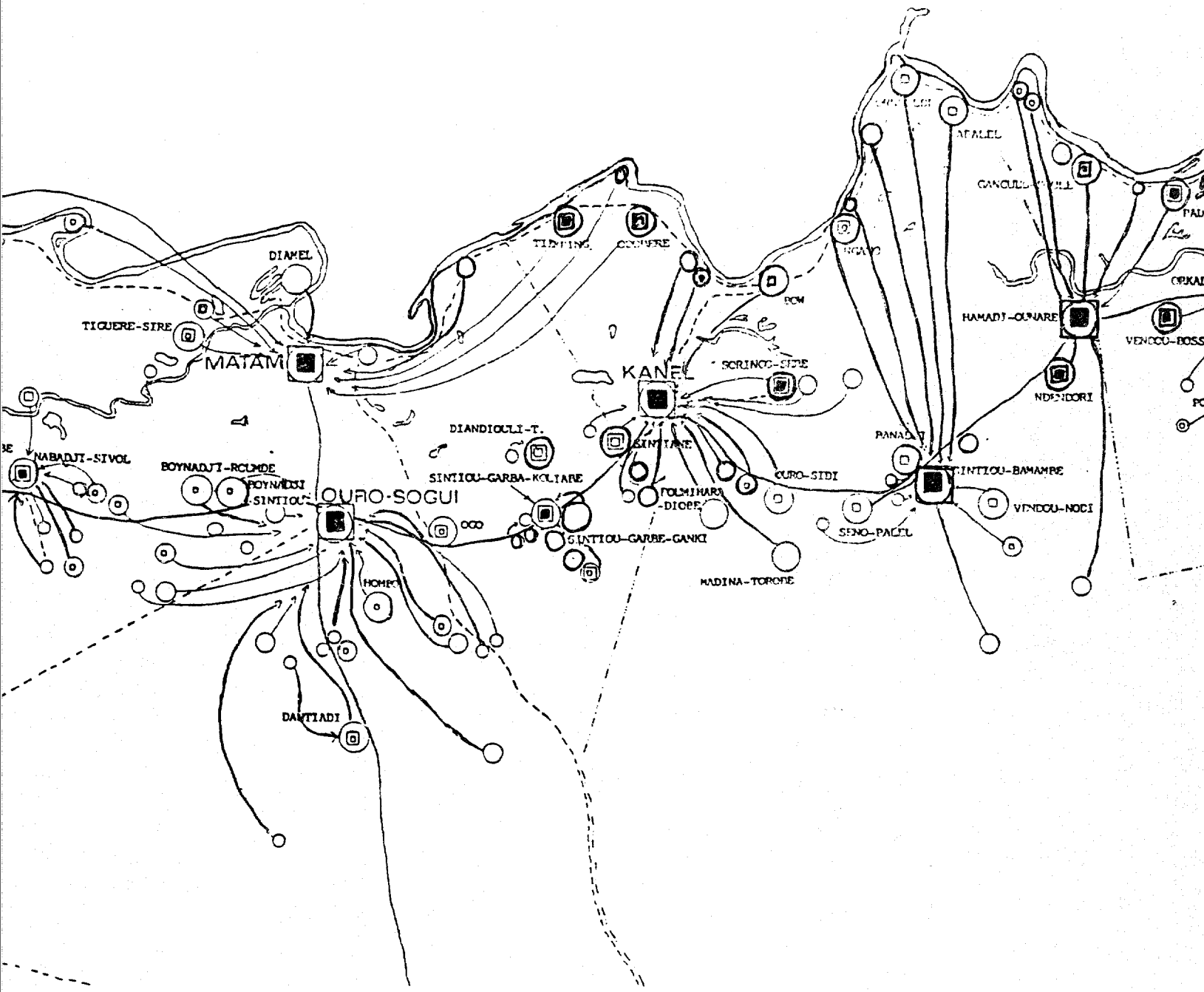
period. Because cowpeas are grown on rainfed as well as flood recession lands, both the pods and the leaves can be harvested and marketed locally throughout the year. Cowpeas are also exported. Village households stock important quantities to sell to Wolof traders from Baol who come in February to purchase cowpeas for transport toward the interior of the country.

Household marketing of cowpeas and cereals is often induced by a pressing need for cash. In Doumga Rindiaw, household sales of millet, sorghum, and paddy in 1988/89 accounted for 28 percent of grain harvests. In Thiemping and Boyenadji Roumde, the figures were only 7 and 6 percent, respectively. An interpretation of these figures must take into account the different outcomes of the rainfed, flood-recession, and PIV harvests, as well as the different levels of nonagricultural revenues in the three villages. Both Thiemping and Boyenadji Roumde benefited from relatively high levels of nonagricultural revenues, but had to contend with disappointing rainfed and flood-recession harvests during the 1989 agricultural season. Doumga Rindiaw, on the other hand, a relatively revenue-poor village, enjoyed a fairly good 1989 agricultural season. Thus, whereas Thiemping and Boyenadji Roumde met most of their need for food and imported items with their nonagricultural revenues, Doumga Rindiaw drew on its food reserves to do so.

A common pattern is for women in the fooyre responsible for the preparation of the daily meals to sell small quantities of cereals or cowpeas from the household granaries when there is not enough cash to buy condiments and other essential items for meals. In general, these women sell to vendors of grain in the market, and because they are rushed to obtain cash needed for the preparation of daily meals, they sell quickly and at little profit. Similarly, women may sell or barter small quantities directly to the local shop owner from whom they buy such basic food items as coffee, sugar, rice, and oil.

Figure 11.2 Commercial Centers in the Department of Matam

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TIGUERE-SIRE
MATAM
NABADJI-SIVOL
BOYNADJI-ROUMDE
BOYNADJI
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OURO-SOGUI
HOMPO
DANTIADI
DIANDIOULI-T.
SINTIOU-GARBA-KOLIARE
SINTIOU-GARBE-GANKI
TIENTING
COUFERE
KANEL
SORINGO-SIDE
SINTIANE
TOUMIHARA-DIOPE
OURO-SIDI
MADINA-TORODE
BOW
MEALEL
GANGUL
HAMADJI-OUNARE
NDENDORI
PANADJI
SINTIOU-BAMAMBE
VENDOU-NOCI
SENO-PALEL
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0 - 4 boutiques
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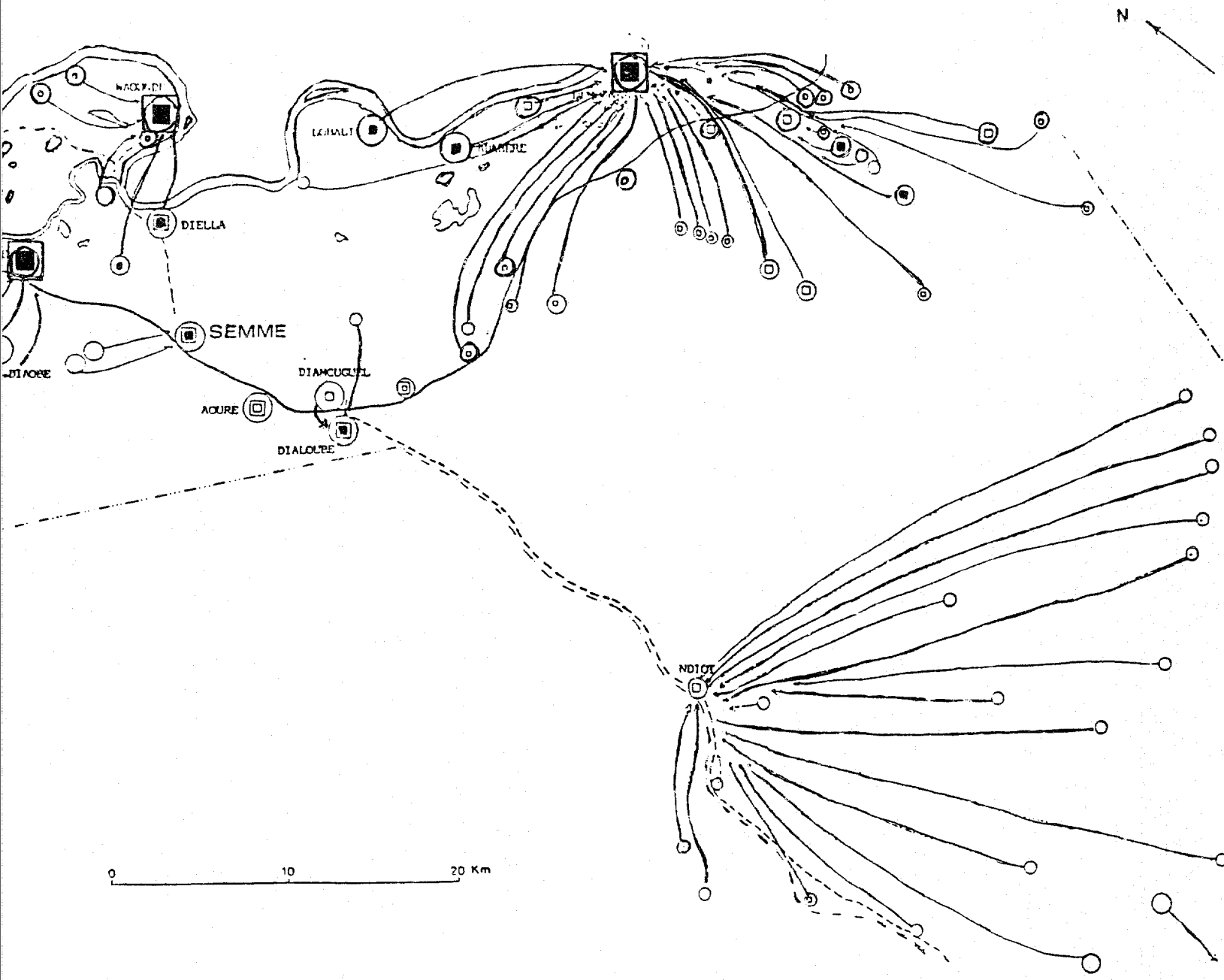
N
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0
10
20 Km

Migration revenues, when present, facilitate this process because they contribute to the economic security of Middle Valley households. That is, grain sales generally occur immediately following the harvest (in December for rainfed crops and in March for flood recession crops) when household cash reserves are lowest. Once household food stocks are near depletion, families draw on outside revenues to replenish their granaries. The tendency for households to sell grains when prices are low and to purchase grains once prices have risen hasa couple of explanations. First, household members working abroad limit what they remit home during the harvest period when they know the family can support itself with its crop sales. Once scarcity sets in, however, families do request that members abroad send the necessary revenues. Second, seasonal migrants generally leave for Dakar and elsewhere in search of work just as the guarding of waalo fields is beginning (ca. January). They usually do not return with their earnings until June-July when grain reserves have dropped to low levels.

For many households, then, the urgent need for cash hinders temporal speculation in cowpeas and cereals, and especially in irrigated rice. When farmers do not have the funds to finance capital-intensive irrigation on the perimeters, they borrow from local merchants or traders and repay them in kind at post-harvest depressed prices. Farmers, moreover, find that SAED, a buyer of rice, frequently lacks the funds to purchase paddy at harvest time when they are hard-pressed for cash. Merchants or traders take advantage of this situation by buying paddy from farmers at 50-60 FCFA/kilo, and stocking it until SAED is able to buy it at the official price of 85 FCFA/kilo. As long as SAED remains a buyer of rice, timely grain purchases on SAED's part could help ensure that farmers receive the higher price.

11.2.4.2 Garden Vegetables

Women's marketing of garden vegetables has grown substantially in recent years. Remittances, by enabling households to purchase these vegetables, foster the development of gardens and help village women who have few other sources of income.

Vegetables are cultivated on river banks (falo land), on irrigated perimeters (in the cool, dry season), and on household and communal gardens next to villages. Because of the lack of proper storage facilities and the high costs of transport, produce must be sold soon after the harvest and the market is restricted to local villages and towns. This local demand is quickly saturated. Kaedi, which before the Senegal/Mauritania conflict absorbed a good portion of the produce from villages downstream from Matam, is now inaccessible.

11.2.4.3 Milk and Fish

Trade in milk and fish products has been an important component of the exchange economy in the Senegal river basin. Milk from local livestock is most abundant during the rainy season, when grasses are plentiful. By February/March, production slackens considerably and powdered milk makes up the deficit. Fulbe herders generally exchange their perishable milk for grains. At times, herders' sorghum and millet stocks surpass their consumption needs and they resell the grains to villagers during periods of scarcity (Lericollais et al. 1990:34).

Fishing in the Senegal river basin having been severely limited by the drought, salt water fish from St. Louis gradually replaced riverine fish in the local diet. With the return of the rains, river fishing is beginning to reestablish itself, even though salt water fish remains an important component of household diets. Several obstacles, however, are hindering the full reinstatement of this activity. The Senegal/Mauritania conflict has forced fishers to concentrate their activities in the marigots further inland, and low prices for salt water fish reduce the returns for local fishers (Lericollais et al. 1990:35). The absence of floods in 1987 and 1990 has further weakened fishing on the plains.

11.2.4.4 Artisanal and Consumer Goods

Migration remittances have reinvigorated demand for certain craft products, notably cloth and jewelry, the products of Soninke indigo-cloth dyers and Haal Pulaar artisanal castes: the Maabube (cloth makers) and the Wayilbe (blacksmiths/jewelers). Yet, at the same time, by encouraging the influx of industrially produced substitutes, migration revenues have brought on the decline of other artisanal products. Many artisanal castes therefore no longer specialize in their trade, but rather give priority to agricultural production. This is true of some cloth makers (Maabube), blacksmiths (Wayilbe), potters (Burnaabe), woodworkers (Lawbe), and leather workers (Sakkeebe) (Lericollais et al. 1990:46).

In the large villages and semi-urban centers, trade in manufactured goods imported from outside the region and the establishment of modern services continue to grow. Table 11.6 presents a count of some of the urban enterprises in Matam and Ourossogui. Although there is some question as to the accuracy of the count, the table indicates the range of commercial enterprises now found in the Middle Valley.

Construction, principally of mosques and homes, is the modern commercial activity most closely associated with migration remittances. For the most part, materials come from Dakar or from hardware stores in Ourossogui, and construction is carried out by men from Wolof villages located in the jeeri. The most elaborate and expensive homes are usually built by Dakar-based construction companies. No building firms have established themselves in the Middle valley, despite the rather heavy construction that takes place there. One explanation is that villagers and village groups prefer to contract the work to "outsiders" who maintain no formal or informal ties to the villagers and who are therefore more likely to respect the terms of the contract (Lericollais et al. 1990:46).

11.2.5 Education and Health Services

At 20 percent, the proportion of children and young adults in school in the Middle Valley in 1989 was below the national average. The poor attendance record stems from the geographic dispersion of the Middle Valley population as well as from its seasonal agro-pastoral labor requirements and movement. This is especially the case among the Fulbe. Indeed, in the Ferlo all the schools that used to operate in the small villages are now closed because attendance rates

were too low. Schools located in river basin villages, moreover, do not attract many students from surrounding areas. Thus, in the smaller, more remote, and poorer villages schooling rates are close to naught, whereas in Matam they reach as high as 50 percent. Migration and the introduction of irrigation in the past two decades have kept children from school because children are increasingly relied on to complete the agricultural tasks formerly accomplished by young men. Much more prevalent in the Middle Valley are the Q'oranic schools where virtually all young boys receive some religious training.

Table 11.6 Urban Enterprises in Matam and Ourossogui

Mercantile Firms	Matam	Ourossogui
Grocery stores	25	20
Dry goods stores	1	5
Jewelry stores	1	5
Pharmacies	1	3
Hardware stores	1	2
Auto parts stores	0	1
Service Establishments		
Restaurants	4	6
Flour mills	1	1
Gas stations	1	3
Bars and clubs	0	2
Hotels	0	2
Movie theaters	1	0
Repair Agencies		
Tailors	50	30
Watch, radio repair	1	8
Auto repair shops	3	3
Tire repair shops	1	5
Metal working shops	3	4
Bicycle repair shops	1	?
Transport		
Pick-ups	1	5
Trucks	0	1
Taxis	0	0
Buses	0	0

Flammang et al. 1989.

Yet, Middle Valley residents are aware that public education improves chances of finding remunerative employment abroad or in the modern sector at home. Today, a number of villages invest in the construction of classrooms. For those young men and women who do receive a modern education, the impetus is to leave the region, as the agricultural sector has little use for the skills they acquire at school. Public education, albeit on a small scale, reinforces the relationship of Middle Valley households to Dakar and other migration destinations (Lericollais et al. 1990:54).

The size of a village and the cash reserves of its population determine the health care services it can provide its households. Government- and donor-established health care facilities are targeted to the principal towns, and only the larger villages can afford to build and staff community clinics. As a result, residents of these villages have preferential, if not exclusive, access to these facilities. In the last decade, villages have financed 12 of the 16 clinics established in the Department of Matam, mainly using migration remittances.

In Ourossogui and Matam, the health care infrastructure is considerably more developed than elsewhere in the department. In 1977 an EEC project managed by the "Coopération Technique Belge" financed the construction of a hospital in Ourossogui. The "Coopération Belge" also established a general pharmacy in Matam and rehabilitated its health center in 1984. Between 1977 and 1982 the hospital in Ourossogui was staffed by three Belgian doctors (a surgeon, a gynecologist, and a pediatrician), and a Senegalese general practitioner, and offered the full array of medical services to villagers from throughout the department. The departure of the Belgian doctors in 1984 greatly reduced the medical services offered, and today the hospital attracts fewer Middle Valley residents and functions primarily as a community clinic (Lericollais et al. 1990:58).

11.2.6 Conclusion

Steady population growth rates and the influx of remittances have promoted the development of an active commercial sector, concentrated, for the most part, in the large towns (Ourossogui, Thilogne, Bokidiawe, and Kanel) of the Middle Valley that benefit from lying close to the national highway. Rural buyers and sellers are drawn to these market towns where they find buyers for their produce, and sellers of food and consumer items they wish to purchase. The construction of intermediate-sized perimeters close to the national highway, near Ndouloumadji, Kobilo, and Matam/Ourossogui, will reinforce the development of this region. It is not clear, however, whether these factors can weaken the tie that Middle Valley households maintain with Dakar and other migration destinations. Sustained high rates of outmigration reflect the current inability of the agricultural sector to meet the food needs of the entire population and the fact that the most remunerative employment opportunities are still sought outside the region. Public education seems to reinforce this exodus.

11.3 The Agricultural Sector, Employment, and Rural Income Generation

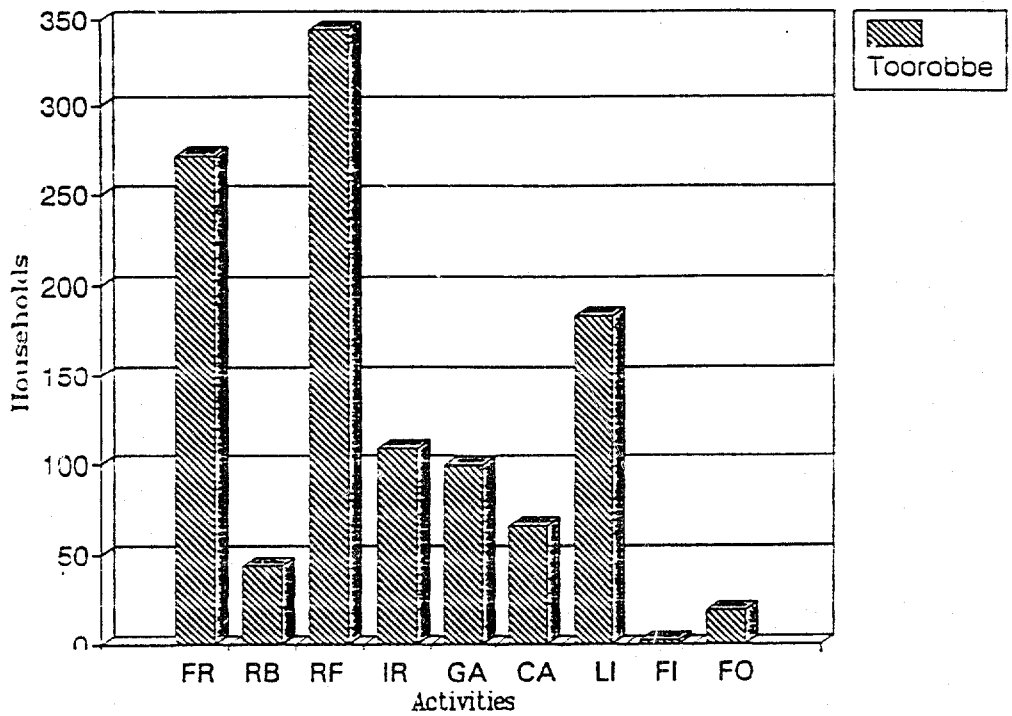
The Introduction (Section 11.2) highlighted the importance of income for the development of farm-town exchanges. This section discusses the part played by agriculture in employment and household income generation. Attempts to improve regional employment and household income levels (and, hence, development of farm-town exchanges) should include measures that help households in their efforts to reduce risk, protect food security, and accumulate cash reserves for the purchase of consumer goods. According to a 1989 OECD and Club du Sahel report on cereal demand in West Africa, concentrating on agricultural production is not, it seems, the optimal strategy for protecting food security in Sudano-Sahelian zones, because agricultural outputs and income are too unstable. The report asserts a "clear delinking of the agricultural output of a given household and its food entitlement; purchasing power plays the key role" (Reardon 1988:5). In other words, although rural households continue to produce coarse grains largely for home consumption, they rely increasingly on income generated off-farm for the purchase of food necessary to complete their diets and to cover periods of scarcity.

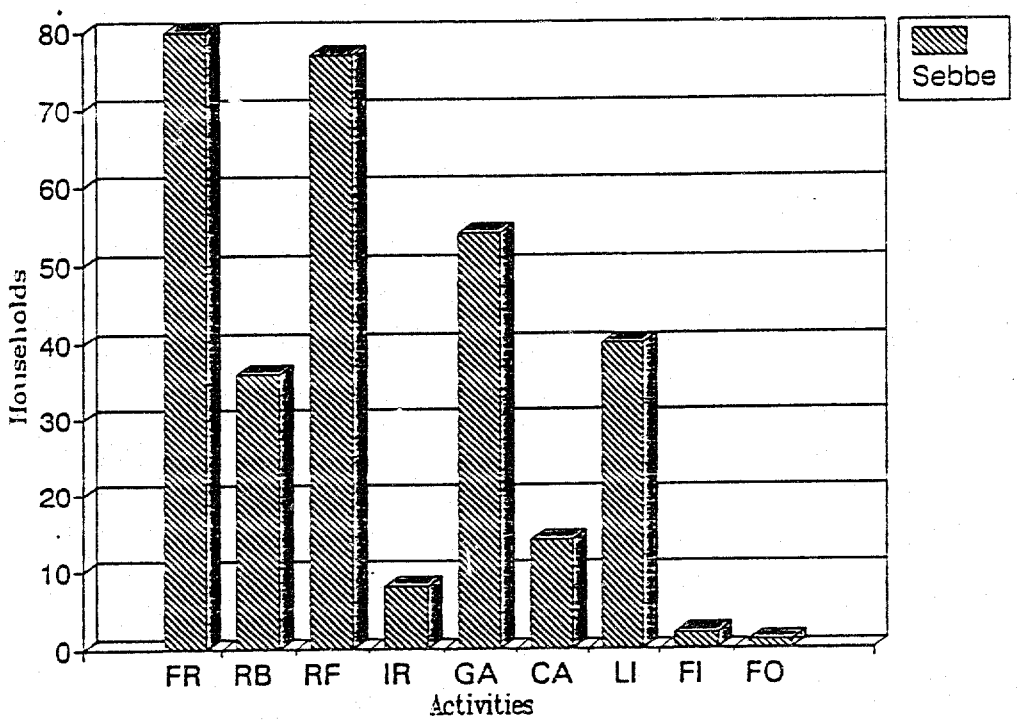
In the three study villages, households entirely dependent on agriculture, without members working in Dakar or abroad, were among the poorest. Findings from Doumga Rindiaw and Thiemping also indicate that expenditures for local and imported food items predominate in household budgets. On average in 1988/89, 78 percent of household expenditures in Doumga Rindiaw were devoted to food purchases. In Thiemping, households spent 6.4 percent of their budgets on local fish, grains, vegetables, and livestock products, and 74 percent on imported rice, fish, and other foods. Thus, if we can extrapolate from the sample villages, the preferred strategy for the majority of farmers in the Middle Valley is to combine agricultural production, largely for home consumption, and nonagricultural income to stabilize food availability and accumulate cash reserves.

A brief analysis of this strategy is simplified by arranging farmers' activities into three groups: agro-halio-pastoral activities dependent on rainfall and the annual flood; irrigation; and migration. The on-farm sector has a diverse set of production activities: sorghum cultivation on waalo lands, men's and women's vegetable gardens on falo and jeeri lands, millet cultivation on fonde and jeeri lands, fishing in the river and the flood basins, herding on both rainfed and flood recession fields, and irrigation. Diversification effectively minimizes risk and enables households of different social and economic standing to participate in the agricultural sector. The diversified production system has an additional advantage in that it is extremely flexible. Household members can alternately emphasize certain activities and de-emphasize others depending on where they find themselves in the domestic cycle (i.e., depending on their land, labor, and capital resource endowments).

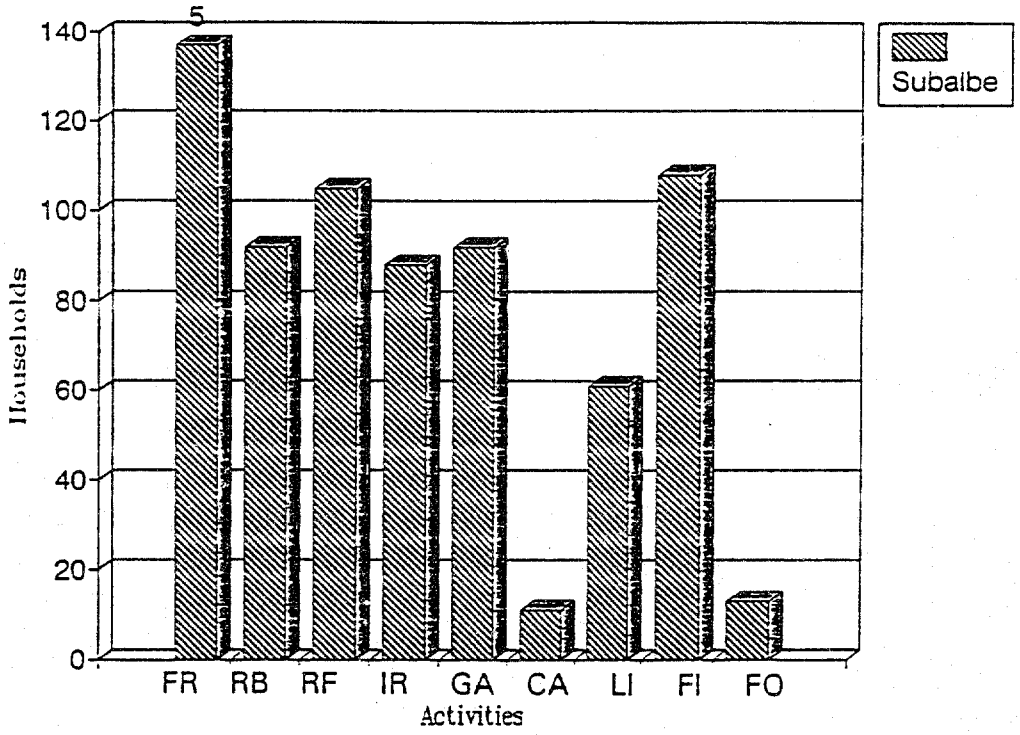
The graphs of Figure 11.3, based on a December-January 1989-90 survey of 17 villages of the Middle Valley, demonstrate the numerous agro-halio-pastoral activities engaged in by each statutory group. In each village, households were asked about those activities that employ their labor force and that contribute significantly either to household revenues or to household food stocks. For all statutory groups, diversification is the norm. Very few groups do not engage

Figure 11.3 Diversified Production Among Statutory Groups in the Department of Matam





FR: Flood recession farming
RB: River bank farming
RF: Rainfed farming
IR: Irrigated farming
GA: Gardening
CA: Cattle herding (more than five head)
LI: Small livestock herding (more than five head)
FI: Fishing
FO: Foraging (principally gum arabic)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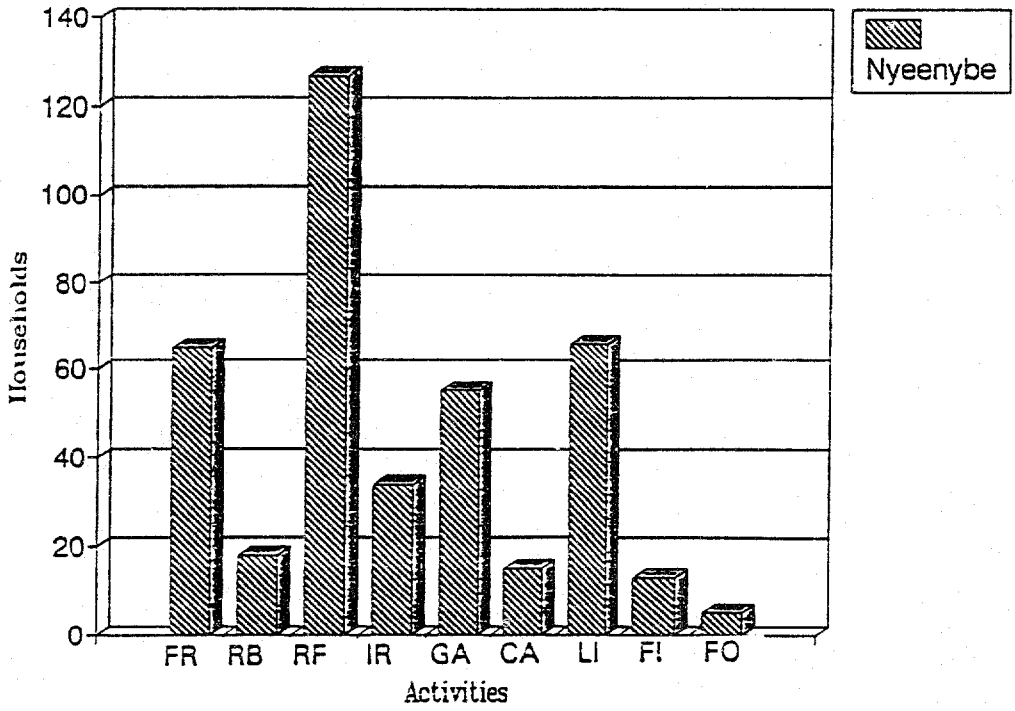
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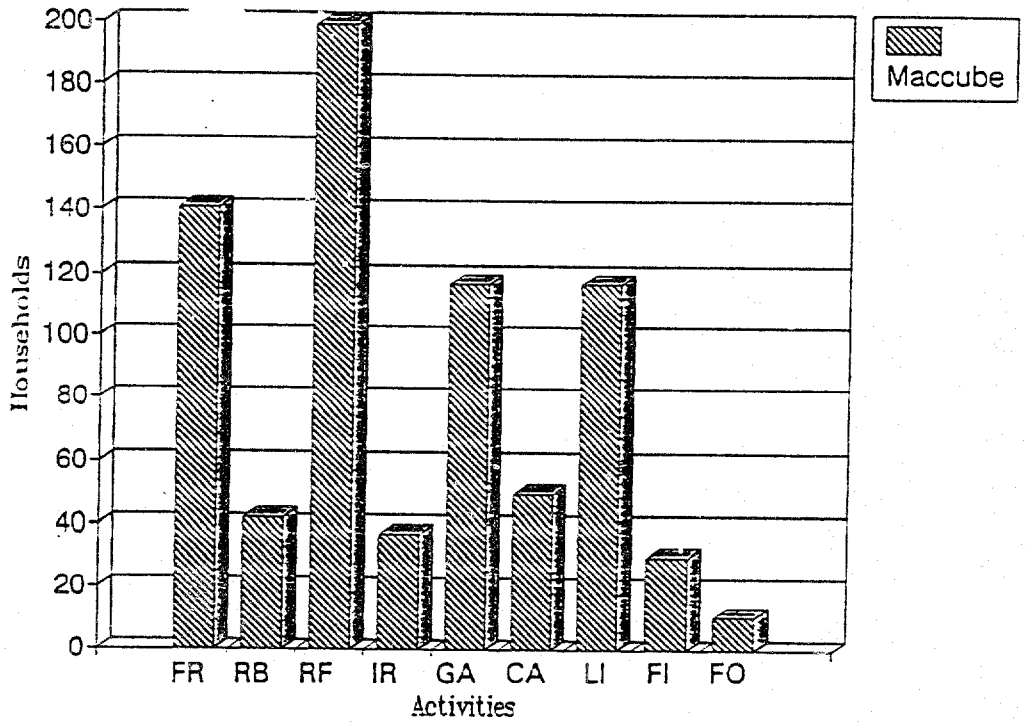
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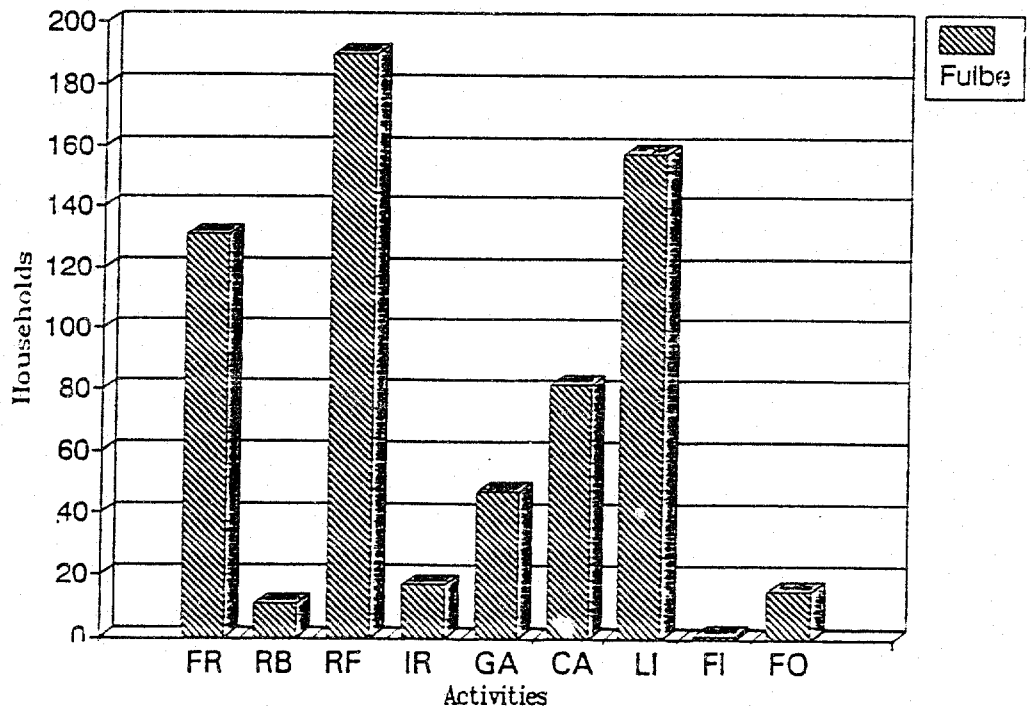
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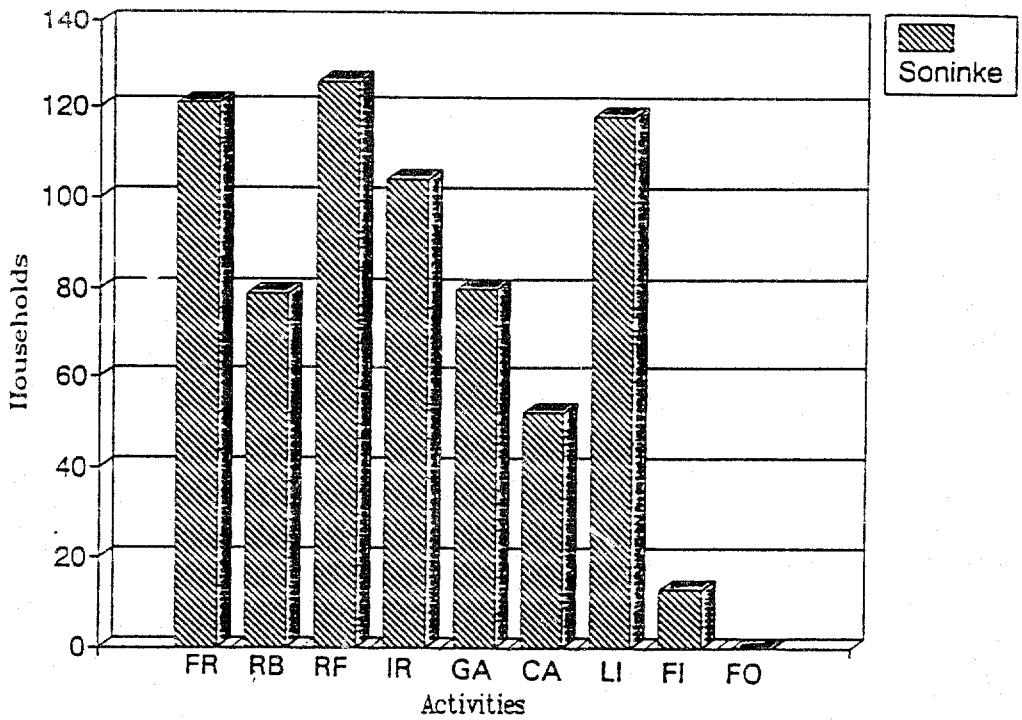
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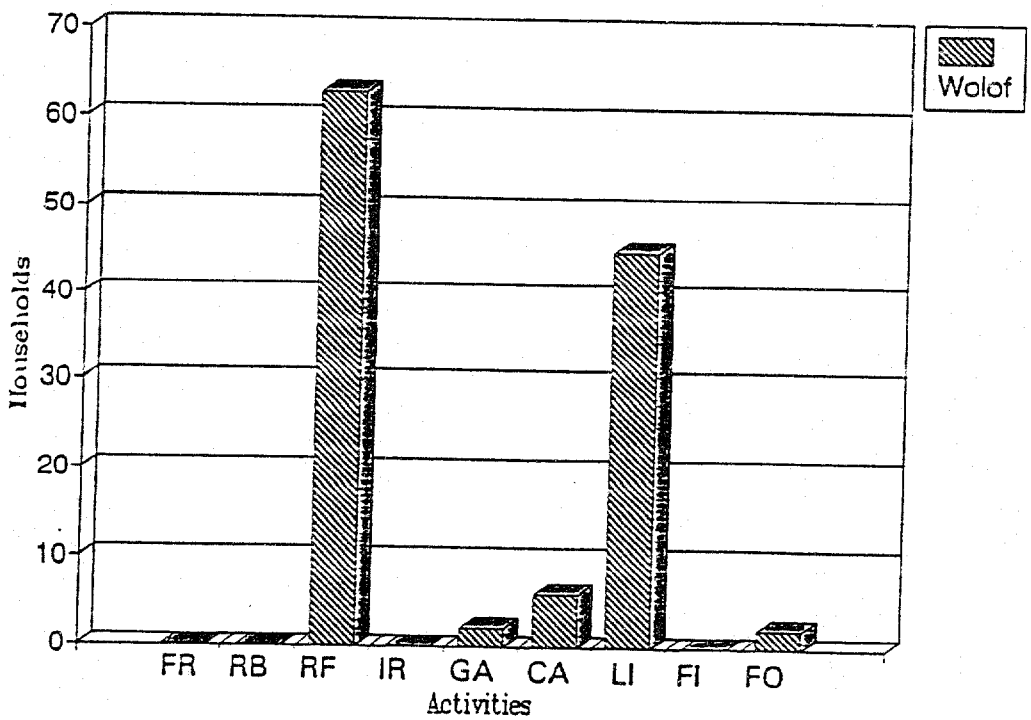
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Activities

in agro-pastoral activities. Not all groups, however, take part in all activities. The Fulbe and the Toorobbe generally do not fish, and the Wolof do not have access to waalo land. Some groups traditionally associated with specialized activities, moreover, today accord them only secondary importance. This is true with cattle herding for some Fulbe and with fishing for most Subalbe (Lericollais et al. 1990:31).

Neither the agro-halio-pastoral nor irrigation sectors, however, seem able to compete with migration in terms of the potential remuneration they offer young men. Although no studies have been undertaken to confirm this, the consumption patterns of households with migrants working outside the region and the reliance on remittances to cover the costs of a capital-intensive irrigation sector support this claim. Employment outside the region or abroad attracts labor either because the daily wages earned are higher than the daily net returns to participation in the agricultural sector, or because migrants are able to accumulate savings more readily when distant from the demands of family members and friends.

Because of the more attractive off-farm opportunities, production in the on-farm sector is carried out in such a way as to release labor for employment outside the region. That is, village households shift the allocation of labor across age groups and sexes in order to incorporate migration while maintaining agricultural diversity. For example, in 1989 on Bosséa I, a perimeter at Doumga Rindiaw, over 80 percent of household labor was undertaken by those between the ages of 5 and 24, so that older sons could migrate in search of wage labor. Some households with parcels on the irrigated perimeter, migrants abroad, and insufficient labor at home leased their parcels to sharecroppers. On Boyenadji Roumde's Tiguere Cire II perimeter, women undertook approximately two thirds of the necessary labor. Similarly, on the flood basins near Doumga Rindiaw three-fourths of household labor was carried out by men and women under 25. Virtually the same pattern was noticed on Boyenadji Roumde's Noussoum Yirlabe plain and on Thiemping's Cangay Dow Seyji plain. And in Doumga Rindiaw, young men under 20 usually take part in seasonal migration beginning in December or January following the weeding of flood-recession crops. Once they leave, women pick up the slack by participating heavily in the guarding of fields and in harvesting.

11.4 Conclusion

This chapter on rural-urban dynamics has described the exchanges that take place between rural areas in the Middle Valley and towns and cities inside and outside the region. It has also examined the part played by the agricultural sector in employment and income generation. The relationship seems to be one in which a diversified agricultural sector provides on-farm employment to individuals from a wide range of socioeconomic and statutory groups. At the same time, farm activities that are not overly labor intensive make it possible for a large proportion of young men to leave in search of wage-labor. The revenues they remit home fuel purchases of goods imported from outside the region, as well as purchases of such locally produced items as women's garden vegetables and some artisanal products. The commercial activity engendered by the influx of capital, moreover, has contributed to the rapid growth of a number of towns located along the national highway.

The introduction of irrigation on a large scale at the expense of the current diversified set of production activities is likely to disrupt employment in the rural areas and come into conflict with wage-earning opportunities outside the region. Simply stated, because irrigated perimeters are labor- and capital-intensive, the poorest and those with little access to labor will find it much more difficult to participate in the agricultural sector. Also, labor requirements will increase appreciably with the larger perimeters, making it impossible for women and young people alone to complete the necessary tasks. It is not at all certain that migrant labor will return to farm the irrigated areas.

How, then, does one reconcile the government's desire to increase food output in the region with farmers' twin objectives of protecting food security and minimizing risk? And how too does one raise rural incomes so as to encourage the development of farm-town exchanges? Two suggestions are offered here. First, as long as more lucrative income-earning opportunities exist in the off-farm sector, and as long as high levels of risk induce farmers to engage in multiple production activities, government and donor efforts at agricultural development in the region should be directed at improving the productivity of labor, more so than that of land. This will increase output and at the same time permit farmers to participate in a diverse set of productive activities, both inside and outside the region. Second, as long as SAED purchases rice from farmers at the government set price, it should do so promptly at harvest time so that fixed prices for farmers will actually benefit producers.

12. The Importance of an Artificial Flood in the Wider African Context

12.1 Introduction

Operating mainstream dams to release floods for the benefit of riverine economies and ecosystems is not a new management strategy, but it has rarely been applied in Africa. For over sixty years, the Aswan Dam passed the initial silt-laden floodwaters of the Nile through its sluices, which were closed only toward the end of the flood season to fill the reservoir. Starting in the early 1970s management of South Africa's Pongolapoort Dam has shown the benefit of controlled flooding for fisheries, grazing, and the riverine habitat. A controlled flood on Malawi's Shire River has similarly benefited fisheries; and releases from Zambia's Itezhitezhi Dam—though inadequate—are intended to improve the productivity of the Kafue Flats.

The controlled flooding with the most significant implications for development policy, however, is the release, since August 1988, from the Manantali Dam. This artificial flood was intended for the direct benefit of the riverine population of Mali, Mauritania, and Senegal (a population large as compared to that affected by the Kafue, Pongolo, and Shire cases) until such time as irrigated perimeters would be able to support that population. SRBMA research findings call for a continued and permanent artificial release during all but the driest years, as the benefits of doing so exceed the costs. Throughout tropical Africa tens of millions of people depend on annual (or biannual) flooding. In documenting this dependence and illustrating the devastating impact that the elimination or serious reduction of the natural flood regime has had on such people, this overview suggests that the costs and benefits of controlled flooding, synchronized with controlled reservoir drawdown, should be assessed as a matter of course in the planning of future African river basin development projects.

The time is appropriate for taking a new approach to river basin development for a number of reasons. One is the increasing evidence of the substantial environmental, economic, and sociopolitical costs of river basin development strategies that sharply reduce annual flooding. Another is the growing emphasis being placed on development for the low-income rural majority. A third reason is the added attention that African governments are paying to decentralizing decision-making and management responsibilities to the local level, while a fourth is the widening awareness, as reflected in the recent report of the World Commission on Environment and Development (1987), that successful environmental management requires the participation and development of the rural poor. Development strategies that impoverish such people and degrade some of the most productive ecosystems in Africa, as has much river basin development in Africa, are clearly outdated (Scudder 1989 and forthcoming).

12.2 The Importance of Africa's River Systems for Riverine Populations

Fewer than ten major river systems drain most of Africa. Their basins are largely characterized by unimodal or bimodal rainy seasons followed by dry seasons during which lack of moisture precludes rainfed agriculture. The mean maximum discharge of African rivers,

which occurs during a heavy, relatively short flood season, is frequently ten times their mean minimal discharge.

Sedentary communities, crop agriculture, states, and civilizations of Africa originated in riverine and lacustrine habitats. Currently, dependence on annual flooding encompasses over a million people in the Senegal River Basin and tens of millions in the Niger Basin. It is difficult to imagine life in the Sudan and Egypt without the Nile. Though the populations are lower in such countries as Mali, Nigeria (Niger River), Gambia (the Gambia River), and Zambia (the Zambezi river system), nonetheless their river basins remain national heartlands, while Somalia's Juba River Basin is a potential heartland. Indeed, riverine habitats from small tributaries to large rivers are a critical African resource. Bingham, for example, considers Zambia's Kafue Flats as Zambia's "most valuable agricultural entity," (1982:102), while Williams and Howard believe that "the biological productivity of an area such as the Kafue Flats may in the long run prove to be vastly more important to mankind than its short term value as a modified water storage for the generation of electrical power" (1977:6).

12.3 The Nature of Riverine Production Systems and Their Dependence on Annual Flooding

12.3.1 Introduction

A few examples will illustrate the magnitude of people and livestock that depend on annual flooding of African rivers. The Sudan's Sudd is an essential resource for over one million Nilotic people and several million livestock. The largest numbers, and the most intricate systems of production, however, are associated with the Senegal, Lake Chad, and Niger Basins. Each instance involves floodwater cultivators, herders, and fishermen. In good years, well over 300,000, and perhaps more than 500,000, hectares are utilized for flood-recession agriculture: over 100,000 hectares in the Senegal Basin; an estimated 165,000 hectares along the Niger in Guinea, Mali, and Niger, of which up to 110,000 hectares are within the Inland Delta; and a large area whose exact extent is unknown in the Nigerian portion of the Niger basin and in the Lake Chad-Logone-Chari basins.

During the mid-1950s nearly half a million people utilized the Inland Delta of the Niger, including 70,000 farmers, 80,000 fishermen, and over 300,000 pastoralists (Gallais 1967). They were incorporated within a single political framework, with the various ethnic and occupational groups linked together in a set of dynamic, complex, and environmentally sustainable relationships.

12.3.2 The Nature of Riverine Production Systems

Riverine production systems in tropical Africa include rainfed agriculture, floodwater agriculture, livestock management, fishing, gathering and hunting, and wage labor. While some of these components do not directly relate to flooding, their relative importance through time is responsive to changes in rainfall and river flows.

Where rainfall is good (both in quantity and distribution) riverine farmers emphasize extensive rainfed agriculture on alluvial and other soils because its returns per unit of labor exceed returns from other work. Where rainfall is poor they emphasize flood-recession cultivation during the following dry season, and where both rainfall and flooding are restricted, the people turn to wage labor, and especially labor migration.

Transhumant pastoralists may respond to periods of drought or political instability through temporary or even permanent sedentarization along such rivers as the Senegal and Nile. Currently along the Middle and Lower Tana River in Kenya some herders are taking increasingly to farming, while others, marginalized by drought, conflict, and other misfortunes, hire themselves out to herd the stock of farmers, wealthy pastoralists, and cooperative ranches. Urban unemployment and inflation also increase the numbers of fishermen, as in Zambia both in the late 1950s and during the past fifteen years, when the number of subsistence fishermen on the Kafue Flats has been steadily rising (LaMuniere 1969; Hayward 1981).

12.3.2.1 Floodwater Agriculture

The four types of floodwater agriculture in Africa, dating back several thousand years in their areas of origin, utilize rainfall, sheet flow, river flood regimes, and tidal action, either singly or in various combinations. Associated with riverine and lacustrine habitats, the first two are freshwater flood-recession and freshwater flood-rise cultivation. The third and fourth are valley (swamp) and tidal cultivation. None has received the attention it deserves.

The most common type of floodwater agriculture throughout Africa is flood-recession cultivation, in which farmers sow the banks of rivers, streams, and lakes as the floodwaters recede during the dry season. Its antiquity throughout Africa is affirmed by the evolution of a wide variety of cultigens to deal with different flood and drought conditions. These include 90-day cereal varieties that trade off higher yields for drought resistance and early maturation. Total hectarages sown vary from river basin to river basin and from year to year within the same basin, varying in relation to floodplain morphology, flood conditions, soil conditions, and the nature of the preceding rainfed harvest. Yields of cereals vary between 400 kg and 800 kg per hectare. While areas cultivated per household tend to be relatively small (in comparison to rainfed fields), land suitable for flood-recession cultivation is the most highly valued by riverine populations, and is subject to elaborate rights of usage and tenure.

12.3.2.2 Livestock Management

After the recession of the annual flood, floodplains throughout Africa provide a critical source of pasture during the latter part of the dry season when vegetation elsewhere is scarce. At that time livestock converge on wetlands. Without access to such dry-season pastures, herd size could not be maintained. Within the Pongolo floodplain (South Africa), Buchan reports that "mean stocking densities on the floodplain and in surrounding dry-land areas were 0.78 AU (Animal Units)/ha and 0.24 AU/ha respectively, so, while floodplain vegetation covers only 8 percent of the total vegetation area available to stock, cattle spend an estimated 23 percent of

their grazing time on it" (1988:16). For the Kafue Basin, Bingham estimates the total cattle population at about 500,000 in 1978: "It is likely that at least 50 percent of these cattle depend on the flats for their dry season grazing" (1982:95). For the Inland Delta of the Niger, Diarra reports 1981 floodplain stocking rates on *Eragrostis* grasslands similar to those reported by Buchan from the Pongolo (1988).

12.3.2.3 Fishing

Annual flooding significantly increases the productivity of riverine fisheries by providing food and protection for spawning fish and their fry. Not only are floodplains more prolific, but they are easier for local populations to fish than the main channel. The fishing season starts when the floods encroach and continues until the waters dry up or recede back into the primary channel. In some areas, for example the Nile Sudd and Zaire's Ubangi River, riverine communities increase the floodplain area by excavating canals to connect low-lying basins to the main channel. Along the lower reaches of the Oueme in Benin, they dig narrow trenches over a kilometer in length perpendicular to the main channel; fish are trapped in the trenches when floodwater subsequently recedes (Welcomme 1979).

Observers from as far apart as South Africa, the Sudan, and West Africa have noted "how riverine fisheries make available an important source of high quality protein in areas that otherwise would suffer from serious nutritional deficiencies" (Scudder and Conelly 1984:12). According to a 1984 written communication from FAO's Francis Henderson, surveys suggest that some 40,000 tons of fish per year are consumed locally along the Nile and its tributaries in the Southern Sudan. Estimates of landings that exceed 100,000 tons a year are reported from the Inland Delta of the Niger and in the Lake Chad basin, where fluctuations in water levels cause yearly landings to vary between 30,000 tons and 220,000 tons (Lowe-McConnell 1985).

12.4 Justification of an Artificial Flood

Whether built for hydropower generation, irrigation, or both, mainstream dams in Africa significantly reduce the annual flood during most years and adversely affect riverine habitats and local production systems. While post-impoundment ecological research has dealt more with reservoir than with downriver impacts, the latter can be severe in the short term, including serious river bank erosion and reduced aquifer recharge. Over the longer term, reduced flooding negatively affects floodplain creation, riverine forests, alkalinity, and coastal deltas and beaches.

Elimination of downstream flooding has devastated local production systems. It has drastically reduced riverine habitats for floodwater farming and livestock management, on the one hand, and fisheries productivity and hence fish landings for consumption and commerce, on the other. The most detailed analysis of the adverse effects of dam construction on downriver users deals with the Bakolori and Kainji Dams in northeastern Nigeria (Adeniyi 1973; Welcomme 1979; Adams 1985b).

Notwithstanding such serious impacts, planners have made no attempts to assess systematically the development potential of riverine floodplains or production systems in tropical Africa, let alone to assess how to develop whatever potential exists. In their 1982 report on the Pongolo Floodplain, for example, Heeg and Breen wrote that "the asset value of the floodplain has not yet been considered in any of the development plans, largely because none of the planners have ever visited it" (1982:92). Similar statements could be made for other riverine habitats throughout Africa. In the Kainji case, for example, "little effort has been made to monitor . . . the downstream effects of the dam" (Welcomme 1979:21). The situation is identical in regard to dam construction in Kenya's Tana River Basin. Here, the lack of attention to downriver impacts is even less justified; first, because five dams are involved, and second, because the construction on the fifth, Kiambere, proceeded after socioeconomic and environmental guidelines for World Bank-financed projects had been formulated and approved. If the Bank had followed its own guidelines, Kiambere Dam would not have been built.

Since electricity generation provides much (and in some cases, all) of the justification for dam construction in terms of development and debt repayment, what is the justification for a suboptimization strategy whereby dams are used to realize a range of partial benefits as opposed to optimizing a single benefit?

First, riverine production systems have sustained relatively dense (by African standards) populations for millennia. With the increased interest in sustainable development, there is reason to give serious attention to the enhancement of these systems. Second, current experiments with man-made flooding on the Pongolo River in South Africa show it to be an attractive option as a permanent feature of dam operation. Third, during the early stages of industrialization it is the rising productivity of tens of thousands of small-scale producers like those who inhabit Africa's river basins that drives development forward.

Fourth, as Adams has pointed out (1985a), provision of hydroelectric power often has not catalyzed the expected "blossoming" of local industry, while World Bank evaluations conclude that the construction of some major dams—as least-cost energy sources—has been premature. Granted Africa's hydropower potential (at least 30 percent of the world's, only a small portion of which has been tapped), plus the gradual expansion of interconnecting international grids, and the reconsideration by heads of state of common market options, surely it is not necessary to optimize the hydropower output of each dam—especially when such optimization is clearly at the expense of riverine habitats and production systems.

12.5 Policy, Management, and Environmental Constraints to Man-made Flooding

Though designing and operating dams so as to permit a regularized annual flood is both economically and ecologically desirable, a number of constraints could interfere with the implementation of such a flood. These can be divided into policy, management, and environmental constraints.

12.5.1 Policy Constraints

Hydropower generation and man-made floods benefit different constituencies. Hydropower primarily benefits the elite-dominated urban industrial and residential sectors. Man-made floods, while facilitating longer-term national development, provide immediate benefits primarily to low-income rural households with little political clout. Suboptimization strategies that favor the latter will require enlightened policy-making on the part of national governments planning dam construction.

As for donors, their policies will need to distinguish between debt repayment and the realization of longer-term development goals. Sale of hydropower to urban users provides greater opportunity for generating cash income to repay construction debts than does broad-based rural development arising from dam-released floods and rural electrification.

12.5.2 Management Constraints

In order to release the proper amounts of water at the right times, an annualized man-made flood requires a sophisticated hydrometric network such as has been recently activated on the Senegal River. For farmers to utilize those releases requires an effective extension service. Using dams to achieve a multiplicity of goals also requires improved management skills within river basin authorities and key ministries. Such skills are in short supply in Africa, and where they exist—as in Ghana's Volta River Authority—they continue to be backed up by expatriate expertise, which in turn requires payment in foreign exchange.

12.5.3 Environmental Constraints

The most serious potential environmental constraint is increased drought. Especially in the Sudano-Sahelian zones, droughts since 1968 have put pressure on riverine habitats and riverine production systems, thereby promoting conflicts between different categories of users. Drought has also reduced reservoirs backed up behind mainstream dams.

Reduced inflows during the first half of the 1980s required the Volta River Authority to cut off all electricity in 1984 to the prime industrial user (VALCO) in order to provide essential services to Accra and other urban areas in Southern Ghana. In Egypt, decision makers received a reprieve at the last moment from making difficult decisions about the use of seriously depleted waters behind the Aswan High Dam only because of exceptionally high rainfall during the latter part of 1988 in the upper catchment of the Blue Nile.

A second problem concerns lack of knowledge about the role of natural flooding in the maintenance of riverine ecosystems. While controlled flooding can be expected to have major environmental benefits, elimination of river flow extremes will have ecological impacts whose nature is unclear.

12.5.4 Summary

Should these constraints preclude the "hydropower cum man-made flood and regularized reservoir drawdown option," the unsatisfactory record to date with African dam construction suggests that most mainstream dams now on the drawing boards should not be built. As currently designed and implemented, mainstream dams are supported by a powerful coalition of heads of state, other national decision makers, donors, and engineering firms. They are opposed by an increasingly powerful coalition of environmental and human rights organizations. As a compromise that might satisfy both sides, designing and operating dams to allow hydropower generation, irrigation, and an annualized man-made flood, among other uses, warrants careful analysis.

12.6 Acknowledgements

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A:

aalmaami	imam prayer leader—head of the theocratic state of the Fuuta Tooro after the Tooroodo Revolution of 1776
aawde	to plant
almuudo (pl. almubbe talibe)	student of a marabout
amo	a heavy flood inundating foonde as well as waalo lands
anja njaara	a type of hand-held fishing net attached to small poles and manipulated in shallow waters
arano	first weeding
ardo	title held by the chief of certain Fulbe tribes or families
asakal	a religious tithe paid to the joom leydi and given to the poor. This tithe applies also to herds and estates, but the percentage is not the same as for crops
asakal diine	Islamic tithe representing a tenth of the harvest
asbugol	census of goods and, by extension, the portion that is allotted to the person who renders decisions concerning inheritance
awdi	planting

B:

ballal	help, in the general sense of the word
ballongiral	reciprocal help
Bambara	Mande peoples from western Mali (Kaarta and Segu)
bammbaado (pl. wammbaabe)	Fulbe griot caste (musicians and genealogists)

barba	title held by the king of the Jolof. It signifies "the king" or "the king of kings" because he rules over other kings
baylo (pl. wayilbe)	blacksmith caste
bayti	state lands; "land of the Muslim community;" land located between lands held by two feuding factions of a family and taken over by the joom leydi
bekkugol	covering up; either a young child or an elder places a small handful of sand in a planting hole to protect the seeds from insects
beyaat	second weeding
bidaan	white Moor
biirde	to milk
birnajo	gorwori
boowol	open spaces
burnajo (pl. burnaabe)	potter: subgroup of the Sebbe (freemen), specializing in pottery

C:

caambal	gillnet
caangol (pl. caalli)	thalweg, a valley drained only during the flood
caatal	gift representing a portion of the harvest given to individuals who have not cultivated
capaato (pl. safalbe)	referring to Moors
ceddo (pl. sebbe)	former warrior caste (free men)
ceedu	the hot, dry season

cengalaal	traditional woven baskets
ceerno	religious teacher/leader; marabout
ciifol	field, plot of land
ciifol bottaari	small plot lent free of charge by the joom ngesa to a sharecropper practicing the rem peccen didabal
coggu	rent paid in kind for land for 1 to 2 years in the waalo
cokde	annual closing of fishing rights in the river, which takes place near the end of the cold season, usually in January or February
coktal (pl. cokte)	opening of the period of communal fishing undertaken from luggere to luggere, upstream to downstream along the river
conyal (or cona)	harvest
cootiigu	the right paid by a man to claim his father's right to cultivate a field; right of mutation
cuballo (pl. subalbe)	caste of fishermen (free men)

D:

daande maayo	secondary river bed, bounded by steep banks
dassiri	to remove weeds and thorny plants
dawol	collective labor; half-day of work (from about 9 AM to 2 PM)
dawol fedde	labor carried out by an age grade
dawol kaaliss	collective labor; a half-day of work (from about 9 AM to 2 PM)
deedal (pl. deede)	the lowest lands in the waalo
deenal	guarding against predators other than birds (monkeys, wild boars, etc.)
deeniyanke	

(pl. deeniyankoobe)	family of the former rulers of the Fuuta
demal	general term for weeding
demoowo (pl. remoobe)	farmer
demoowo lubal	cultivator who has been lent a field free of charge by the joom ngesa
demoowo rem peccen	sharecropper
dende	watermelon
der dera	fields situated in the interior of the kolangal
desndaadi	cattle cared for by another member of the family
diacre	sandy-clayey soil of the waalo
dimgal	transport
dimo (pl. rimbe)	noble caste (free men)
doftal	unpaid work day on the land of another farmer
doftal esiraado	help organized by a prospective son-in-law and undertaken by his age grade for his future father-in-law
doftal giyiraabe	help in the form of labor that an entire age grade performs for the family of one of its members (in case of death, for example)
dokkal pandungal	a field (ngesa) given as a permanent gift by the joom leydi
dolinge	fishhooks
donaadi	cattle received as an inheritance
dôoftade	thinning
dôoftagol	thinning
doppere	clay

dowrowal (pl. dowrowe)	lands located at the highest elevations in the waalo
duggitaade	light clearing of land by removing stubble from the previous season
dumel (pl. damel'en)	title held by Sebbe or Subalbe dignitaries
duppude	to burn
duyru	type of fishing net attached to small poles that are manipulated by hand in shallow waters

E:

elimaan	imam (prayer leader). The term now refers to the temporal title given to certain land owners

F:

falo (pl. pale)	agricultural recession lands located on the banks of the river
farba	title held by the chiefs of various Sebbe clans
fedde	groups of girls or boys of the same age
fela	variety of sorghum
femmbirge	a female animal presented as a gift to a newborn child at its first ritual shaving, when the child is named (a type of preinheritance)
ferlo	land area, used largely as pasture
follere	sorrel
foonde (pl. poode)	river banks traditionally devoted to rainfed agriculture, now often developed as PIVs
fooyre (pl. pooye)	household

Fulbe Feroobe	Fulbe clan
Fulbe Ururbe	Fulbe clan, especially well-represented in the Fuuta Tooro
Fulbe Yaalalbe	Fulbe clan
Fuuta	a generic term referring to the Fulbe country
Fuuta Jallon	a mountain in Guinea, inhabited by the Fulbe and the Jallonke, site of the sources of the Senegal, Niger, and Gambia Rivers
Fuuta Tooro	Middle Valley of the Senegal River, formerly called the Tekrur
Fuutanke (pl. Fuutankobe)	inhabitant of the Fuuta

G:

gaawgol	planting
galle (pl. galleeji)	all the pooye in a compound; fence surrounding a field
gambol	small dams constructed of layers of mud between which trapped water is bailed out until only fish remain
garbaari tokosiri	bull
gawlo (pl. awlube)	caste of griots, musicians, genealogists, and keepers of the oral tradition
gawoowo (pl. awoobe)	fisherman (freeman)
gawri ndiyamiri	finger millet, including the Suuna and Saanyo varieties
gaylinké	a herder who cares for animals belonging to other people
gaynaako (pl. aynaabe)	herder
gesa mangu	field on joowre land taken over by the mawdo lenyol/mawdo galle for cultivation

gedal mangu	the portion of asakal amassed from rented joowre land and given to the mawdo lenyal
goniakie (gawdi; pl. gawduule)	acacia nilotica
gool (pl. gooleeji)	a young unweaned male or female animal (a bull calf or a heifer)
gooyol (pl. gooyi)	the stalks and leaves of the cowpea
gorwori	part of a herd belonging to the head of the household

H:

haacoonde	a weed found in the waalo
haako	a term utilized often to refer to leaves eaten in the form of a sauce (e.g., cowpea leaves)
Haal Pulaar (pl. Haal Pulaaren)	Fulani, a Pulaar speaker
haange	cow
haw hawo	weeding undertaken before planting
hollalde	very heavy clay soils of the waalo

I:

itita	fields located on the edge of the floodplain

J:

jaagaraaf	traditional collector of land use fees, now tax collector
jaasi	machete
jaawando (pl. jaawambe)	a Torrobbe's political advisor
jabbere	to sow fields; to hoe
jagodin	

(pl. jabodin'en)	title held by Sebbe dignitaries
jaltaabe	chief fisherman (Cuballo), water use administrator
jambere (pl. jambe)	axe
jawli kofe	type of fishing net attached to small poles that are manipulated by hand in shallow waters
jeejegol	intermediate zone between the jeeri and the waalo
jeeri	rainfed agricultural land, usually sandy or clayey-sandy
jeewo	a man's first wife
jeyngol	fire
jiggoore	the acquisition of wholesale grain for food
jolirde	cattle paths (on the foonde) that access the river
joltoobe waalo	a seasonal migrant who returns to his home region to cultivate the waalo
jontannde	rotation of cultivation rights on joowre lands
joom (pl. jomiraabe)	master
joom galle	head of the galle, the family compound
joom ganndal	master of knowledge; land owner through receipt of plots of land donated to him as thanks for services performed
joom jambere	owner of land obtained through clearing by axe
joom jeyngo	owner of land obtained through clearing by fire
joom lewre	owner of land obtained through clearing by machete
joom leydi	master of the land/agriculture/territory
joom ngesa	master of the field (owner)

joom wuro	village chief
joowre	lands held communally
jumtinaadi	part of a woman's herd given to her married son and subtracted from his future inheritance
juude	river crossings
juuwde	to cross a river

K:

kawule	the second (short) fishing season in October and November
kirwal	period of guarding against birds, which takes place late in the season when sorghum ripens
kolangal (pl. kolaade)	recession cuvette/depression
koliyaabe	clan of Sebbe associated with the Deeniyanke family
koolaado (pl. hoolabe)	confidant; refers sometimes to the title held by certain Fulbe dignitaries close to the Ardo
kowgol	construction of a protective fence around a house or a field
kurnal (pl. kuurne)	period of guarding against birds when sorghum matures
kurtordi	a gift of cattle given to a bride by her parents on the occasion of her marriage

L:

labbo (pl. lawbe)	caste of artisans who specialize in woodworking
lana	dugout canoe
lappol	cattle path located along the cultivated fields
lawake	

(pl. lawakoobe)	those who exercise or who are called upon to exercise political power; associated with Deeniyanke power
leegal (pl. leede)	neighborhood (of a village)
lembel	a man's second wife
lenyol	lineage, family, tribe
lewre	newly cleared land; clearing; machete
lewre bottaari	plot reserved for payment in lieu of food
lewtade	extensive clearing of land formerly in long-term fallow
lewtu ngesa	temporary cultivation rights obtained by clearing a plot of land belonging to another person
leydi (pl. leyde)	agricultural land
lorngo	transplanting
lorwa	guarding against birds that takes place late in the season when sorghum matures
lowre	a plot of land in a field
lubal	a loan
lugal	a pointed stick used to make a hole in the earth in which seeds are planted
luggere (pl. lugge)	fishing hole; a river branch that cannot be forded
lulnde	guarding fields through continual surveillance
luugol	the act of digging a planting hole for seeds

M:

maabo

(pl. maabube)	weaver caste
maccudo (pl. maccube)	(former) slave caste
mawdo galle	the oldest member of a galle
mawdo lenyol	the oldest member of a lineage
mbaatu	a disease that causes dwarfing in plants
mbargu	a method of constructing dams to catch fish
mbereeji	cattle entrusted to the care of a person who is not a member of the family
miskiino (pl. miskineebe)	poor people; needy individuals who are given a share of the asakal
mjoldi	a fee paid when work begins in the waalo
munu (pl. munuuji)	river spirit
muudo (pl. muudi)	a measure varying between three and three and a half liters, equivalent to approximately 4 kg of grain
muudo horma	"muudo of protection;" tribute paid in kind by the inhabitants of the Fuuta to the Moorish emirs (Trarza and Brakna), which dates back to the 17th century. This tribute is taken off the asakal.

N:

nafoore	a good deed or large gift given by the prospective groom to his fiancée's mother
nayeeri	old bull
ndennal	a period of general surveillance against such animals as monkeys and wild boars beginning just after the crops have begun to grow
ndiyamiri	millet, finger millet

ndoodi	tribute paid by the joom ngesa to a central power considered to be the eminent master of the land
ndungu	the short and unpredictable rainy season in the middle or at the end of June
nduumtaaji jeeri	migrants returning to cultivate the jeeri
ngaabu (pl. gaabi)	a hole; a very shallow well providing access to the surface water table
ngaari kalhaldi	breeder bull
ngaari tokoriri	young bull
ngesa (pl. gese)	field
ngesa cukka	in the case of the joowre, a plot allotted to a junior
ngesa mangu	a field taken over by the oldest person in the case of the joowre
ngesa nguurduba (pl. gese guurdude)	a field allotted to the head of a household so that he may provide for his family
ngesa suudeewa	a field that is transferred from the joowre to family use
njeylaari (pl. jeylaaje)	a waalo field taken from the joowre and allotted to circumcised single men of the lenyol
njinn danngu	long-handled hoe
njobdi	daily wage laborer
nyaayko	sorghum stalks and leaves
nyaayngal	opening of the waalo to herds after the harvest
nyale	a three-year-old weaned cow
nyeenyo	

(pl. nyeenybe)	all artisan castes
nyendiko	a variety of rainfed sorghum
nyippere	a type of weed found in the waalo
nyobdi	salary, payment for work

Q:

P:

pale	falo field
parka	a method of constructing dams in order to catch fish
pullo (pl. fulbe)	Fulani (herder); free caste, descendants of the first inhabitants of the Fuuta
purdi jorngal	large, black-grained sorghum
pusam	a destructive flood

Q:

querool (pl. queeri)	small mounds denoting the boundaries of plots

R:

rem bamaa = rem nawaa	loan of agricultural lands, or a field lent free of charge
rem itaa giye	see "lewtu ngesa"
remooru (pl. remoobe)	farmer
rem peccen	sharecropping
rem peccen didabal	sharecropping where half of the harvest is paid in rent to the joom ngesa

rem peccen tatabal	sharecropping where a third of the harvest is paid in rent to the joom ngesa
remru	weeding
riginy	old cow
rumaano (pl. rumaanooji)	seasonal rainy season camp
rumtude jeeri	to return to cultivate the jeeri

S:

saanyo	a variety of finger millet
saatigi (pl. saatigi'en or saatigeebe)	title given to Deeniyankoobe kings and certain Sayboobe dignitaries
sadaake	segment of the herd belonging to the first wife
sakite	a particular type of caambal that is utilized in the floodplain and at the edge of a marsh where it is set at night and checked the following morning
sakkade	thorn barriers erected during the initial phases of clearing, used only in the kolaade nearest the village
sakke (pl. sakkeebe)	caste of leather workers
samba remooru	landless farmers; sharecroppers
samme	recession sorghum
samme baleejo	black samme
samme bodeejo	red samme
samme daneejo	white samme
samme yaki	another samme variety similar to black samme

sandareeje	the part of a herd belonging to a man's second wife
satindaade	agricultural labor paid in kind
sawa suuka	a variety of sorghum
sayboobe	class of Fulani warriors. This term is derived from the Arabic "as sahab" (companion) and refers to Fulbe warriors who accompany the saatigi
seedaano (pl. seedaanooji)	dry season camp
seeno	sandy land in the jeeri
seno	sand
sewil	samme with fairly white grains whose taste and smell attract birds
siiwre	pasture grass found in the falo after the period of recession
sincu	a newly established neighborhood or a new village established with people from another village
soonyo	insufficient or nonexistent flood
suudu	house
suuna	a variety of finger millet

T:

tatabo	third weeding
tati	three
teen (pl. teen'en)	title held by Subalbe dignitaries like those in Dounguel and Kaedi
tengne	dowry
tiwaande	period of interdiction lasting until the opening of harvest, fishing, or the entry of herds onto fields. With the lifting of the tiwaande, all of these activities are permitted

tobaani ilaani	"no rain, no flood"
toggere (pl. togge)	elevated zones left unflooded, usually wooded, in the middle of a kolangal
tooroodo (pl. toorobbe)	marabout caste of free men; education specialists who took power in 1776.
torndoogam	runoff waters
tufnde	access ramp to the river for people as well as cattle; port
U:	
uddude	period of very heavy fishing when villagers occupy strategic positions at the main tributaries on the plain to seine for fish swimming in canals toward the interior plain
uguude	siiwre root, used for incense
V:	
W:	
waalo	recession land in the floodplain
wadde galle	to enclose behind a fence
wafdu	sickle
wallere ballere	very black, heavy clay soils in the most elevated zone of the falo
wallere ceenal	light, alluvial soil found at the lowest elevations in the falo or the waalo
wallere ranene	sandy alluvial soil found in the intermediate zone of the falo
weccu beli	a widespread form of diking and bailing undertaken in drying ponds
weendu (pl. beeli)	pond

wiige	a cow older than three years that has not yet reproduced
wodaabe	large Fulbe clan inhabiting the Tooro and the waalo
X:	
Y:	
yiyal	bone; part of a sacrificed animal given to the land owner
Z:	

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