The University of Michigan
Gambia River Basin Studies

Rural Development in the Gambia River Basin

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PREFACE

This report represents part of the work of a number of researchers and field staff. The actual report was written by William Derman, Frank Casey, Sarah Lynch, Cynthia Moore and Charles Steedman.

The following researchers contributed significantly to this report:

• Judith Carney	Balingho Dam impact study
• Frank Casey	Basinwide survey, village studies in Senegal, marketing and analysis of village data
• Lucie Colvin	Migration in Senegambia
• Christine Elias	Village studies and irrigation in The Gambia
• Jim Fitch	Economic analysis
• Rolf Jensen	Guinea
• Robert Kagbo	Irrigation study
• Sarah Lynch	Economic analysis of development plans for the basin
• Leonard Malczynski	Data management and analysis
• Cynthia Moore	Basinwide survey, irrigation study in Senegal, analysis of village data
• William Roberts	Qualitative work in the Senegambian villages, and survey of the dam impact zones in Guinea
• Michael Vuister	Data management
• Walter West	Kekreti Dam impact study
• Andrée Wynkoop	Guinea

In addition to the above researchers the following Gambians, Guineans and Senegalese worked in the field:

<u>The Gambia</u>

- Ousainou Baldeh, Falnakoi Janneh, Bouba Jarra -- Supervisors
- Lamin Barrow, Mamdou Balajo, Cherno Bojang, Musa Suso, Yukase Darbo, Mamadou Marong, Mamadou Barry, Yusupha Jobe, Dembele Fye -- Enumerators
- Musa Ceesay -- General research associate
- Bakari Sanneh, Tuku Jallow, Yahya Marong -- Data entry operators

Senegal

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- Maguette N'Diaye -- Trainee from the Ministry of Rural Development

Kekreti Impact Study

- Fula Ba, Dowda Sow -- Enumerators who also served as data entry operators

Guinea

- Professor Fode Keita -- Supervisor
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- Mamadou Baillo Diallo -- Researcher
- Seydian Camara -- Trainee
- Professor Ali Oulare -- supervisor and counterpart

All of the Gambian, Guinean and Senegalese researchers carried out their responsiblities with professionalism and commitment despite the range of challenges posed by village living.

John Sutter, the original team leader, and Michael Watts wrote the plan of study for Senegal and The Gambia and many of the stock and flow questionnaires used in the Senegambian survey villages. Their dedicated efforts, assisted by those of Chris Elias, got the village studies underway on time and with an excellent staff.

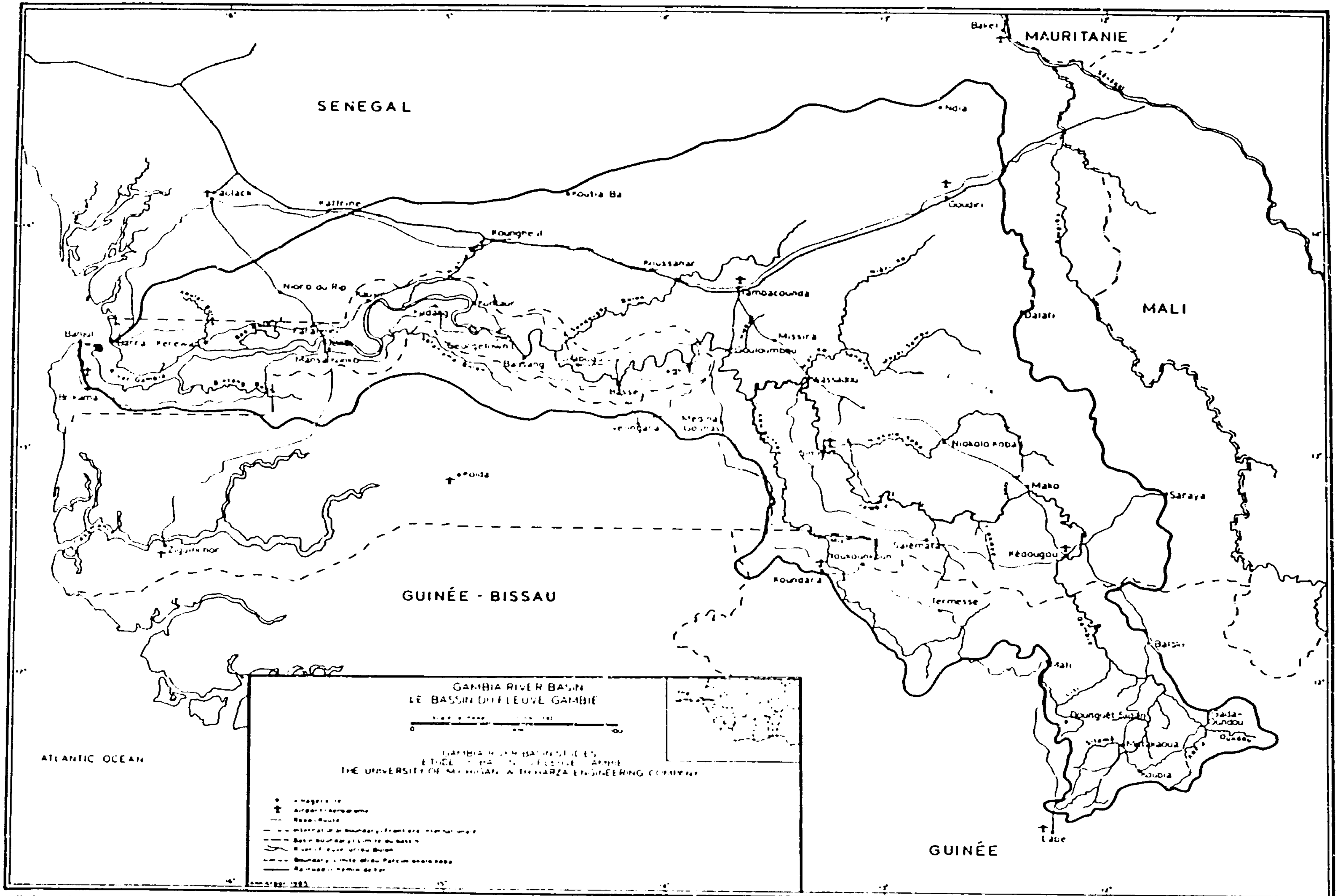
In addition, we express our profound thanks to the numerous individuals and agencies too numerous to cite who gave so generously of their time and resources to facilitate our studies.

Our great appreciation is given to Rebecca Doyle, Patricia Humphrey and Carol Wilson of the Center for Research on Economic Development who have worked unceasingly to produce this report. Sherry Cogswell performed logistic and administrative miracles to help us both in the field and in Ann Arbor.

Special thanks go to the hundreds of villagers who permitted us to live in their villages, shared their hospitality and often scarce food, and who submitted to our endless questions in the hope that through our studies and OMVG's action, positive changes might occur.

Ann Arbor, Michigan
September 1985

William Derman
Team Leader



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LIST OF ACRONYMS AND ABBREVIATIONS

ADP	Agricultural Development Project (The World Bank)
AHT	Agrar-und Hydrotechnik
CDC	Commonwealth Development Corporation
CPMS	Crop Produce Marketing Societies
CPSP	Caisse de Péréquation et de Stabilisation des Prix
CRED	Center for Research on Economic Development
CRS	Catholic Relief Services
DOA	Department of Agriculture (The Gambia)
ERCOA	Entreprises Régionales de Commercialisation Agricole
FAO	Food and Agriculture Organization of the United Nations
FAPA	Fermes Agro-Pastorales d'Arrondissement
FFHC	Freedom From Hunger Campaign
GCU	Gambian Cooperative Union
GOS	Government of Senegal
GOTG	Government of The Gambia
GPMB	Gambia Produce Marketing Board
GRBS	Gambia River Basin Studies
HHL	Howard Humphreys Limited
IFAD	International Fund for Agricultural Deveopment
IMF	International Monetary Fund
IVS	Intensive Village Studies
LBA	Licensed Buying Agents
LDRC	Land Development and Reclamation Consultants
LRD	Lower River Division
MID	MacCarthy Island Division
NBD	North Bank Division
NTC	National Trading Company, The Gambia
OFADEC	Office Africain pour le Développement et le Coopération
OMVG	Gambia River Basin Development Organisation
OMVS	Organisation pour la Mise en Valeur du Fleuve Sénégal
ONCAD	Office National de Coopération et d'Assistance au Développement
PISO	Périmètres Irrigués du Sénégal-Oriental

PPMU	Planning, Programming and Monitoring Unit, Ministry of Agriculture
PRC	People's Republic of China
PRL	Pouvoir Révolutionnaire Local
RDA	Regional Development Agency
SAED	Société Nationale d'Exploitation des Terres du Delta du Fleuve Sénégal et des Vallées du Fleuve Sénégal et de la Falémé
SDR	Special Drawing Rights
SIES	Société Industrielle d'Engrais au Sénégal
SMIG	Salaire Minimum Interprofessionnelle Guaranti
SODIFITEX	Société de Développement des Fibres Textiles
SONAR	Société Nationale d'Approvisionnement du Monde Rural
SONED	Société Nouvelle des Etudes de Développement en Afrique
UNDP	United Nations Development Programme
UPI	Unité Paysannale d'Irrigation
URD	Upper River Division
USAID	United States Agency for International Development

1. EXECUTIVE SUMMARY

Since the 1968-73 drought there has been an emphasis on the development of irrigated agriculture in the river basins of West Africa including the Gambia River Basin. The Gambia, Guinea and Senegal strive to increase agricultural production, increase the income of rural producers, and diminish the disagreeable dependence on food imports and food assistance. The obstacles to overcome to achieve these goals are formidable.

The fundamental questions to be asked of current development strategies focusing on dam construction for irrigation and hydro-electricity in the Gambia River Basin are:

- will they attain the stated goals of Gambia River Basin Development Organization (OMVG) and the riparian states?
- will the water control provided by the dams give reasonable assurance that the large risks and costs entailed achieve the desired goals?

The answers to these questions are not easy. While the Gambia River is important in The Gambia, Guinea and Senegal, it is not equally so. The possibilities for both successful development and failure will have the greatest consequences for The Gambia because it has no other rivers or river basins. If there are problems, Guinea and Senegal will have alternatives, but The Gambia would not. The risks are greater for The Gambia in both the long-term and the short-term because it has far fewer ways to diversify its economy than Senegal and Guinea. In addition, the potential amount of land to be irrigated is greatest in The Gambia portion of the basin (approximately 53,500 hectares compared to 16,500 hectares in Senegal and 15,000 hectares in Guinea). The Gambia already has approximately 43 percent of this irrigable land in rainfed or swamp cultivation and therefore could suffer a loss in production if the shift from rainfed and tidally irrigated agriculture to irrigated agriculture is not very carefully thought out. The land in Senegal and Guinea has a much lower current rate of utilization.

The central foci of this volume are the current social and economic status of the basin, the likely impacts of the proposed dams, past experience with irrigation, and the current integration of irrigation into village farming systems. Our socioeconomic study has also examined development options and forms of organization suggested by others in light of the results of our own surveys, and some initial thoughts on monitoring and evaluation.

It is assumed that current rainfall patterns will permit little or no additional land to be irrigated during the dry season without dams. Most of the irrigable land along the river exists in discontinuous tracts of less than 1,000 hectares. This will permit a range of experimentation with crops, varieties, types of technology and forms of organization (from private landowners to cooperatives). Similarly, the diversity of peoples and ecologies suggests the need for varied organizational forms suited to different parts of the basin.

1.1. Current Status

In addition to agricult re and livestock, there are other important economic activities in the basin. These include essential domestic tasks (obtaining firewood, cooking, drawing water, fishing, hunting and so forth). One conclusion we have reached is that other forms of nonagricultural activities need to be considered in assessing labor availability for irrigation. It is difficult to underestimate the importance (from the rural populations' perspective) of nonagricultural sources of income, even if these do not generate a high percentage of the total necessary to sustain existence. Many households achieve a delicate balance through diversification of economic activities. Despite their best efforts, poverty and malnutrition are widespread in the basin.

Not only have rural producers been unable to produce food quantities sufficient to meet the needs of urban consumers; they have also been unable to meet their own household needs. The inability to satisfy changing household needs, combined with employment opportunities in the cities, have led to very high rates of labor migration. Basin residents have become increasingly dependent on food markets; government efforts to help peasants and farmers meet their household needs impedes production for regional and national markets. The key is to balance the two:

improving subsistence crops, while maintaining cash crop production and developing rice (where appropriate) as a food and cash crop. The rural exodus demonstrates the lack of income opportunities, schools, health facilities, and other services that rural populations seek. Thus development in the Gambia River Basin involves more than improving income for agricultural producers and providing increased quantities of food to the cities.

The relevant baseline material on national economies, population, ethnicity, migration, farming systems and marketing are presented in Chapter 3.

1.2. Socioeconomic Impacts of the Proposed Dams

The socioeconomic impacts of the proposed dams are considered with primary focus upon agricultural impacts on those populations which will lose land, either through flooding or cessation of tidal action. The five proposed dams have been separately considered in order to view the social and economic impacts of each one. The impact zones were defined to be principally the reservoir and impoundment areas for Balingho, Kekreti, Kouya, Kankakoure and Kogou Foulbe. Impacts might occur in a much larger region. Our studies, however, concentrated on the direct impacts on rural livelihoods that would be produced by the dams and on actions necessary to mitigate negative consequences.

The scale and magnitude of impacts vary by dam. The greatest are from Balingho, followed by Kekreti. Those from the different Guinean dams are difficult to assess without further technical information. The antisalt barrage with navigation locks and bridge to be built at Balingho would stop the tidal movement upstream of the bridge-barrage as well as creating a large freshwater lake. Downstream from the bridge-barrage, salt levels would be raised throughout the year, and there would be an amplification of the tides. These would only be of significance in the areas closest to the barrage. The rationale behind the bridge-barrage is to facilitate transport across the river and to prevent saltwater intrusion beyond Balingho, thereby allowing the development of irrigated rice in what is now the upper estuary.

Historically, the British began a deliberate policy of expanding swamp rice cultivation to meet food deficits in the 1920s. Gambians increased swamp rice production, both rainy and dry season, primarily to make up grain deficits produced by the shift in upland crop production from millet and sorghum to groundnuts. In recent years declining rainfall and soil fertility has led to the virtual abandonment of rainfed upland rice in many parts of the basin, leading to an even greater reliance on swamp rice.

The elimination of tidal action would lead to the loss of a large percentage of swamp rice. The number of hectares to be lost has not been precisely determined. This is due to the unavailability of appropriate contour maps as well as the variation from year-to-year of hectares in swamp rice. Aside from variations in the annual flood, there are fluctuations in the large numbers of intermediary fields which combine rain retention and water from high tides or flooding. All of this land lies in The Gambia. Senegal and Guinea are not affected.

The development of swamp rice has been the domain of women. Through time, households with swamp rice fields have been able to shift their food from millet and sorghum to rice. This crop is exchanged between households and villages (usually through kin), but only a small percentage is marketed and thus does not contribute directly to feeding urban populations. The trade-off for the development of irrigated land through the building of both Kekreti and Balingho is the loss of all land irrigated by tidal action. In the aggregate, the loss will be compensated by the addition of irrigated land but this will provide little solace to the populations downstream of Kuntaur, the approximate end of the reservoir. An undetermined (but large) number of women would lose their rice fields, with severe consequences for the households that depend upon them.

Gambians rely far more on fish for protein and other important nutrients than on meat, which is beyond the means of most households. The Aquatic Ecology and Gambia River Basin Development report expects that reservoir fishing will more than replace the losses due to the operation of Balingho. Both the Aquatic Ecology of the Gambia River Basin and the Terrestrial Ecology and Gambia River Basin reports hypothesize the potential loss of the large mangroves (rizophora racesoma) which will alter the nutrient supply which in turn may negatively impact upon fish production.

The impacts both upstream and downstream of Kekreti dam are multiple. Downstream the dam would act to regularize water flow during the rainy and dry seasons. Under current plans most of the flow of the Gambia River upstream of Kekreti would be diverted to filling the reservoir. This will greatly diminish the annual flood which will limit lands available for rice cultivation in The Gambia. Upstream, some of the best farmland in the Kekreti reservoir zone would be flooded and at least 10,600 people would require resettlement. The marketing and communication nexus would be disrupted. The continued cultural survival of several groups would be threatened. These major potential negative impacts are balanced against the benefits of hydroelectricity and water for irrigation. These and other benefits to occur in the reservoir zone may facilitate acceptance of dam construction by those populations who have the most to lose.

In socioeconomic terms, the disruptive potential of the Guinean dams is much less than that of the dams proposed in The Gambia and Senegal. The Guinean dams are to be constructed in relatively isolated zones where population density is low and infrastructure is weak or nonexistent. The direct benefits from the dams will flow to those outside the impact zones. Residents of the impact zones could benefit from improved access, communication, infrastructure and employment. In addition, resettlement would be much less of a problem than in the other riparian states because of land availability.

1.2.1. Summary of Direct Impacts

(Irrigation is considered separately from dam impacts)

Non-Loss Impacts

- New roads
- New bridges
- Hydropower
- New fisheries
- New employment
- In-migration
- Construction settlements

Loss Impacts

- Loss of villages due to inundation

  Balingho - 0
  Kekreti - 22
  Kouya - 3
  Kankakoure - 3
  Kogou Foulbe - 0

- Loss of agricultural lands due to flooding behind the dams

A full study of current land use needs to be done for all five dams with highest priority : the Balingho zone.

- Loss of swamp rice production due to cessation of tides under the current operational scenario of Balingho

- Loss of agricultural production due to cessation of flooding caused by the annual filling of Kekreti reservoir

- Loss of agricultural lands due to tidal amplification downstream of Balingho

- Loss of roads, bridges, markets due to new lakes (particularly at Kekreti and Kouya)

- Loss of pasture

- Loss of nonagricultural activities

- Intensification of out-migration

1.2.2. Mitigative Measures

Mitigative measures include resettlement, the utilization of the drawdown zones upstream of the proposed dams, developing freshwater fisheries in the reservoirs, and using some of the displaced populations to develop irrigation perimeters. With hydroelectricity from Kekreti and Kouya, small-scale rural industry becomes possible, particularly in the upper basin.

The major socioeconomic mitigative measure is resettlement. Resettlement is always painful at best. In addition, a decisive determination remains to be made about the extent of resettlement required by the loss of rice land due to the ending of tidal action and the ending of the annual floods. It is recommended that a study be conducted to determine the criteria for resettlement and whether or not it is necessary in the case of Balingho. Our hypothesis is that it will be necessary because of the high dependence of households upon rice from tidally inundated rice fields. In any case, resettlement will be required for several villages in the Kekreti zone and in Guinea.

An appropriate mitigative measure to protect tidal rice and to lessen the extent of social disruption is to delay the construction of Balingho while mastering irrigation through the use of Kekreti's and Kouya's storage capacity while using releases to impede the movement of the salt tongue. In addition, the possibility of controlled floods from Kekreti needs to be explored to protect farm lands, grazing lands as well as important fish breeding grounds on the flood plains. When the combined needs of hydroelectricity, irrigation and impeding the salt tongue conflict then Balingho could be brought on line.

It has been suggested that the simulation of tides might be feasible to protect the tidal rice lands. Resolution of such possibilities await engineering studies and the costs associated with them.

1.3. The Guinean Portion of the Basin

This portion of the basin has been isolated. Aside from limited state-sponsored agricultural schemes, few resources have been put into rural development. The change in government has meant a time of transition. Rural cultivators have welcomed the lifting of the burdensome marketing quotas, which were a tax in kind. Yet they still face severe environmental and infrastructural constraints to improving agricultural production. Nonetheless, Koundara has been an important producer of rice and groundnuts for Labé, Mali and Pita The best prospects for the development of irrigated agriculture is in Koundara.

Labor migration rates are very high. Our survey found 18-35 percent of the adult labor force absent (29-64 percent of adult males) in the sample villages. The migrants principally were working in the urban and rural areas of Senegal and Guinea. The high rate of migration reflects the general basinwide problem of a lack of income-earning opportunities in the rural areas. Rural development in Guinea requires a different orientation focusing more on rainfed agriculture, and maintaining the environmental integrity of the watershed.

1.4. Irrigation Experience in the Gambia River Basin

The Gambia has had a series of small irrigation projects initiated by the World Bank, Taiwan and China, and presently farmed by individuals or groups of farmers. There is one large new project involving two swamps, Jahaly and Pacharr.

Irrigated rice production in eastern Senegal is more recently developed and less extensive than in The Gambia. It has developed under the auspices of two agencies: SODEFITEX (Société de Développement des Fibres Textiles), a parastatal rural development agency whose primary mandate has been cotton production, and OFADEC (Office Africain pour le Développement et la Coopération), a nonprofit, nongovernmental organization. OFADEC has created new villages in the sparsely populated zone along the Gambia River west of the Niokolo Koba National Park to the Gambian border.

The situation in the Guinean portion of the basin is quite different. Aside from hand irrigation along streams primarily for cash crop dry season vegetable gardens, there have been a few attempts by the now-defunct FAPAS (Fermes d'Arrondissements Agro-Pastorales) to practice irrigation. Rice is grown in many parts of the upper basin but only as an upland crop during the rainy season. It is not possible to evaluate the past performance of irrigation in the Guinean portion of the basin.

The irrigated perimeters in both Senegal and The Gambia demonstrates the difficulty in making the transition from rainfed to irrigated agriculture. Most of the irrigation is currently carried out in the dry season, despite the original intention, particularly in The Gambia, to have double-cropping. The difficulties encountered include unreliable input delivery, lack of an efficient and reliable water delivery system, poor maintenance of the perimeters, and a general underestimation of the time required for households to incorporate irrigation into their farming systems.

Data from the village studies indicate that in the past, irrigation has had difficulty competing for labor, since rainfed cash crops have been considered less demanding but equally profitable. By avoiding rainy season irrigation, farming systems have been perceived as more flexible, better able to balance early and late maturing cereals grown with cash crops. In the past, double-cropping of rice has not been considered the pattern of choice. However, land scarcity and adverse climate changes may alter the past bases of decision making. If rainfall returns to a more "normal" pattern, irrigated agriculture must be competitive to succeed.

Past experience has shown that farmers interrupt work on irrigated fields when the rains begin to plant their upland crops: maize, cereals and groundnuts. There is a subsequent labor bottleneck when the rainfed crops require their first weeding. The result is that farmers either devote less labor to irrigation, or do not do rainy season irrigation. Male household heads give precedence to upland crops to secure adequate food and cash income as well as maintaining rights over the land in cultivation. In general, with men allocating labor to upland crops, women have to spend more time on irrigated rice.

Three of the ten survey villages in Senegal and The Gambia have been analyzed to produce farm budgets. The budgets are compared to reveal patterns in households practicing irrigated agriculture and in those who do not. In the case of Nema and Alunhari (The Gambia) the comparison is between households doing rainy season irrigation and those who do not, since all households in the sample had dry season irrigated rice fields. The third village Pakeba (Senegal) compares households with and without dry season irrigation. In general, the year of the surveys, 1983-84, was a very low rainfall year and many of the yield and labor figures are lower than normal. The perspective has been to examine irrigated rice profitability from the farmer's viewpoint under current conditions. Because irrigated rice has been incorporated into an existing system, it is compared to other crops with which it has to compete during the rainy season. In 1983-84 irrigated rice was competitive with alternative income generating activities in the agricultural sector. As a dry season activity, it has even greater importance since more farmers cultivate irrigated rice (and bananas in some Senegalese villages). It is clear that rainy season irrigated rice required access to sufficient labor or labor saving devices, a willingness to reallocate labor among crops, and the alteration of cropping patterns. Such changes will not be undertaken by large numbers of farmers without favorable returns to labor relative to other crops and sources of income.

The experience of Nema, Alunhari and Pakeba (along with the other villages surveyed for the irrigation studies) argue for serious reconsideration of the assumptions commonly used for expected adoption levels of irrigation by farmers. These assumptions include double-cropping, high yields, reliable input delivery, and comparative profitability relative to other on-farm or off-farm activities. Double-cropping is the exception, rather than the rule, and was only observed among a small number of relatively wealthy households. Examination of labor use versus labor availability supports the widespread assumption of underutilization of labor, but a comparison of returns to rainfed and irrigated crops indicates that higher returns and lower risk are required to attract more labor to irrigated crops. Farmers balance input and policy uncertainties with climatic ones. Where human uncertainties are better controlled, as in Jahaly Pacharr and by master farmers, double-cropped rice can be successfully grown. The question then becomes one of scale and the economics of subsidy provision.

Since irrigation has not been practiced in the Guinean portion of the basin, a baseline cannot be established nor lessons be drawn from past experience. Proposed areas along the Koulountou, while promising, will have major constraints. These include: health problems (particularly onchocerciasis; lack of villages close to the river with the exception of Koulountou, a new village and Oudaba, a village declining in population; lack of prior experience with irrigation; and poor roads and marketing difficulties. On the other hand, the region does have a number of successful farmers using tractors (comparable to The Gambia's master farmers) a need to expand land under cultivation, a concentrated population, diverse markets and proximity to the main road from Tambacounda and Labé.

1.5. Current Development Programs and Suggestions for their Improvement

We have compared three alternative irrigation approaches. These are Jahaly Pacharr, Land and Reclamation Development Consultants' (LRDC)

Bansang Nibras pilot project, and the Périmètres Irrigués du Sénégal-Oriental (PISO) of SODEFITEX. In addition, the improved swamp component of the Jahaly Pacharr project has been examined as an alternative to total water control in their pump-irrigated perimeters. We discuss the scheme's key assumptions with respect to compound behavior, management, integration of irrigation into the prevailing farm system, investment, operation and maintenance costs. The comparison with LRDC is hypothetical since it is not in operation. It is also based on the unproven, though potentially worthwhile, use of oxen to prepare rice fields.

In the Jahaly Pacharr irrigated model, an average hectare costs $11,600 to develop. One hectare in the LRDC model costs $7,500 to put into production. These figures are similar to cost estimates for other total water control irrigation projects in West Africa. The cost of PISO perimeters is much lower -- $2,000. This figure, which reflects little reliance on imported equipment may not include other investment costs absorbed elsewhere in SODEFITEX's budget. The cost of improved swamp at Jahaly Pacharr is $2,200 per hectare, which includes mechanical land development work. Recurrent costs of each model follow the same pattern. Schemes with high water control requirements generally have high recurrent costs in order to maintain pumps and canals, and to complete repairs very quickly. The question is whether users will be able to pay for the annual operation, maintenance and replacement costs in addition to their own production costs. If these costs cannot be recovered from users, then the government must make up the difference either through its own or external resources.

The economic rate of return (ERR) calculated for the LRDC model is 5.4 percent over forty years. The ERR for Jahaly Pacharr's irrigated component is -2 percent but using projected yields from project documentation and not the actual yields from 1984-85. Improved swamp rice at Jahaly Pacharr has an ERR of 3 percent. The negative ERR for the Jahaly Pacharr irrigated rice scheme coupled with the low ERR for the LRDC pilot project underscores the questionable economic viability of large total water control projects under current conditions. The estimated costs for the improved swamp scheme could be appreciably lower if land preparation could be done in other ways than those at Jahaly Pacharr.

A few years ago the Stanford Rice Study raised serious questions about the viability of existing irrigated rice schemes in West Africa. The authors found that in only two countries (Sierre Leone and Mali) could domestically produced rice be substituted profitably for imported rice. They argued that most West African nations have a comparative disadvantage in rice and that at least through 1981, rice production had led to a loss in national income because of the inefficient use of national resources. Despite this experience, there are more than 150 West African projects in which rice is a significant component. This is because West African governments, particularly where rice has become an urban staple, are committed to obtaining national self-sufficiency in rice. Conditions have changed since 1981, but the evidence for successful irrigated rice in West Africa to meet both rural and urban needs has not been demonstrated. In our view caution is appropriate in the pacing of rice development within the Gambia River Basin because of the specific history of irrigation in the basin, in particular, and in West Africa in general.

The type of irrigation development adopted by OMVG and Member States has many ramifications. Given the constraints that we have found in past irrigation practices and current farming systems we suggest an open-ended strategy that permits both the development of larger scale commercial agriculture and support of smallholder production. The national goals of rice import substitution (and national self-sufficiency) and food self-sufficiency for peasant farmer households are difficult to achieve simultaneously. Larger scale commercial irrigated production may make sense in some parts of the basin, but it is not the best option when considering the interests of the local producers. Trade-offs will be made between national goals and desired rates of rice production and the slower rate of development implicit in developing sustainable smallholder schemes oriented toward marketable surpluses for urban consumers. Our perspective is that pushing too hard too soon for rice production will both lead to poor performance of irrigation and further difficulties involving peasant farmers integrate irrigated rice into their farming systems.

Serious questions about the key assumptions underlying the existing and proposed irrigation schemes require resolution. The scale of current proposals and the rapidity of the social, economic, institutional and educational changes that are the consequences of placing 600 hectares or more of irrigated rice in production per year following the completion of the dams, will make the attainment of the stated goals difficult. In addition to the strains placed upon Member States' resources in developing irrigation potential, there will be the series of dam impacts discussed above. If the project impacts from the different reports occur, then it would mean years of resettlement, food assistance and environmental disruption for a scale of rice production that, unfortunately, has yet to succeed in West Africa. The phasing of the dams from a socioeconomic perspective is important. The building of Balingho after Kekreti will diminish the number of negative socioeconomic impacts and provide more time for the transition to greater reliance upon irrigation. With a properly paced, incremental program that minimizes investment costs, there will be less financial risk for cultivators, national governments and donors, as well as less reliance on imported technicians, technologies, spare parts, and management skills.

2. INTRODUCTION TO RURAL DEVELOPMENT IN THE GAMBIA RIVER BASIN

2.1. Introduction to the Current Situation

From its source in the highlands of Guinea to its Atlantic mouth, the Gambia River sustains life for 1,308,63 people in the Republics of Guinea, Senegal and The Gambia.[1] As West Africa has suffered through years of declining rainfall, the waters of the Gambia River have become of increasing importance to greater and greater numbers of people. This importance can be seen through the movement of peoples into the basin in search of permanent or semipermanent sources of water. The Gambia River, as one of the major river systems in an increasingly dry savannah, is seen as a potential solution to the critical provisioning of water to permit an improved standard of living within, and close to, the basin. An impressive series of studies and consultant reports have presented and assessed the range of possible strategies to more effectively utilize the river. Leaving aside the differences in emphases and strategies that emerge from particular reports, they agree that planned interventions of a major magnitude are required to reverse the current declining socioeconomic situation within the basin. The problems detailed for the basin are of a more general nature. They affect almost all of West Africa but the waters of the river provide the possibility for genuine development.

The most commonly cited contributors to the current crisis include: low and irregular rainfall leading to declines in agricultural production; ecological degradation which in turn is linked to both human activities and low rainfall; high population growth rates placing pressure on both human and natural resources; loss of rural labor due to urban migration; increase in import costs (particularly energy but also fertilizer and manufactured goods); declines in export revenues; critiques of governmental efforts to control prices; and inefficiencies in governmental or parastatal organizations. In addition, particularly

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[1] 1985 population estimate calculated by the United Nations Development Programme (UNDP) Development of the Gambia River Basin: Multidisciplinary Multidonor Mission, April 1980. In the draft OMVG Indicative Plan they calculated an overall population in the basin (including rural and urban) of 1,687,000 people.

in the case of The Gambia and Guinea are the lack of a sufficient number of trained personnel to carry out development programs and strategies. The list is long. However, no matter the particular slant of analysis, the conclusion remains that the future prospects for the basin, even with a return to previous pattern of rainfall is bleak. This does not imply that the productive systems of the basin have been unchanging or unresponsive to environmental and socioeconomic conditions. Indeed, the reverse holds true. Many of the contemporary features that appear traditional are not of long historical duration, and the cultivators of the basin have altered their crops, the varieties of crops planted, even the sexual division of labor, to meet changing circumstances. The governments of the riparian states have themselves initiated many programs to increase agricultural production, to improve the health and educational level of basin populations, and to formulate an overall strategy to maintain greater human control over the vagaries of climate, in order to directly resolve the causes of the underdevelopment of the region.

Despite the series of initiatives and increased aid after the drought of the early 1970s, per capita food production has decreased, food imports have increased, foreign exchange constraints have intensified, and there has been no decrease in the rate of population growth.

Given the situation in the Gambia River Basin, it is clear that the most important issue for at least the next twenty years will be expanding agricultural production, and providing the income-generating opportunities to enable both the rural and urban populations to obtain an adequate diet.

2.2. The United Nations Development Programme and the Formation of OMVG

Through time, there have been both local and external pressures to alter the productive systems within the basin. The first was the introduction and adoption of peanuts in combination with indigenous food crops. The second was the development of rice schemes during the colonial period to begin to make up for perceived food shortages, particularly within The Gambia. Senegal, having reached the limits of what was possible with a rural economy based on peanuts, has been exploring alternative paths since independence. Because of the different ecology and access of the Guinean basin, peanuts were not of the same importance except in portions of the region of Koundara. Following independence, discussion began on the possibilities for damming the Gambia River somewhere near the current Farafenni ferry. In the 1970s, serious discussion began about dams in Senegal and in Guinea. These ideas have now been elaborated and developed under the auspices of OMVG (Gambia River Basin Development Organization) created by the national governments, with the assistance of UNDP (United Nations Development Programme).

UNDP addressed the regional nature of the crisis by sending study missions to the Gambia River Basin; first to Senegal and The Gambia, and then to the Republic of Guinea.[2] After concluding a series of studies, an Action Plan for the Riparian States was developed. As part of that process, the Member States and UNDP concluded that the base scenario (i.e., no interventions) would lead to the increasing impoverishment of basin inhabitants. They recommended a series of steps leading to a major development effort in the basin. (The University of Michigan's Gambia River Basin Studies are one part of the necessary studies to lead to donor financing.) The UNDP looked toward:

- the intensification of agriculture (both rainfed and water managed)
- the increase of the availability of livestock products destined for human consumption
- the increased integration between the livestock and agricultural subsectors
- the protection of forest resources
- their better management for human use without concomitant deforestation to improve standards of living and increase food production

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[2]UNDP, Multidisciplinary Multidonor Mission, April 1980; UNDP, Development of the Gambia River Basin: Annex of Expert Reports for the Preinvestment Action Plan for Guinea, June 1982.

The centerpiece of the action plan is the construction of dams to provide the water needed for hydroelectricity and irrigation.

2.3. Current Strategies in the Gambia River Basin

The riparian states in coordination with the OMVG have formulated a strategy to try to overcome declining food production, reliance on food imports, insufficient water for cultivation, lack of hydroelectric power, and poor communication and transport by proposing a series of dams along the Gambia River. These are to be:

i) a high dam and generating station at Kekreti in eastern Senegal whose stored reservoir will also provide enough water to irrigate approximately 70,000 hectares of land (16,500 in Senegal; 53,500 in The Gambia).

ii) the antisalt barrage and bridge at Balingho, which has multiple functions in combination with Kekreti; to prevent the upriver movement of the salt tongue which currently renders any expansion of irrigation upriver impossible; a high and more regular water level which will permit increased river transport; the construction of navigation locks to permit oceangoing vessels to utilize the river; the linking of the Trans-Senegal highway between Dakar and Ziguinchor ending time-consuming and costly waits for the ferry.

iii) Kogou Foulbe to provide hydroelectric power and water to irrigate 15,000 hectares in Guinea.

iv) Kankakoure to generate hydroelectric power.

v) Kouya to generate hydroelectric power, to control water flows into the Kekreti reservoir and irrigation downstream of Kouya and upstream of the Kekreti reservoir.

The emphasis upon the dams reflects the determination to control water, which is viewed as the major constraint in increasing agricultural production. The exact number of dams, their exact time of construction, and their phasing have not been fully decided at the time of this writing. There has been agreement to seek funding for the construction of Balingho, Kekreti and Kouya. The situation remains somewhat fluid, because dams require years to finance, plan, build and implement the programs associated with them. The urgency is that all three countries have reached, or will by the end of the century, the limit whereby agricultural production can be increased by expanding the area under cultivation. OMVG has a critical role to play in the transition from the land-extensive farming systems to intensive farming systems, based on the results of scientific research and irrigation. The other arenas of OMVG activity regarding rainfed agriculture (although of equal importance) are not as clearly defined. Because of the uncertainty associated with the donors it appears that no matter what the plans of OMVG are at this point in time, they are dependent on external funding for the construction of the dams. It is therefore quite possible that the strategies considered in this report will change due to donor requirements or shifts in OMVG and Member States' perspectives.

AHT (Agrar-und Hydrotechnick), HHL (Howard Humphrey Limited), LRDC (Land Reclamation and Development Consultants) and Rhein-Ruhr have been serving as consultants during the time of the University of Michigan Gambia River Basin Studies (GRBS). Since they were contracted by OMVG to develop specific plans for the construction of dams, soil maps, scenarios for the development of irrigation agriculture, and the formulation of a pilot irrigation project, we have drawn on their material in the relevant sections in this report to examine both the current socioeconomic structures of the Gambia River Basin, and the consequences of the proposed dams and associated developments. These consultants' materials refer primarily to Senegal and The Gambia. Similar work for Guinea is just beginning to get underway and were not available at the time of this writing. All consultants and OMVG have been consistently helpful to the requests for time and information from the socioeconomic team. Their cooperation is gratefully acknowledged. Their proposals are not summarized in this report but are used in later chapters as the most likely future developments. The evaluations that are made of them are intended to clarify issues and problems, and to contribute to the overall strategy for the Gambia River Basin.

2.4. Regional Considerations

There is no attempt made here to summarize the national and local political systems of the riparian states, although they will be of great importance in the actual implementation of development strategies. Not only will the national level be significant but development work has demonstrated that the actions of local political forces can greatly influence the success and failure of different strategies.

It is clear that the political interests of the three nations studied will not be the same because of the differential importance of the basin to their national economies. For The Gambia, the proper and appropriate use of the Gambia River is literally a matter of national survival. Unlike Senegal and Guinea, The Gambia has access to only one river basin which encompasses the entire nation. Any river basin development will initiate a series of changes that could affect all aspects of Gambian life. It is because of the recognition of the river's critical importance that this report tends to be conservative with respect to the types of changes suggested. For The Gambia to begin to resolve any of its long-term development needs, and to prevent a further deterioration in the standard of living of its citizens, development of agriculture and fish are essential. The same critical importance does not apply for Senegal. The Gambia River Basin will not be the rice bowl for Senegal. However, eastern Senegal remains an underpopulated zone and an outlet for the overpopulated and declining peanut basin. More important is the hydroelectric potential from Kekreti linked to potential mining developments near Saraya. The economic importance thus derives less from agriculture than hydroelectricity as part of a move away from fuel imports and agricultural exports. In the case of Guinea, the Gambia River flows mainly through some of the more isolated zones of Guinea and secondarily in the densely populated region of Labe. The economic potential of the Guinean portion of the basin is least known. It appears that agriculturally, with the exception of Koundara, it is not a particularly promising zone. It is just the reverse in terms of potential hydroelectric power. There is a large market in the densely populated zones of the Fouta-Djallon. Current electrical needs are met only by the aging dam and turbines at Kinkon. There are potential mining possibilities but there have been no commitments to exploit them yet. Guinean decisions with respect to the specifics of how the dams will best serve the country's development needs have not yet been made.

2.5. River Basin Development

It is clear that a broad view of river basin development has been adopted by OMVG. This reflects the differential importance of the river basin in Member States and somewhat different national emphasis on overall development strategies. In general, river basin development ought to and can lead to a series of processes enabling each nation to utilize the basin for improving living standards, increasing production for local consumption and export, increasing employment generation and increasing natural resource use and preservation. As Thayer Scudder has emphasized, while water is the key resource, river basin development focuses more broadly than on just one or two crops, or only on hydroelectricity. Indeed, it can serve as the means by which crucially important multiplier effects can be linked to enhance "...the development of the agricultural, service and urban-industrial sectors; and, more specifically, rural hinterlands with rural service centers and rural towns."[3] For this study the terms of reference and the work plan demanded a focus on agriculture. A broader perspective on river basin development needs to be kept in the forefront in balancing the needs and plans of the riparian states. Current emphasis on irrigated rice does not imply that water control and other resource development are not of equal importance in balancing differing national resource bases to ensure an equitable development by both donors and Member States.

While the physical limits of the Gambia River Basin are hydrologically defined (the land drained by waters that flow into the Gambia River), these boundaries do not necessarily coincide with

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[3]Thayer Scudder, "Report on African River Basin Development" (1981), p. 7.

economic, political and social forces that influence or determine what occurs in the basin. Many of the populations within the basin are also found outside the basin. Virtually all ethnicities and languages are found outside as well as within the basin. The flow of labor out of the basin to Conakry, Dakar, and even Europe demonstrates other centers of influence over the basin. Discussions of marketing and migration point to the wider influences on the basin. The discussion of irrigation possibilities has to always be in the context of the cost and availability of rice on the world market. Predictions about the success of irrigation in the basin need to take into account other experiences in Africa to identify key problem areas that transcend one situation. This report focuses primarily on the basin itself but with the recognition that it is not self-contained.

2.6. Brief Summary of the Rural Sector in the Gambia River Basin

Both Senegal and The Gambia are seeking to alter their rural economies through diversification of agricultural production. Historically, both nations have relied on groundnuts as a cash crop, serving to meet the income needs of rural populations, to generate revenues for the governments to sustain existing organizations, and to meet other development priorities. In the past, rural populations have met most of their food needs through millet and sorghum production. This pattern has been somewhat modified in The Gambia with the increase in local rice production principally by women as more of the uplands has been used for groundnuts, and the millet and sorghum harvests have not been sufficient for household needs. The larger pattern in Guinea is different than in Senegambia. Historically there has not been a dominant cash crop within that part of the basin. Moreover, in most areas of the Guinean portion of the basin there has never been a single dominant household food crop to match the importance of millet and sorghum. To the degree that there is one, it is fonio. Fonio has a much greater importance in Guinean agriculture than elsewhere. The other major area that is somewhat different from the dominant pattern in the lower portions of the basin is upstream from Kekreti. There, as in Guinea, one finds a more diversified agriculture without a dominant cash crop.

One of the most significant features of agriculture in the basin is the experience with rice. Unlike most of the Senegal River Valley, where rice was not indigenously cultivated. Rice has been cultivated for hundreds of years in upland rainfed conditions and along the Gambia River in a system of tidal irrigation for at least 150 years. The 1950s marked the debut of pump irrigation begun by the British and continued by the World Bank, Republic of Taiwan, People's Republic of China, and the governments of Senegal and The Gambia. These experiences are analyzed in Chapter 4. The Guinean experience with rice has been different, but does involve the development of plains with the use of tractors for plowing, but harvesting still being carried out by hand in the prefecture of Koundara. In other parts of the basin, rice is cultivated on hillsides with little use of either tractors or animal traction.

The earlier patterns whereby households produced enough food for their own needs and a cash crop for income, barely obtains anywhere in the basin. Throughout the basin, imported rice makes up an increasing part of the diet of rural citizens without a concomitant increase in grains sold onto the national market. For reasons not fully understood, households cannot or will not meet their grain requirements through their own production but use money sources of revenue to purchase rice. Significantly, in those portions of the basin where household-produced rice is a significant portion of the diet, that rice has not been sold to the urban areas. Most of it is consumed within the household or in the surrounding region (with the possible exception of Koundara). Simultaneously the notion that groundnuts are only a cash crop is not the case. Groundnuts are an important food crop, with groundnut sauce having become a staple in virtually all of the basin.

The agricultural system is part of a wider economy in which all basin dwellers are engaged. The thrust of an irrigation strategy is to create rural producers who can meet the internal demand for grains, principally rice. There are other dimensions of the rural economy that will affect these plans, in particular migration and marketing. Decisions on what crops to grow and in what combinations, are related to sources of outside revenue, marketing possibilities, prices, and other means of earning an income. In the Guinean portion of the basin, where agriculture is both enhanced and constrained by livestock practices and a rugged terrain, rural development will rest less on larger-scale irrigation and more on improved rainfed and smaller-scale water control measures.

2.7. Socioeconomic Component of the Gambia River Basin Studies

2.7.1. Objectives

There are several objectives of the socioeconomic component of the Gambia River Basin Studies and they are interrelated:

- to provide a study that delineates the basic characteristics of the productive systems in the Gambia River Basin with an emphasis on agriculture;
- to assess the current irrigation programs and their corresponding water-use associations;
- to assess the probable socioeconomic consequences and possible mitigative measures associated with the construction of the dams at Balingho, Kekreti, Kogou Foulbe, Kouya and Kankakoure;
- to suggest measures to mitigate negative socioeconomic impacts of those dams;
- to assess the probable consequences and possible mitigative measures in the shift from nonirrigated to irrigated agricultural systems;
- to suggest potential monitoring methods;
- to provide some general conclusions about current development plans for the Gambia River Basin in light of the results from the socioeconomic studies.

The content, organization and interrelationship of the different parts of the socioeconomic studies has been described in detail in the work plan.[4] The different reports prepared by the socioeconomic team

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[4]These are in GRBS Working Document No. 4. "The Gambia River Basin Studies Work Plan and Addenda." Addendum No. 3 contains the Guinea Work Plans.

have been based on a large amount of primary field data collection, as well as on reviews of the relevant literature and other government and donor documents. The range of studies conducted attempted to answer the objectives stated above; methodologies chosen varied because of the range of objectives that needed to be achieved. The socioeconomic team worked with the three environmental teams obtaining needed information from them, as well as providing information to them.

2.7.2. Village-Based Studies

These began in The Gambia and Senegal in May 1983 and ended in July 1984. In Guinea they began at the end of February 1984 and ended on November 1. The criteria for village selection have been described in both the Work Plan and its addendum. Villages in Senegal and The Gambia were chosen to be in areas of likely irrigation intervention. Some of the villages were to have had direct experience with irrigation perimeters (e.g., OFADEC, SODEFITEX in Senegal; World Bank, People's Republic of China, and Taiwan, in The Gambia). Two villages, Chamen and Bati Ndar are not in the priority area for irrigation but are in the direct impact zone of the Balingho barrage. Villages were chosen to reflect the ethnic diversity existent in the basin.[5] In Senegambia these studies were based on a series of questionnaires administered on a regular basis.[6] The studies in Guinea were parallel to the others, but not identical. The Guinean village selection emphasized representation of each prefecture within the basin, closeness to a major tributary of the Gambia River, representation of each of the major ethnic groups, and the use of plains that had some microbarrage potential.

Table 2.1 is the list of villages where field staff were placed for the duration of the study. (See also Figure 2.1.)

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[5]The information was gathered in each of the villages is described in GRBS Working Document No. 68, "Socioeconomic Field Data Collection and Management."

[6]The criteria for village selection and household samples has been described in GRBS Working Document No 15, "The Design and Relevance of Intensive Village Surveys to River Basin Development Projects."

TABLE 2.1.

VILLAGES SURVEYED IN THE GAMBIA RIVER BASIN

	Ethnic Group
The Gambia	
Bati Ndar (Nianija District)	Wolof
Chamen[a] (Upper Saloum District)	Toucouleur
Tabanani (Fulladu West)	Mandinka
Tuba Kuta (Niani District)	Mandinka
Nema (Fulladu West)	Mandinka
Sotuma Samba Koi (Fulladu East)	Fula
Sotuma Seine Kande (Fulladu East)	Fula
Alunhari[b] (Fulladu East)	Serahuli
Senegal	
Pakeba (Maka)	Diakanke & Mandinka
Madina Diaka (Maka)	Diakanke, Mandinka, Fula
Sankagne I and II (Missira)	Fula, Serer
Adiaff (Missira)	Fula
Guinea	
Tabadel (Koundara)	Fulbe
Oudaba (Koundara)	Fulbe
Ithiou (Koundara)	Cognagui
Souma (Koubia)	Diakanke
Nianou (Koubia)	Fulbe
Kinsi-Kimpa (Koubia)	Fulbe
Simily-Bembaya (Koubia)	Fulbe
Liti Dian Boi (Mali)	Fulbe
Fetore (Mali)	Fulbe
Mayadin (Mali)	Diallonke
Hoore Dima (Labé)	Fulbe
Telire (Labé)	Fulbe

NOTES: a) Spelled Charmen on the map of The Gambia.
b) Spelled Alohungari on the map of The Gambia.

University of Michigan, Gambia River Basin Studies, 1985.

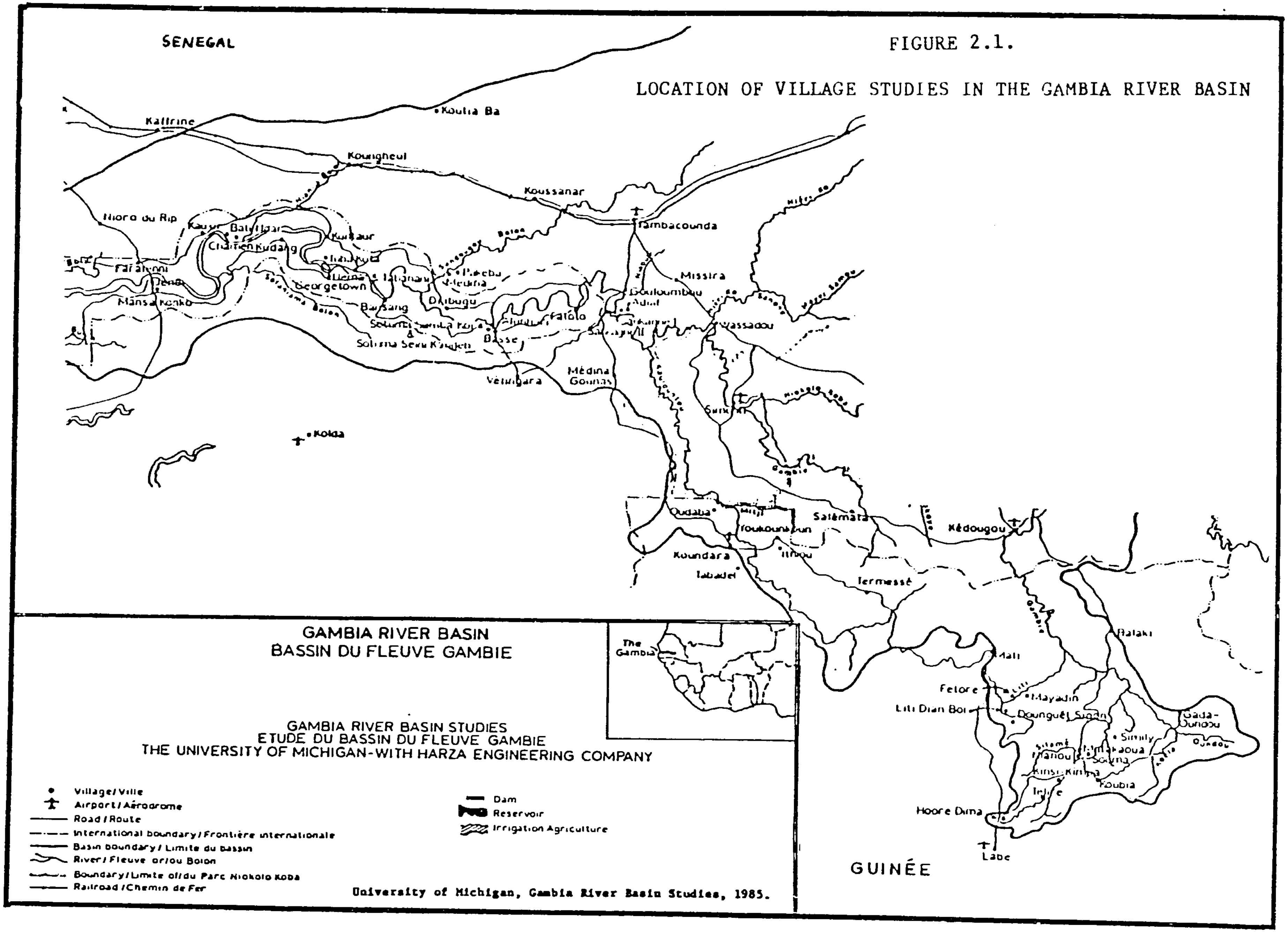

FIGURE 2.1.

LOCATION OF VILLAGE STUDIES IN THE GAMBIA RIVER BASIN

2.7.2.1. Basinwide farming systems survey. A rapid reconnaissance survey was carried out in the basin order to describe the range of farming systems. The procedures on the farming systems survey in Senegambia are described in GRBS Working Documents No. 21 and No. 22.

2.7.3. Thematic Studies

Separate studies were devoted to the following subjects: irrigation in Senegal and The Gambia; migration; crop marketing; and the potential impact zones of the Balingho, Kekreti and Guinean dams.

2.8. Organization of the Report

This report presents an overview of the current economic and social situation in the Gambia River Basin. The next chapter describes the dam impact zones, potential dam impacts and some mitigative measures. Chapter 5 examines the Guinean portion of the basin and the major development issues facing the river's watershed. Irrigation experiences to date are reviewed, followed by an analysis of irrigation, data from three village surveys to see how cultivators have incorporated irrigation into their farming systems. The different irrigation proposals are then examined in Chapter 8 from a critical perspective and the lessons to be drawn from the irrigation experiences. The report concludes with a brief discussion of monitoring.

3. THE CURRENT SOCIAL AND ECONOMIC SITUATION IN THE BASIN

In this chapter the current economic and social status of the Gambia River Basin is presented. A synopsis is provided of the OMVG Member State economies as well as a description of the major agricultural zones within the basin. The demography is briefly discussed, with emphasis on rural migration which will greatly affect possible development strategies. This is followed by an outline of some major features of social, village, and household organizations. An overview of the farming systems and of some marketing patterns concludes this chapter. The purpose is to provide the reader with an understanding of the contemporary situation while presenting sufficient background to enable assessment of the potentialities for planned change. The next chapter offers a review of the potential dam impacts.

3.1 Background on Member State Economies

3.1.1. Levels of GNP and Income

Of the three Member States having significant land areas in the Gambia River Basin, Senegal has the highest level of GNP per capita and Guinea, the lowest. Recent World Bank comparative figures, expressed in 1982 U.S. dollars, place Senegal's per capita GNP at $490, The Gambia's at $360 and Guinea's at $310 (World Bank, 1984). The same source shows average annual growth rates of real GDP as being higher than population growth rates in all three countries. From 1970 to 1982, The Gambia was highest with 4.5 percent, followed by Guinea with 3.8 percent and Senegal with 2.9 percent. Other sources, however, tend to provide lower estimates both for GNP per capita and for average annual GDP growth rates.

Of the three countries, Senegal has the smallest rural population as a percentage of total population. The rural sector in Senegal employs 65 percent of the national population of 6 million but produces only about 20 percent of GDP. In The Gambia, the rural sector is responsible for 40 percent of GDP and accounts for 60 percent of the total population of 700,000. Basic data about the Guinean economy is less reliable, but Guinea appears to have about 70 percent of its population of 5 to 6 million in rural areas. Despite the importance of bauxite mining and the production of alumina, about 40 percent of GDP is produced by the rural sector.

The output of rural producers in all three countries remains low and is insufficient either to feed populations growing by almost 3 percent annually, or to provide incomes that are high enough to create significant markets for domestic industry. The common characteristic of agriculture is stagnation in output. Guinea is far better endowed in water resources, in soils, and in variety of topography than its two northern neighbors, but its political isolation of the last 25 years led to steep declines in commercial crop production and food crop stagnation. In Guinea, Senegal and The Gambia, the cultivated surface area has expanded as a response to population pressures and increasingly unreliable rainfall patterns, but yields have remained at low levels. As forest cover has been removed and fallow periods have been shortened, declines in soil fertility on the lowland plains in Senegal and The Gambia and soil erosion in the highlands of Guinea have become matters of increasing concern.

If the Senegalese government once taxed rural producers to subsidize urban consumers -- an option chosen in the early 1970s -- changed conditions both in the rural sector and on world markets will no longer permit it. There have been recurring years of very poor production in agriculture as a consequence of drought. Farmers have tended to shift land into foodgrains in the year following poor rains, but most continue to grow some quantity of groundnuts as a primary, if not sole, cash crop. Higher groundnut producer prices in the early 1980s did not elicit any surge in production. At the same time there has been a secular decline in world prices of groundnut oil and meal. In recent years Senegal has therefore been obliged to tax rice imports to cover a large deficit in its groundnut operations. This reversal of fortunes has dramatized the inability of the rural sector as it is presently organized to contribute to the nation's economic development.

The Gambia is in similar difficulties as a consequence of its even heavier dependence on groundnuts. The primary objective of the Second Five Year Development Plan (1981/82-1985/86) is diversification away from groundnuts into crops like rice or cotton. As has been the case in Senegal, The Gambia's national marketing board has used profits from rice imports to cover some of its deficit from groundnuts. The Gambia has fewer alternatives than Senegal or Guinea, either for the generation of export earnings or for increasing agricultural production. Gambian diversification strategy has placed emphasis on the tourism sector, but the domestic earnings promised by renewed growth in the tourist trade have not materialized as hoped because of important leakages of foreign exchange.

Guinea once exported quantities of bananas and other tropical crops which its northern neighbors are unable to produce -- coffee and pineapples. In the past 25 years, official exports of these crops have fallen to negligible amounts or to a mere 10 or 15 percent of earlier levels. Among the food crops, rice is the most important. Before independence there was an effort to produce enough for export. Since then, production of rice, primarily upland but also cultivated on alluvial plains and bottomlands with limited water control, has increased by only 2 percent annually. Fonio (digitaria) is the second largest food crop and has increased in importance on the impoverished soils of the Fouta-Djallon. There are indications that Guinea has a comparative advantage in both rice and coffee, but improved practices and producer incentives would have to be introduced to reverse the current trend.

3.1.2. Trade and Balance of Payments

The Gambia lacks both the phosphate deposits and the length of coastline that have allowed Senegal to compensate for losses in groundnut export earnings with phosphate and fishery exports. Even so, UN trade figures show that both countries experienced declines in merchandise exports that averaged almost 2 percent annually from 1970 to 1982. This was a sharp reversal for The Gambia, whose merchandise exports increased by more than 6 percent annually from 1960 to 1970. For Guinea, its mineral exports are so important and its agricultural exports have declined so sharply in the past 25 years that the latter account for only 3 percent of total exports.

Senegal's exports in recent years have been characterized by relatively constant levels of phosphates, steadily increasing amounts of fish products and widespread fluctuations in groundnut products. A peak in groundnut earnings was reached in 1977, although even then it was less than 50 percent of the total value of exports. For 1981, after the severe drought of 1980, groundnut export earnings were a mere 12 percent of the 1977 figure.

The Gambia has traditionally reexported significant quantities of its imports, primarily to Senegal, as a consequence of having both relatively lower tariffs and a long open border. About 90 percent of domestically produced exports are groundnuts or groundnut products. Fish and fish products make up the bulk of the remaining 10 percent.

Foodgrain imports for both Senegal and The Gambia are at high levels. Senegal imported not less than 450,000 tons of rice and wheat annually from 1978 to 1982. Fruits and vegetables are also prominent among Senegal's imports, having reached 40,000 to 50,000 tons annually in recent years. The Gambia imports about 30,000 tons of rice per year for a population about one-tenth the size of Senegal's. Imports of all food products averaged about 22 percent of all imports in the late 1970s but rose to 32 percent in 1981/82, partly as a result of the poor harvest of the previous year and partly as a result of a decline in imports under government stringency measures. Stagnation in Guinea's rice production has obliged the country to import an average of about 87,000 tons of rice each year since 1978.

Senegal has been in serious balance of payments difficulties for the last few years. At the same time the cost of servicing Senegal's foreign debt as a percentage of exports of goods and services has increased substantially. From 1977/78 to 1980/81, it averaged 16 percent. Following Paris Club debt reschedulings, it fell to 11 percent in the next three years. Projections of the Ministry of Economy and Finance show the percentage increasing to as much as 30 percent by 1986, even with a slackening in the rate of domestic investment to 14 percent of GDP. Senegal's ability to incur large new investment expenditures in irrigated agriculture in the next several years must therefore be considered to be virtually nonexistent unless there are massive reschedulings of prior foreign debt.

The Gambia's overall balance of payments was in equilibrium in the 1970s until 1977/78, when deficits on the order of SDR 10 million annually began to appear. Increasingly high levels of official loans and transfers through 1981/82 kept the overall deficit from getting much worse, but the net inflow decreased sharply from SDR 54 million to SDR 36 million in 1982/83. Meanwhile, the balance of payments on current account deteriorated from being in rough balance in 1970 to a deficit of $47 million in 1982, according to IMF data. As might be expected, The Gambia's outstanding official external debt has increased sharply in recent years. By March 1983 it stood at SDR 163 million, at which time the debt service ratio was about 15 percent. The country's official reserves were enough to cover less than two weeks of imports. The Gambia has been able to avoid even more serious damage to its international finances through an IMF standby arrangement. It has also benefited from a recent surge in world groundnut prices. Yet its position appears precarious. This raises questions about the country's ability to undertake massive investments in irrigated agriculture in the next ten or fifteen years.

Guinea continues to have a balance of payments deficit despite a substantial increase in the value of its mineral exports. From 1978 to 1982 the deficit averaged more than 1.8 billion sylis (about $75 million at the official rate of exchange). Guinea's foreign debt grew rapidly in the same period, almost tripling in the space of four years.

3.1.3. Relevant Agricultural Policies

In the past 18 months the Senegalese government, responding to growing unease about the agricultural situation within the country and among donors, undertook an examination and revision of its agricultural policies. The institutions and policies of the 1960s had proven to be both costly and ineffective. ONCAD, the state agency which provided inputs and credit to farmers and controlled groundnut marketing through the cooperatives, was the most prominent example. Mismanagement and corruption led to dissolution of the agency in 1980. ONCAD left a sad legacy of public debt, farmer mistrust of government cooperatives, and a lack of any efficient input delivery systems. The collapse of ONCAD also left most rural areas without any agricultural credit program. To some extent this gap was filled by the regional development agencies (RDAs), which had been created to channel donor funding to rural development efforts. By the 1980s, however, there was growing disillusionment with the performance of the RDAs. The agencies had largely become entrenched rural development bureaucracies into which large sums were poured by the government and donors, with little resulting increase in rural production or productivity.

The Senegalese government's first attempt to render its rural development institutions more efficient, the Economic Recovery Plan of 1979, placed some controls on the growth of the rural development bureaucracy. It also began to reduce agricultural input subsidies and instituted the use of performance contracts between the government and individual RDAs. These measures were not enough however. The government's budget and balance of payments deficits, combined with the disastrous harvest of 1983, brought the crisis to a head.

A new agricultural policy was announced in April 1984. The new policy was based on the principle of sharply reducing the state's role in the primary sector. As a consequence, rural communities, farmers' groups and the private sector were to assume more responsibility for their own production activities. Four of the RDAs were scheduled for sharp reductions in budget and personnel or even for dissolution. Only SAED, responsible for development in the Senegal River Basin, and SODEFITEX, whose territory falls largely within the Gambia River Basin, escaped relatively unscathed. The new agricultural policy placed emphasis on promoting cereal production in order to move toward greater food self-sufficiency. It specified that government efforts in future, while becoming more limited, would be concentrated on those zones where irrigation is possible or where there is sufficient rainfall to minimize risks to rainfed crops.

The Gambia is in a similar situation. Anxious to diversify the crop mix, to develop irrigated agriculture, and to improve production of rainfed crops, the Gambian government faces the same general set of constraints. While it allows, in practice, a more liberalized disposal of coarse foodgrains, the government fixes producer prices for cash crops. It also maintains an exclusive responsibility for marketing cash crops, importing fertilizer, and importing rice, through the Gambia Produce Marketing Board (GPMB). The country has paid a price, as has Senegal, for the rigidities and inefficiencies of a state-run system of this sort. In addition to cotton and rice, the diversification effort has focused on maize, through a combination of measures. On the production side, the Mixed Farming Project and others have emphasized maize. There has also been a guaranteed market for maize organized by the GPMB with government subsidies.

Neither The Gambia nor Senegal, whose currencies are respectively pegged to the pound sterling and to the French franc,[1] have suffered as much as Guinea has from a seriously overvalued currency. The existence of an extremely unrealistic exchange rate introduced a number of distortions into the Guinean economy, and created disincentives to agricultural production other than for subsistence. The state marketing and pricing system performed badly under these conditions. By 1980 crop purchases by the state had fallen very low, with the possible exception of coffee. In that year only 5 percent of rice production entered state marketing channels. The system was finally liberalized in April 1981 to give legal recognition to increasingly important private marketing channels. The government's emphasis on collective modes of production continued unabated, however, despite clear evidence that the results were extremely disappointing. With the downfall of the Sekou Touré government, the collective approach was immediately abandoned and further liberalization measures were adopted. The legacy of 25 years of economic distortions and disincentives to agricultural production would not, however, disappear overnight.

The national context both influences and is influenced by the ecology and peoples of the Gambia River Basin.

3.2. A Zonal Overview of the Basin

The productive systems of the Gambia River Basin can be categorized into three major geoclimatic zones with further subdivisions. The classification includes irrigation potential, climate, soil type, topography, population density, and proximity to the Gambia River. In

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[1] Senegal is a member of the West African Monetary Union whose currency, the FCFA franc, is pegged to the French franc at 50:1. The Gambian dalasi had a fixed parity of 4D to £1 from March 1973 to February 1984, at which time it was devalued by 25 percent to 5D/£1.

Zone I, irrigation is practiced or is planned; in Zone II, irrigation is not anticipated, at least not with the waters from the Gambia River; Zone III is the Guinean portion of the basin (including downstream of Kogou Foulbe, which has irrigation potential).

3.2.1. Zone I

Zone I is a narrow strip of land that follows the course of the river, where irrigation exists or can be instituted. Alluvial and colluvial soils predominate, but their amount increases westward or downstream from Niokolo Koba National Park. Mean annual precipitation ranges from 900-1,200 mm from north to southwest over a period of 100-130 days. The size of each potential irrigable area tends to be small, about 1,000 hectares as a maximum,[2] due to the topography and availability of suitable soils. This has important implications for the kinds of programs that have been and will be implemented.

Zone I subdivisions are based on the presence or absence of tides, the height of the banks, and the kind of soils which determine the existence and type of rice production practiced. These three divisions are the result of a farming systems survey throughout the zone. They are not meant to supplant other classifications for Senegal and The Gambia, but rather to permit a characterization of current production systems which may be centered outside the river basin (for example, in the Peanut Basin).[3]

3.2.1.1. Gouloumbou Middle Valley. Located between the western boundary of Niokolo-Koba and the Gambian border, this subdivision's soils (according to AHT) are 33 percent indurated plateau soils unsuitable for agriculture, 30 percent colluvial soils suitable for rainfed agriculture, and 37 percent alluvial soils suitable for irrigation. Present use of the alluvial plain for agriculture is low. Of the 3,300 hectares identi-

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[2]See LRDC (1984) and AHT (1984) for the classification, location, and area of lands suitable for irrigation.

[3]For details of the methodology and findings of the basinwide farming systems' survey, see GRBS Working Documents No. 21 and No. 22, which describe the general methodology and its application to one zone. Also, for the Kekreti Zone, see GRBS Working Document No. 30; and for Balingho, GRBS Working Document No. 46.

fied as suitable for irrigation, less than 500 are currently in production. Much of the rest is used for pasture, hunting, gathering, and seasonal fishing. The relatively steep and high riverbanks permit only pump irrigation. Little of the land is currently used for rainfed agriculture.

3.2.1.2. Upper River division. Stretching from the border of Senegal to east of Georgetown, in this subdivision tidal influences are both felt and measurable. The banks begin to decrease in height, in comparison to upriver, and soils are fairly arenaceous. Population density increases along the river, and there is rainfed rice cultivation. Most observers consider the area more suited to crops (such as maize) other than irrigated rice. There are villages within the division which grow rice with and without pump irrigation.

3.2.1.3. Middle River division. This section begins just east of Georgetown, and reaches to the eastern limit of planned irrigation development near Kuntaur. Included here are areas along the major bolons (streams) where dry season swamp and rainy season tidal rice are cultivated, even though some portions may be located in Senegal.

Just upstream from Georgetown the height of the riverbank drops. Lower banks, increased tidal action, and the relatively flat terrain subject the land to flooding. The river water is salt-free year-round up to Carrol's Wharf, although the exact spot varies annually depending on the amount and duration of fresh water carried downstream in the rainy season. The fresh water permits cropping of tidal rice in dry and rainy seasons. The subdivision ends where salt intrusion prohibits the cultivation of the dry season tidal or swamp rice crop. The Middle River Division (MRD) contains most of The Gambia's current production of irrigated rice and the most suitable soils for future irrigated rice.

3.2.2. Zone II

The nonirrigated Zone II is divided into four agroclimatic subdivisions.

3.2.2.1. Sahelo-Sudano division. In the northern reaches of the basin, the Sahelo-Sudano subdivision has an average rainfall of 600-900 mm over a period of 60-90 days. Land slope is moderate, and soils are rated marginal for agricultural use. Vegetation is relatively sparse, and the productive capacity of the soils is more suitable to low intensity livestock production.

3.2.2.2. Intermediate Sudano division. Lying south of an imaginary line from Koutiaba to Bala in eastern Senegal to Mako near Kedougou, the subdivision is bounded on the south by the north bank of the Gambia River. Average annual rainfall ranges between 900 and 1,100 mm over 120 to 130 days. The slope of the terrain is moderate; sandy to sandy loam soils are derived from alluvial and colluvial deposits.

3.2.2.3. Southern Sudano division. This subdivision covers most of the administrative district of Kedougou, some of eastern Kolda, a southern portion of the Peanut Basin, and the entire north bank of The Gambia not included in Zone I. Average annual rainfall exceeds 1,100 mm over a period of 130 days. Slopes are high to moderate in most areas. In the west, soils are deep with a high clay content; in the east, notably in the Peanut Basin and northeastern Gambia, soils have a high sand content, and slope is low to moderate.

3.2.2.4. Sudano-Guinean division. The Sudano-Guinean area corresponds to the south bank of the Gambia River up to the upper Casamance region near Kolda. There is an average rainfall of 1,000-1,400 mm over 120-130 days. Soils are sandy to sandy loam, and slopes are moderate to low.

3.2.3. Zone III

Zone III, the Guinean portion of the basin, corresponds to the upper reaches of the Gambia River. It can be subdivided into three sections on the basis of rainfall, population density, and altitude.

3.2.3.1. Upper Watershed division. The Upper Watershed is located on the high plateau of the Fouta-Djallon, along the tributaries of the Gambia River. There is a high population density (55-60 people/km^2), a six-month rainy season with an approximate average rainfall of 1400-1650 mm and a very rugged terrain. Fields tend to be located on steep slopes.

3.2.3.2. Middle Watershed division. The Middle Watershed is adjacent to the Gambia River and its tributaries flowing toward Senegal. Population density is 25-30 km^2, the rainy season is four and one-half months, and rainfall is 1,000-1,300 mm. The terrain is rugged, and the fields are located on relatively steep slopes.

3.2.3.3. Koulountou Basin division. Located east of the Fouta-Djallon, elevation is lower in this division than in the rest of the Guinean Basin. The population density averages 20 km^2, elevation 300-900 meters, and rainfall from 900-1,100 mm in a rainy season from June to September. The Koulountou Basin is similar to the Southern-Sudano section of Zone II. Aside from the highlands of Guinea, the terrain is less hilly and field slope more gentle.

3.3. Populations of the Gambia River Basin

3.3.1. Demographic Status and Trend

The rationale for irrigation rests partly on current demographic trends in the Gambia River Basin. OMVG estimates the resident population at 1.7 million, expected to increase to 2.5 million in 2000 and to 3 million in 2010. The figures used here (see Table 3.1) are slightly lower but nonetheless indicate rapid growth combined with increasing rates of urbanization.

The region with the most difficult statistics to interpret is Guinea because of the systematic augmentation of results during the 1983 census (recensement). The figures we have found most reliable were gathered at the subdistrict (sous-prefecture) level. They are given in Table 3.2.

A major feature of West Africa during the later twentieth century is urbanization. Population growth in cities, both large and small, is around 6 percent. Dakar grew most rapidly in the 1950s through the 1970s and still has the largest total number of inmigrants each year The Gambian capital area and other administrative centers are expanding quickly. While the population in Banjul has grown slowly, in the surrounding areas of Brikama, Kombo, and St. Mary it has risen from 169,596 to 286,000 (1983 preliminary census results); the four combined constitute 43 percent of The Gambia's total population. Figures for several cities in or adjacent to the basin are provided in Table 3.3. The Senegalese urban population increased from 16 percent in 1955 to 35

TABLE 3.1.

GAMBIA RIVER BASIN POPULATION PROJECTIONS
(thousands)

Geographical Unit	Regional Growth Rate[a]	Population Segment	1976	1985	1990	2000
The Gambia		Rural	409.4	503.1	553.5	626.3
	6.5	Urban	137.6	242.4	331.9	622.6
	3.5	Total	547.0	745.5	885.4	1248.9
Senegal Oriental		Rural	207.0	296.2	361.1	534.7
	5.7	Urban	32.7	53.9	71.1	123.7
	4.3	Total	239.7	350.1	432.2	658.4
Sine Saloum		Rural	190.4	222.7	247.2	304.1
	4.0	Urban	7.8	11.1	13.5	19.9
	2.2	Total	192.2	233.8	260.7	324.0
Kolda		Rural	50.0	60.8	67.8	84.3
		Urban	0	0	0	0
	2.2	Total	50.0	60.8	67.8	84.3
Senegambia portion		Rural	856.8	1091.1	1237.7	1559.5
		Urban	178.1	307.4	416.5	766.2
		Total	1034.9	1398.5	1654.2	2325.7

NOTE: a) Intercensal compound annual growth of the total population, including natural growth, in-migration, and out-migration. The reference periods are 1973-83 for the Gambian growth rates and 1960/61-1976 for Senegal. No intercensal comparison is possible for Guinea, due to the lack of historical data.

University of Michigan, Gambia River Basin Studies, 1985.

TABLE 3.2.

POPULATION ESTIMATES FOR GAMBIA RIVER BASIN

	Official Census	Adjusted Official Census
Labe Prefecture		
(excluding the sous-prefectures of Daralabe, Diari, Djoufo, Garambe, Hafia, Kalen, Kouramangui, Noussy and Popadara)		
Sous-prefectures (in Gambia River Basin)		
Dalen	3,448	2,463
Tountouroun	20,159	14,818
Labe-ville	(40,360)	(28,828)
Subtotal:	44,383	31,680
Subtotal w/Labe-ville	(87,743)	(60,508)
Koubia prefecture		
(excluding a portion of Missira which is in the Niger basin)		
Sous-prefectures:		
Koubia	19,908	14,220
Fafaya	20,818	15,878
Gada Oundou	5,540	3,812
Matakau	13,166	9,793
Pilimini	25,039	17,885
Missira	8,250	5,873
Subtotal:	92,721	66,229
Mali Prefecture		
(excluding Dougountouni, Medina Dura, and Yembering)		
Sous-prefectures:		
Mali Center	33,078	23,627
Balaki	8,818	6,298
Dongol-Sigon	33,554	23,967
Lebekere	11,610	8,298
Salambande	10,142	7,244
Hidayatou	13,877	9,912
Fougou	18,019	12,870
Subtotal:	129,092	92,210
Koundara Prefecture		
(excluding most of Kamaby and Sarebodio)		
Sous-prefectures:		
Koundara Center	17,941	12,815
Youkounkoun	9,076	6,496
Guingan	12,416	8,868
Termesse	12,405	8,860
Sambailo	9,735	6,953
10% Kamaby & Sarebodio	3,264	3,264
Subtotal:	64,837	47,256
Totals:	331,033	237,375
Totals with Labe-ville	371,393	266,203

University of Michigan, Gambia River Basin Studies, 1985.

TABLE 3.3.

POPULATION GROWTH IN SENEGAMBIAN CITIES

City	1950	1960	1978	1983	1950-83 ann.growth
Dakar	204,846	421,470	602,100	1,209,042	6.1%
Thies	38,549	76,227	105,456	165,099	5.0%
Kaolack	43,084	75,236	111,096	140,672	4.0%
Banjul	combined estimate		39,179	44,536	combined rate
Kombo/St. Mary	20,000		39,404	102,858	6.9%
Brikama	n.a.	n.a.	91,013	138,504	
Ziguinchor	20,011	33,402	51,168	107,917	5.8%
Tambacounda	3,915	12,312	25,569	44,227	8.4%
Kolda	n.a.	n.a.	n.a.	25,274	
Labé	n.a.	n.a.	n.a.	29,036	
Mali(Guinea)	n.a.	n.a.	n.a.	23,798	
Total	c.400,000	c.763,000	c.1,124,985	2,030,963	

SOURCES:
Republic of Senegal, Ministry of the Economy and Finance, National Census Bureau.
Republic of the Gambia, Ministry of Economic Planning and Industrial Development, Central Statistics Division.
People's Republic of Guinea, Prime Minister's Office for Planning and Statistics, National Census Bureau.

University of Michigan, Gambia River Basin Studies, 1985.

percent in 1978 and is now higher. Guinea's urban population is about 27 percent, with more than 12 percent living in the capital.[4]

3.3.2. Ethnicity

The Gambia River Basin has always been a zone of intercultural influences and a diversity of peoples and languages. The river, especially the lower half, has served as an important means of communication, transport, and trade, which in the past has generated many conflicts over control. Different sections of the basin feature different populations, who in turn use the river in varying ways depending on its local characteristics.

Downstream from the source in the highlands of the Fouta-Djallon in the prefecture of Labé (leaving aside for the moment peoples along the many tributaries), the dominant ethnic group is the Fulbe. This remains the situation as the river plunges out of the highlands and along the borders of northern Guinea, but in the subprefecture of Balaki (on the east bank) the population shifts to Diallonke. As the river enters Senegal one finds Fulbe, Malinke (Manding), Diakhanke, and Bassari. Both in northern Guinea and in fareastern Senegal, the river generates fear in many of the local populations, apparently due in part to the association of proximity to the river with disease, particularly onchocerciasis (river blindness). From Kedougou to Mako and along the park to Lengue Koto (the village closest to the proposed dam site), the river banks are relatively steep; the water runs fast during the rains but becomes puddles by the end of the dry season. On the shores are villages representing a wide range of ethnic diversity, especially in the highlands just back from the river. When the Gambia River leaves the park its banks remain high, but the land behind is flatter. Diakhanke, Fulbe, and Manding communities are found on the stretch from the park to Gouloumbou, with Wolof and Serer also present in some of the newer settlements. The bridge at Gouloumbou marks the replacement of river transport by road, and Tambacounda is assuming growing importance as the commercial and administrative center for the zone. As the river enters

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[4] Bureau National du Recensement, Recensement Général de la Population et de l'Habitat, 4-17 février, 1983.

The Gambia, the banks become less high, the descent less rapid, and the influence of the tides greater.

Near Georgetown on MacCarthy Island, the tides and a major tributary, the Sandougou, permit flooding of low-lying land. This is the important rice growing area of The Gambia, which is associated not only with the Mandinka but also now with most of the peoples of the region. Downriver from Sapu the percentages of Fula and Serahuli diminish, while the Mandinka increase. On the north bank are increasing numbers of Wolof and a series of Toucouleur villages. East of Tendaba there are more and more Jola communities, especially on the south bank, and Mandinka and Wolof settlements on the north bank.

In this report we use the nationally accepted way of referring to the different peoples. Thus there will be variations in the spelling of the same language or group. The major groups found in more than one country in the region are listed in Table 3.4.

The percentages of different native speakers for each language in the basin, known only for The Gambia, are shown in Table 3.5.

In Senegal the ethnic groups are:

- Wolof
- Fulbe (referred to as Peulh)[5]
- Toucouleur
- Manding
- Diakhanke
- Serer
- Bassari
- Bambara
- Sarakole
- Bedik
- Diallonke

No exact figures are available by ethnicity in the basin, but the most numerous are the Manding, Fulbe, Wolof, Serer, and Diakhanke. The Department of Kedougou contains a very diverse population and some of its resident groups are unique to that region of Senegal.

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[5]There is a self-perceived difference between Fulbe and Toucouleur, although both speak Pulaar (but different dialects).

TABLE 3.4.

MAJOR ETHNIC GROUPS IN THE GAMBIA RIVER BASIN

The Gambia	Senegal	Guinea
	Badiaranke	Badiaranke
	Bassari	Bassari
	Bedik	
	Cognagui (Unyee)	Cognagui (Unyee)
Fula	Peulh, Peuls	Fulbe, Peuls
		Fulakunda
Jakhanke	Diakhanke	Diakhanke, Diakhanke
	Diallonke	Diallonke (Djallonke)
Jola	Diola	
Mandinka	Manding or Malinke	Malinke
Serahuli	Sarakole (Soninke)	
Toucouleur	Toucouleur	Toucouleur
Wolof	Wolof	

NOTE: The basin has always been a zone of great intercultural influences and contacts. This is partly due to fact that the river has always served as a major means of communication. It has been a major cause of many conflicts for control of the trade along the river, and access to the water itself. Thus there will be variations in the spelling within the same language or group.

University of Michigan, Gambia River Basin Studies, 1985.

In the Guinean portion of the basin, the predominant peoples are:

- Cognagui (Unyee)
- Fulbe
- Diallonke
- Diakhanke

Again, no specific figures are available, but the Fulbe are in the majority. They live mainly in the upland areas and along the higher reaches of the major tributaries in relatively dense populations. Away from the highlands, other populations tend to predominate. Along the Gambia River there are Diallonke, Diakhanke, and Fulbe; the Kolountou River and its tributaries flow through much of the Guinean homeland for the Cognagui and Bassari.

In the urban areas of each country the entire range of populations is represented. In Labé, for example, live Soussou, Malinke, Kissi, and members of all other language groups of Guinea. The same holds for Banjul, Dakar, Tambacounda, and so forth.

Ethnic categories can be deceptive, masking within them differences as real and as great as those between ethnic groups. Furthermore, social status often plays an important part in determining access to land and other resources. In limited space it is not possible to identify the full complexity and role of these factors, but where they may be important for planning purposes they are discussed. In general, a call to participate in projects for the national good may lead to the transfer of existing conflicts or inequalities into new arenas.

TABLE 3.5.

DISTRIBUTION OF NATIVE SPEAKERS AMONG THE FIVE MAJOR LANGUAGES IN THE GAMBIA (excluding English)

Division	Mandinka	Fula	Wolof	Jola	Serahuli	Other	Total
Western	44.2%	7.1%	2.6%	39.7%	1.0%	6.7	100%
Lower	77.2	16.6	1.4	1.5	2.0	1.3	
North Bank	50.7	13.3	27.9	0.8	0.4	1.3	
MacCarthy Island							
North	31.4	31.5	34.4	0.5	0.4	1.8	
South	35.5	36.9	18.8	0.4	7.1	1.3	
Upper River	42.3	18.2	15.7	9.5	8.7	5.6	

NOTE: From the 1973 census; it appears the relative distributions have remained the same.

University of Michigan, Gambia River Basin Studies, 1985.

Our research has not found any evidence to conclude that some peoples in the region are more progressive or innovative than others. Rather, a series of internal and external forces are at work which both maintain ethnic groups and often lead to greater commonalities. That is, processes are occurring which enhance separate ethnic identities while also uniting peoples in a single nation. A key element in the successful organization and use of labor-intensive irrigated agricultural systems will hinge in part on understanding the differences in the organization of production by the ethnic groups involved.

3.3.2.1. Spatial organization. Within the Gambia River Basin there are very few nonsedentary peoples. Along the river, aside from a few Mauritanian and Fulbe herders, the basic settlement pattern is one of relatively stable villages. Through the influence of the colonial powers (the French and English) and now national governments, there has been a consolidation of settlements and relocation near roads. The village is the most significant residential, social, and economic organization in the countryside. Depending on ethnic group and historical factors, villages may have a differential importance and influence; some will be able to garner greater resources. Each village reflects the social organization of the group. Those of noble lineage may live apart in one village (as among the Serahuli) or with former slaves in another (a pattern found among the Fulbe of the Fouta-Djallon). Despite governmental efforts, most ethnic groups choose to live in their own villages; even in those which are biethnic or multiethnic, there are separate wards. This does not imply a lack of mutual cooperation and assistance between ethnicities, which exists in many cases, but it is also true that there are regions in which a particular ethnic group (or a segment of it) dominates politically and/or economically. For planning, purposes it is important to know that within any single zone of proposed irrigation development in The Gambia, Guinea, and Senegal, there are several ethnic groups whose village and social organizations will be altered.

The emphasis on village should not disguise the importance of intervillage relations. These are significant in terms of marriage, in-laws and other kin as sources of labor, and economic assistance in hard times, as well as potential conflicts over land and other resources. Villages are not self-contained economic or social entities but are embedded in a web of regional and national affiliations. Villagers are quite aware of these complex realities. For example, villagers who are members of OFADEC, the Senegalese cooperative organization which has founded new settlements along the Gambia River, depend on international, national, and regional resources to carry out its program. Their major income derives from marketing of bananas to Dakar. OFADEC members respond to multiple affiliations simultaneously. Villagers in the Gambia River Basin have had much experience with both national and international agencies. Although in the Guinean portion of the basin there has been much less involvement with international organizations, there has been considerable interaction with the national government on administrative and political levels. Villagers in the basin are (and have been) active in trying to obtain more from their governments and outside donors to improve living conditions. They do not see their communities as separate from the larger context in which they live. If nothing else, the continued reliance on imported rice to supplement rural food supplies continues to testify to this fact.

The physical organization of villages varies greatly throughout the basin. In The Gambia, they tend to be larger, and almost all houses are in a clearly defined settlement area. This is now true for virtually all ethnic groups, although it was not so much the case in the past. In the Guinean portion of the basin, because of the location of fields within the village, compounds are not necessarily contiguous, and earlier patterns of settlement are reflected in the dispersion of villages. There are ethnic variations. For example, it was only in 1959 that the Cognagui ceased shifting their villages when they changed cultivation sites. Similarly, the Bassari also moved far more frequently than is the practice among other groups. Also, whether or not a village has a mosque is quite important in its relations with others, since this is a gathering place for several villages for the Friday prayers. Mosques and markets serve as essential places for providing and receiving information.

3.3.3. Migration Patterns

3.3.3.1. Labor migration. Labor migration is an important dimension to be considered in development plans for the Gambia River Basin. Patterns have been well established for many years, but they do not remain static through time. In virtually all rural areas in the basin one finds a significant outflow of people, principally young men, seeking employment.

The prevalence of labor migration raises several key questions with regard to development initiatives:

- Will there be an adequate labor supply for proposed developments?

- Will these developments ameliorate or exacerbate the rural exodus to the cities of West Africa and Europe?

- Can planning achieve the dual purpose of permitting enough labor migration to sustain rural communities while stabilizing the younger male labor force to increase agricultural production?

- Will large investments in the rural sector slow or halt the flow of migrants to the cities?

Guinea's experience illustrates how complicated and intractable the labor migration issue can be. The annual flow of active adults to the Peanut Basin during the colonial period was considered a loss of productive manpower by newly independent Guinea. Efforts were made by the government in the early 1960s to resettle seasonal workers in Guinean peanut-growing areas, notably the Koundara region at the same time the navetanat was diminishing in Senegal. Although support was provided (travel and seed subsidies), few rainy season migrants chose the alternative because of the overvalued national currency, poor returns to their labor due to the official price structure, and low likelihood of obtaining the necessary inputs. Conflicts with local landholders complicated the process. These efforts ended when the government sought other means to alter agricultural production patterns in the early 1970s.

There is a labor surplus in The Gambia, Guinea, and Senegal. However, it principally exists in the cities, whereas at peak agricultural times there is a shortage in the countryside. Virtually every rural development proposal claims it will significantly slow the rural exodus. Success, however, is elusive because of the attractions of the city. In the present context, a most important area to monitor is the rate of labor migration in the participating villages around Jahaly Pacharr, in comparison to comparable communities in The Gambia, to see whether successful double-cropped irrigated cultivation keeps young men on the land. If it does not, then the labor patterns of women and children need to be examined carefully to see whether their workloads are increasing. Among other things, availability and price of labor will affect technology choices. It is not clear that an exogenously-based rural development strategy will succeed in diminishing the outflow of rural labor unless it has widespread and deep community support. Indeed, if experience elsewhere is a guide, women will soon be joining men in the outflow (as they now do among the Diola and the Bassari).

3.3.3.2. Push/pull factors in migration. African urbanization has not been accompanied by widespread industrialization and the growth of productive employment opportunities. Salaried jobs exist for less than 10 percent of the urban workforce, mostly in the administrative, services, and trade sectors. Nevertheless, urban incomes and levels of consumption average eight or more times rural levels.

The analysis of out-migration rests on "push" factors, the economic stagnation or decline of the area of origin (due to overpopulation, land shortage, disease, and so forth), and "pull" factors, the higher incomes, more jobs, and amenities available in more privileged areas (cities, cash crop zones, and developed countries). Labor migration reflects unequal geographic patterns of development. Costs and benefits cannot be stated easily since much depends on the perspective of the viewer and whether one is assessing the migrants or the villages from which they come. One disadvantage is the strain on West Africa's educational, health, housing, and sanitation facilities due to the rapidity of urbanization, while an advantage to individual migrants may be greater income. Likewise, money sent home may help nourish rural citizens, yet agricultural production may decline when labor is lost. The use of migrant remittances to increase agricultural productivity has been found to be the case in portions of the Senegal River Basin.[6]

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[6]Lucie Colvin, "When the Young Men Leave and the Old Return: Development Policy in an Area of Intense Outmigration, the Upper Senegal River Valley," in Technological Change and Rural Development in Developing Countries (Newark: University of Delaware, 1982), Title XII Publication No. 5; and Weigel, Migration et production domestique des Soninke du Sénégal: La Vallée du Senegal (Paris: ORSTOM, 1982).

Caldwell's study of urban migration in Ghana is the most systematic analysis to date of the causes of rural exodus. He concludes, as do most economic studies of migration, that the size of the gap between average rural and urban incomes is the best predictor of the volume of urban migration. National borders and language differences have little effect, although they influence the destination of migrants and the residence of the educated elite. Villagers living near main roads and in cash crop zones are more likely to migrate than are those in isolated peripheral areas.[7] The places migrants choose to work depend on networks, local knowledge, and the relationship between rural and urban incomes.

In the Gambia River Basin specifically, population was sparse in large areas early in the twentieth century. Basinwide growth has been at a high rate of approximately 4.1 percent since 1960, which means a doubling of the population every 17.1 years. Such an increase requires the rapid growth of all institutions to maintain educational, health, nutritional, housing, and employment opportunities. The perception of the rural population has been that these are more likely to be found in the urban areas. In addition, serious environmental degradation combined with lower peanut prices has led to declines in rural agricultural opportunities.

3.3.3.3. Geography of regional migration patterns. The major migration poles for the Gambia River Basin are no different than those for the other two major basins (the Senegal and the Casamance) in the greater Senegambia region (for its definition, see Colvin et al., 1981).[8] All these waterways have served as avenues of trade, although since the 1920s, river commerce has been greatly diminished first by the railroads and then by paved roads.

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[7] John C. Caldwell. African Rural-Urban Migration: The Movement to Ghana's Towns (New York: Columbia University Press for the Population Council. 1969); John C. Caldwell, ed., Population Growth and Socioeconomic Change in West Africa (New York: Columbia University Press for the Population Council. 1975).

[8] Lucie Colvin et al., The Uprooted of the Western Sahel: Migrants' Quest for Cash in the Senegambia (New York: Praeger, 1981).

Dakar is the primary city in the regional hierarchy of functions, serving as principal port and center of wholesale commerce, banking, administration, employment, educational systems, and health care. Banjul serves in the same capacities as Dakar but more at a national than a transnational level. Secondary cities are Kaolack (also the center for the Peanut Basin, outside the Gambia River Basin), Ziguinchor, Tambacounda, Georgetown, and Labé. The rural hinterland is changing almost as much as the urban areas, due to decline in the old cash crop zones and the emergence of new ones. Through a combination of environmental pressures and poor cultivation practices, the old Peanut Basin is being exhausted. This is affecting the Gambia River Basin in two ways. First, people from the Thies-Louga corridor in Senegal are moving south and east to better watered and more fertile lands along the Kaolack-Gambia roads and the Kaffrine-Tambacounda-Velingara road. Second, the Badibus area, The Gambia's former Peanut Basin, is experiencing social fragmentation; family size is shrinking, adult males are leaving, and those left behind depend on food supplements sent by urban kin. Migrants from Badibus and other upriver areas go to family compounds in Serekunda or Brikama. There they find easy access to urban markets and job opportunities, yet still have access to cultivable land.

Our studies of villages in the Guinean portion of the basin show high rates of labor migration. Table 3.6 gives the percentage breakdown of location for those who migrate in search of work.

TABLE 3.6.

PERCENTAGE OF LOCATION FOR THOSE MIGRATING FROM STUDY VILLAGES IN GUINEA

Rural			Towns			Major Urban			Other African
Senegal	The Gambia	Guinea	Senegal	The Gambia	Guinea	Dakar	Banjul	Conakry	Urban
8	0	13	16	1	22	11	3	7	9

University of Michigan, Gambia River Basin Studies, 1985.

The percentage of Guinean migrants from the study villages are as follows: Senegal, 35 percent; The Gambia, 4 percent; and Guinea, 42 percent. The figure for other West African countries is 8 percent. Rural-rural migration accounts for nearly one-third of the migrants studied, and more than half of these go to Senegal, where most are engaged in rainy season agricultural labor. Interestingly and significantly, most of the rural-rural migrants within Guinea are employed in various sylvan activities rather than agricultural ones; particularly during the dry season, they are engaged in woodcutting, firewood collection, and bamboo fence construction.

Migration from rural areas to regional towns accounts for the largest proportion of location of employment (39 percent). Guinean towns were targets for a higher percentage (22 percent) than those in Senegal (16 percent). It appears that regional towns along the frontiers with Ivory Coast, Sierra Leone, and Liberia have provided expanded trade and wage labor opportunities. Migration to large urban areas was cited by 21 percent of respondents: Dakar, 11 percent; Banjul, 3 percent and Conakry, 7 percent. Rural-urban migration to Abidjan, Freetown, Bamako, and Monrovia was estimated at around 9 percent of the sample. This raises the rural to urban total to 30 percent.

3.3.3.4. Profile of migrants. The rural exodus in the basin predominantly involves young men, the peak age being between 20 and 39 years; women migrants are slightly younger, 15 to 29 being the typical age. The proportion of women who migrate their own, as opposed to accompanying a husband, varies substantially among regions and ethnic groups. Fulbe/Toucouleur, Diakhanke, and Serahuli (Soninke) women are less likely to leave the rural areas on their own, while Diola, Bassari, and Serer women do so more often. Many Diola women continue to engage in full-time urban work even after marriage and having children. The Wolof and Mandinka have a smaller proportion of single women migrants than do the Diola, but more than the Fulbe/Toucouleur and Serahuli.

Data from the twelve Guinean villages indicate that 93 percent of the migrants are males, 70 percent are under the age of 30, and 85 percent have had no public schooling (although most have had Koranic schooling). These findings are somewhat different from the general demographic characteristics of migrants in the other parts of the basin:[9] the overwhelming dominance of male migrants; their younger age; and a lower frequency of married men among the migrants. In addition, there is a very low rate of schooling: 13 percent for males and 5 percent for females. Levels of public schooling among migrants were only slightly higher than the levels of public schooling for the overall population. Schooling therefore cannot explain the high rate of migration. It is probably more important in helping to explain the lack of employment opportunities available to migrants from the Guinean basin.

One indicator to evaluate the importance of out-migration in a given population is to calculate the percentage of male migrants as a proportion of the adult male population. Table 3.7 gives a series of indices to examine the changes in the adult labor force as a result of out-migration.

3.3.3.5. Labor supply and competing opportunities. Two constraints to intensifying irrigated agriculture in the Gambia River Basin are the shortage of labor at key agricultural periods (when there is a conflict between labor demand for rainfed crops and that for irrigated crops -- see Chapter 7) and the loss of labor (particularly male) through labor migration. The current employment context in which people decide to migrate is essential for developing successful agricultural strategies. Jobs are in short supply in The Gambia, Senegal, and Guinea. While official rates of unemployment are low (2.6 percent of the labor force in Senegal, 3 percent in Guinea), it is generally agreed that these are substantially understated. A total of 79.5 percent of all men listed as working in the Senegalese census were either self-employed or helping the family. Small-holder agriculture is the main employer: 60-65 percent in Senegal, 83 percent in Guinea, and just over 80 percent in The Gambia.

Table 3.8 indicates how many find salaried work. Most urban migrants directly from the countryside find poorly paid employment, if at all, in the informal sector. Those in Guinea now enter the tertiary sector in urban areas rather than go to the Peanut Basin. They become small traders, sellers of services, casual laborers, domestic servants, and so forth. Senegal, the only country that has systematically followed

[9] See Colvin et al., 1981. op. cit.

TABLE 3.7.
PERCENTAGE BREAKDOWN OF ADULT LABOR FORCE, BY SEX[a]

	Adult Labor Force[b]		Migrants as a % Adult Labor Force	Male Migrants as % of Adult Males[c]
	%Male	%Female		
Hore Dima	30% (44%)	70% (56%)	27%	61%
Telire	40% (49%)	60% (51%)	25%	50%
Kinsi-Kimpa	41% (46%)	59% (54%)	18%	39%
Nianou	44% (48%)	56% (52%)	18%	40%
Souma	40% (45%)	60% (55%)	20%	46%
Simily	43% (53%)	57% (47%)	24%	44%
LitiDianBoye	32% (40%)	68% (60%)	12%	29%
Mayadine	25% (44%)	75% (56%)	35%	64%
Fetore	37% (46%)	63% (54%)	24%	45%
Tabadel	42% (47%)	58% (53%)	19%	41%
Oudaba	46% (53%)	54% (47%)	24%	46%
Ithiou	40% (43%)	60% (57%)	14%	34%

TABLE 3.7 (cont.)

NOTES: a) Including dry season migrants; migrants as a percentage of adult labor force, and male migrants as percentage of active males, for each village.

b) The first percentages in the two columns to the left are an estimate of the sex composition of the adult labor force present during the agricultural season. The percentages in parentheses below those figures estimate the sex composition of the adult labor force including those who migrate, but excluding daughters listed as family members who have married and were reported as nonresidents.

c) The figures in the far right column in the table are the percentages of adult males who migrate as a proportion of all adult males surveyed for each village. As an average, between 45-48%, or nearly half of all adult males were reported as absent for work at the time of surveys in March 1984. Because this figure represents only those who were absent at the time of the survey it is likely that rates of migration are potentially higher than estimated. Despite this possible bias, the figures cited for villages in this part of Guinea are 10 to 15 percent higher than comparable figures in different regions of the Senegal River Basin.

University of Michigan, Gambia River Basin Studies, 1985.

TABLE 3.8.

SALARIED EMPLOYMENT IN GAMBIA RIVER BASIN COUNTRIES

Country	Labor Force[a]	Registered Employees	Total Wage Earners[a]	Percent of Labor Force
Senegal	2,635,400	132,652	243,300	9.2
Guinea	2,790,000	133,000	243,900	8.7
Gambia	374,300	30,410	55,800	14.9

NOTE: a) Estimates. Labor force is the population age 15-64 years, based on age structure of the population in the 1976 Senegalese census and a similar proportion of the total populations for Guinea and The Gambia in the 1977 and 1983 censuses, respectively (neither of the latter has as yet published age structures). The estimate of total wage earners is likewise based on the Senegalese census, which showed 243,295 persons claiming to be salaried in the same year that the Ministry of Plan recorded 132,652 registered employees. the "nonregistered" jobs claimed by census respondents probably reflect informal sector and small enterprise employment. For lack of data, it is assumed to exist in the same proportions in the other two countries.

University of Michigan, Gambia River Basin Studies, 1985.

this sector, estimated such employment at 227,000 in a 1972 study; 215,000 in 1976; and 269,000 in 1981, roughly the same numbers as in salaried employment.[10]

Incomes for rural migrants frequently begin at bare subsistence. In Senegal and The Gambia, 33 migrants who had returned to their villages were interviewed; 11 had been to towns within the basin and 10 to rural areas (including 2 women to grow rice, and 3 young men to help harvest and thresh). The rest had gone abroad: 9 to Europe (mostly agricultural laborers in Spain) and 3 to Ivory Coast, Gabon, and Congo, respectively. Most of those who stayed in the basin received food and lodging from their employer or relative, and 7 returned home with new personal belongings

[10]World Bank (1979), IV, 80. Sénégal en Chiffres, 1982-83 (Dakar: Société Africaine d'Edition).

and trade goods valued at $1.00-$131.00 for a season's work. Four reported no net income and no savings or remittances. Those who went abroad sometimes made their fortunes, but a few spent all their money. The returnees from Europe, after stays averaging four years, had goods and savings worth an average of $1,250. One had $266 less than he left with, another lost $430 trading, one broke even, and five saved more than $1,000 each. The record was held by a mason who saved $6,250 working four and one-half years for a French company in Gabon.

As is well known, there are strong pulls for Toucouleur, Fulbe and Soninke to seek work in France. Young Gambian men are increasingly looking for opportunities in Spain. The weekly wage for agricultural labor there was typically 6,000-7,000 pesetas (equivalent to 13-15.5 dalasis, or U.S. $3.50-$4.15), while food and lodging expenses were 1,600-3,000 pesetas. Two returned migrants found other more remunerative employment. Returnees tell fellow villagers of their experiences and show off their new clothes and belongings; the villagers were anything but discouraged by the results of their efforts.

Closer to home, migrants can expect both less chance of finding a job, and lower pay if they do. Even if the return to labor is low, however, there are two certain advantages for young people joining the exodus:

i) They can pocket some of their earnings instead of turning all of them over to the head of family, and

ii) if they do find work in the city, they can start a family there, where their wives and children may benefit from water, electricity, better schools, and a more interesting life.

Urban wages are a measurable factor in the migrant's decision, even though very few may ever find salaried work. In The Gambia, the average daily wage in September 1983 for all levels of employees was D12.39; for daily laborers it was D7.44 (equivalent to 1983 U.S. $2.48).

In Senegal the minimum wage (SMIG) has been 140.5 FCFA per hour since 1981, which translates to 1,124 FCFA per day (in 1981 it was worth U.S. $2.99). Average monthly salaries for manual laborers in 1976 ranged from 23,238 FCFA in construction to 37,813 FCFA in commerce; government manual laborers averaged 25,878 FCFA (equivalent to U.S. $117.63, but in 1984 only U.S. $57.50).

Guinea's wage picture is more complex because of distortions between strict official regulations and a fluid parallel economy. The official SMIG has been 50 sylis per day since 1972, but the lowest wages paid in the private sector in 1981 were 100 to 200 sylis depending upon the region. Government salaries have ranged from 1,500 to 15,400 per month since July 1, 1981, plus allowances for children and ration allocation. The official exchange rate has been 24 sylis to the U.S. dollar, with the parallel market rate going as high as 300 sylis.

Wage labor is found increasingly in rural areas. In the sample Senegambian villages, data were collected on paid labor by asking inhabitants what paid labor they did for others and what labor they hired. While most work was paid on a task basis and is difficult to express in daily rates, the following appears to be the case. Rural wage employment is not available on a regular basis. Men's tasks pay about 5 dalasis a day (or 450 FCFA); women earn 1-3 dalasis a day (100-300 FCFA) for weeding and transplanting rice, tending vegetable gardens, and so forth. Children earned from 5 buttuts for scaring birds to D1-1.25 for guarding herds. Rural farm wages, when available, are 65-90 percent of urban wage levels in the area.

3.3.3.6. Implications for river basin development. Since the supply of labor depends on competing opportunities and sufficient household production to ensure subsistence, the key is to develop a program with returns sufficient to draw labor from other activities. We must know how much labor will be needed and under what conditions it will be available. The models proposed for the pilot perimeter by the Land Reclamation and Development Consultants show that Farm Model 1, which offers irrigated land to a larger number of people at lower capital cost per family, provides a return of only D1.90 per man-day of labor, which is far lower than urban wages. This low rate of return also assumes double-cropping and a one-hectare plot per household. Only with LRDC's Farm Model 3 -- 1.5 hectares per household, oxen traction, plow, harrow, and thresher plus income from leasing out the equipment -- is the return per man-day expected to reach the acceptable level of D7.10.

It cannot be assumed that labor from other areas of the basin or adjacent regions will be available for irrigation. At a time when the rural exodus has accelerated, not diminished, evidence from Guinea indicates that most migrants are no longer leaving the upper basin to work in agriculture. Based on household surveys of the location of family members not present during March 1984, the overwhelming number of Guinean migrants were engaged in the tertiary sector, dominated by petty trade. Senegal remains an important pole of attraction, but there has been a shift from seasonal agricultural jobs to long-term migration to regional towns and cities, where migrants are engaged in petty trade or unskilled wage labor.

The decline in labor available to the agricultural sector reflects serious structural problems and disadvantages of investing labor time in agriculture as opposed to other activities. Planners need to take into account these competing or higher returns to off-farm activities when calculating how best to attract producers into (or back into) food production for income and/or increased food self-sufficiency. All too often planners arrive at unrealistically low opportunity costs to expanded agricultural production, based on returns to labor in other agricultural activities, and ignoring risk-spreading through diversification of both agricultural production and off-farm activities in a more global survival strategy.

3.4. Social Organization of Basin Farming Systems

3.4.1. Village Organization

Villages have their own authorities and representatives which are a blend of past emphasis on founding lineages, age, status and birth, and the contemporary importance of wealth, education and ability to mediate between village and national/regional concerns. In most villages, councils of male elders usually make decisions for village concerns. Within most areas there is also a hierarchy of villages based on size, wealth, social status, existence of markets, and other factors. However, increasingly, there are other village or intervillage decision making bodies that play a critical role in the organization of production.

These are cooperatives, or production units (in eastern Senegal). The Guinean portion of the basin is in a time of transition. In the past, the PRLs (Pouvoir Revolutionnaire Locale) were the local forums of the Party. Since these were recently disbanded, no new groups have as yet clearly replaced them. In addition, villages were often grouped together are and no longer referred to as villages but as sections. A transitional phase has been established for rural areas by the new government but whether or not it will be permanent is not clear.

Despite the apparent traditionalism of villages and their strong continuities with the past, they have been subjected to, and have had to respond to, initiatives from national governments to implement development programs. For example, in the case of groundnuts (the most important export commercial crop) the state has played a very active role. This role has included the allocation of credit, furnishing of inputs, marketing of agricultural products, processing and export of groundnut products, along with the creation of organizations to carry these out. In the development of irrigation the question emerges as to whether or not the state/government will similarly seek to dominate the productive process. One would expect so since the expansion of state control through the creation of new organizations to regulate and support agriculture has been an important feature of both The Gambia and Senegal up to the present. The situation in the Republic of Guinea is somewhat different due to the lack of a highly commercialized crop comparable to groundnuts, but nevertheless during the time of President Touré the state did attempt to intervene continuously in the rural sector. Virtually all villages in the basin therefore contain bureaucratic structures (and this is not meant in a pejorative sense) which are present in even the most isolated areas.

3.4.2. Household Organization

The actual range of organizations existing in the basin is great. While this is an area of great complexity there is a tendency to want to simplify, even though simplification may jeopardize the success of development plans. Nonetheless this section both simplifies and overgeneralizes in the hope that specific projects within the purview of OMVG will take into account intravillage and intervillage variation.

Cultivators in the basin obtain land, labor and tools principally from their kin. The ability to carry out agricultural production rests on the organization of the family combined with extrafamilial factors (e.g., availability of inputs, marketing facilities, access to markets). The most important unit for the analysis of production, consumption and distribution in the basin is the household or compound. The household or compound varies in its composition both within and between groups, but it is a named, identifiable group that sets the context for agricultural (and nonagricultural) activities. The compound typically is larger than the nuclear family, it can be identical with one family, or there can be two or more smaller families that make up a compound. Compounds in turn are linked to each other through kin ties (brothers, sisters, etc.) and through affine or marriage ties. These are very important since they provide the mechanisms for assistance and in times of difficulty for performing work that exceeds available family labor. How these ties work varies in the different regions of the basin depending on ethnicity, degree of reliance on cash crops, etc. Throughout the basin reliance on nonwage labor is far greater than the use of wage labor. Households are the most easily manipulated unit of analysis in the understanding of the productive systems of the basin. They vary greatly in size both within and between villages. To explain this variation is beyond the purposes of this report, but to take account of this variation will be important in the design and success of development efforts.

Compounds are nested between larger kin groups (often lineages) and smaller groups (consumption units or families). Each of the different villages studied is divided in this fashion, and each of the different languages has its own terms to refer to these groups.[11] The unit of emphasis in this study is the compound since it is a common denominator. Compounds are typically spatially distinct and engage in the common production of food crops. In addition, the compound can also grow cash crops. Each compound also has a socially recognized head, usually an

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[11]In Mandinka the suo or korda refers to the lineage, dabada to the compound or to those who cultivate together and sinkiro to the consumption unit or those who eat from the same pot. Among the Fulbe of Guinea, gorol refers to the lineage, galle to the compound and beinguure to a husband, his wife(s) and their children.

adult or elder male who, in consultation with other compound heads and with the compound members, decides on what, how much and where to cultivate. There are clear constraints to the decision making authority of compound heads. Compound heads cannot deny land to members nor can they prevent the women (in The Gambia, for example) from cultivating their own rice fields. In addition, there can be a generational conflict between elder compound heads and younger compound members who want to grow more crops for their own smaller families or cash crops. The authority of the compound head may also be constrained by external authorities. The clearest relevant cases are those of OFADEC in Senegal and Jahaly Pacharr in The Gambia where the right to make certain production decisions is given up as part of the agreement to participate in the cooperative (OFADEC) or to be given access to irrigated land (Jahaly Pacharr).

As elsewhere in Africa, the ever-increasing involvement in a cash economy, both through the production of cash crops and labor migration, has led to the smaller size of production units, the declining reliance on collective labor (either family or age-group), and a shortage of rural labor. Weil has observed that for The Gambia the patrilineal extended family constituted the unit of residence and production in the first half of this century. The labor resources and much of its production were managed by the elder in consultation with the heads of the compound's families. However, today, the constituent family has taken over many of the functions of the larger compound. This has led to a decline in the size of the production units.[12]

The approach taken here is that basin cultivators (with some notable exceptions) seek to meet multiple objectives in their agricultural decision making. They may seek to grow certain minimum amounts of food to meet household subsistence needs, to maximize the number of livestock in their herds, to minimize the amount of labor required for production, or to meet certain village, communal or religious obligations which are

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[12] Peter Weil, "Agricultural Intensification and Fertility in The Gambia (West Africa)," in Culture and Reproduction: Reconstructing the Demographic Paradigm, edited by W. Penn Handworker, 1984.

little related to profit. It is also acknowledged that peasants in the basin operate in an environment of extreme uncertainty and that, rather than maximizing profit, they tend to minimize risk. These risks may be the risks of unpredictable weather, unreliable input supplies or services, or uncertain market conditions.

3.4.3. Land Tenure

Throughout the basin, access to land has been through membership in a kin group, or through application to local or regional authorities for the right to cultivate noncultivated land. In lower population zones, permission has not been required. In general, compounds or individuals have gained rights to land through inheritance, participating in local and regional political systems or by establishing land rights through first cultivation. Weil[13] has claimed that the compound or subcompound had access to all of the locally available upland land it had the labor to utilize. (This applied to eastern Gambia but was true for most of the basin.) It has only been since the 1950s that land has become a more important constraint on agricultural production. Inalienability has been a principle of the right to cultivate. This right exists for individuals as members of households, for households as members of larger kin groups, and for villages. The development of national land laws has had, until recently in most areas, little effect on land tenure systems.

Throughout the Senegambian portion of the basin the use of animal traction combined with increased population has "...redefined the value of land and dramatically increased pressure on upland within three miles of the rural communities, a 'reasonable distance' as conceived by local farmers. Wealthier members of Wuli communities have acquired more of the new technologies, attracted more labor under their management within their production units, and thus used far more land than other members of their communities."[14]

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[13]Peter Weil, "Land Use, Labor, and Intensification Among the Mandinka of Eastern Gambia," delivered at the Twenty-third Annual Meeting of the African Studies Association, 1980.

[14]Weil, _op. cit._, 1980: p. 16-17.

While it is still rare for land to be bought and sold, its rental has become common. The use of animal traction has meant that both more land is being utilized and the fallow periods have either diminished or disappeared entirely. As is emphasized later, there is a real problem of land scarcity (or at least of what is defined as "good" land) which will be intensified in the dam impact areas (see Chapter 4).

Senegal has a national land law (1964) under which all land belongs to the state unless it is registered to private individuals or groups. In addition, the state has the right to appropriate land, which gives the state great leverage for rural development but can lead to conflicts with respect to older established land rights. Within the Gambia River Basin the law has been applied to grant OFADEC land for its new villages. The regional development agency, SODEFITEX, has not been granted land but rather works with village or rural community authorities. In addition, individuals have applied for legal claims to land along the Gambia River in amounts of twenty to fifty hectares. The status of their claims is unknown but it does raise the possibility of the alienation of land from local villagers in addition to that already appropriated by OFADEC.

The case of The Gambia will be different. The Land (Provinces) Act vests land in the district authorities while the occupation and use of land is to be governed by customary (albeit unwritten) laws. The act considers land without and within villages in the following ways:

- unused land outside village boundaries belongs to the district and permission to clear the land is needed from the chief;
- unused land within village boundaries belongs to the village and permission to clear and use it must be given by the village head;
- individuals, compounds or lineages can establish ownership rights to land by the act of clearing land and bringing it under cultivation.[15]

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[15]Weil states that there is a new land tenure law dating from 1975 but not operationalized. Under the law the state claims all land.

In the case of Jahaly Pacharr the land rights were held by the Commonwealth Development Corporation, and by district authority (for Pacharr). The use rights for the land was then given to the national government which in turn gave them to the Planning Management Unit of Jahaly Pacharr, which set the conditions for use of the land.

It is clear that control over what is produced and how it is to be produced will be greater if the land tenure system is changed. One of the fundamental social issues in the shift to irrigated agriculture will be who retains rights and ownership of the land.

The Gambia appears to want the Jahaly Pacharr model of land access to prevail in the new irrigation areas. The belief is that the leverage to control production depends on the state's (or an agency of the state) power to monitor compliance with norms of production. The Department of Agriculture looks to both the resources made available to Jahaly Pacharr and to its control over production as the model for the future. One could anticipate difficulties in this area if land is given to larger commercial farmers (currently called "master farmers") or to state-run irrigated perimeters while those who had been independent cultivators would have to work or rent land from others. Indeed, the land tenure issue was a sticky one at Jahaly Pacharr, one still not fully resolved.

Guinea, in turn, is different than both Senegal and The Gambia. The land tenure situation varies from the large privately owned or government-owned tracts on the plains of Oanamou or Koundara, to the small household-held fields in other parts of the basin. In general, while land is held by kin groups, there is a long tradition of those who own sufficient land, and those who do not. The latter have to borrow land for their fields. The major state intervention in agriculture in recent years was the Fermes d'Arrondissement Agro-Pastorales (known as FAPAs). The FAPAs were given agricultural equipment, seeds, fertilizer, and access to fuel, and were granted land by the regional authorities for their own use and without the compensation being paid to the former owners or users. Naturally the FAPAs tried to obtain the best land. With the closing of most FAPAs, the land has reverted back to its traditional owners.

As population in the basin increases and as good quality agricultural lands become scarcer, the older system of shifting cultivation has given way to longer, or in some cases, permanent use of land. The result of this has been the continuous use by compounds of certain lands, and a shift in tenurial arrangements. The degree of land scarcity varies, being highest in central Gambia and in the upper watershed in Guinea and lowest in Senegal Oriental and the lower watershed in Guinea. Where land is scarcer, there has been a shift toward privatization of land rights. Rights in land that women have (usually not ownership but rights in perpetuity) are those that may be lost in the development of irrigation because most of that land which is cultivated is worked by women. In addition, most of the land that will be lost by the construction of Balingho will be women's rice fields.

3.4.4. General Characteristics of the Farming Systems

Farmers and peasants throughout the basin have felt the effects of deteriorating climatic conditions for more than a decade. While rainfall has been normal in a few years, the overall trend has been a decline in total amount combined with midseason dry spells. The northern basin has been harder hit than the southern portions. Farmers have responded by shifting cropping patterns to early maturing varieties and by reallocating household resources toward multiple objectives, using different strategies (including labor migration) to generate enough income to meet basic needs. The decline in rainfall and increase in population have prompted demographic movements to more permanent water sources and greater reliance on wells. While many villages depend on the Gambia River for drinking water, preference is expressed in both words and actions for alternative sources.

In addition to altered physical conditions, the rural population has had to respond to changes in governmental policies and institutions. Price structures for agricultural inputs have fluctuated, and the overall market prospect for the basin's most important income crop -- groundnuts -- continues to decline.

General cropping patterns consist of staple grains (millet, sorghum, maize, and rice) integrated into groundnut or cotton production. The Guinean portion of the basin relies less on a single cash crop than does the Senegambian portion. Generally, farming systems are in transition to intensive cultivation characterized by decreased fallow times and greater use of animal traction, fertilizers, irrigation, and to a more limited extent, pesticides.

In areas of low land pressure (mainly in far eastern Senegal, parts of the north bank in eastern Gambia, and the middle watershed in Guinea), crop rotations may still include long fallow periods of up to fifteen years. This is the time considered necessary for the rejuvenation of soils in most parts of the basin. In areas of high population density (Sine-Saloum, Kolda Region, most of The Gambia, and the upper watershed in Guinea), fallows are rapidly disappearing or have been reduced to two or three years. Annual rotation between cereals and groundnuts and/or cotton is common in these areas. Possible causes for decreased fallow times and intensified land use have been labor shortages and land pressure. The increasing use of animal traction permits larger areas to be placed in production with less labor, but susceptibility to wind and water erosion has been made dramatically worse by the many years of poor rainfall.

The application of improved but simple technologies is spreading. While manuring is reserved for fields adjacent to or within settlements, fertilizer use is widespread in The Gambia and Senegal, although it is subject to problems of low stocks, late delivery, and lack of peasant resources to purchase. Use of animal traction for plowing millet, sorghum, groundnuts, and cotton is frequent, and has accelerated for seeding and weeding. Most cultivators want traction equipment, but not all can afford it; leasing is common among those who do not own machinery. In The Gambia and Koundara in Guinea, the use of tractors for plowing is not uncommon.

Most improved inputs and farm credit are channeled through government development agencies. Selected and treated seeds for groundnuts, cotton, maize, and rice are distributed through them. (This has not been the case in Guinea.) Peasant reliance on the groundnut seed distribution program is high, and for cotton virtually all inputs in Senegambia are available only from the government agencies. Logistical or administrative agencies therefore have direct effects on almost all rural populations. For example, it has been shown that deficiencies in the quality and quantity of groundnut seed available to peasants, due to poor government storage, have been an important contributing factor in recent production declines.

In Senegambia, producing grains and groundnuts is primarily the domain of men, especially household or compound heads. This is less the case in areas where no swamp rice is grown (either due to lack of land or distance from the river) and women have initiated groundnut production on less fertile land not used by men.[16] In most of the Guinean portion of the basin, women produce important quantities of maize and have their own cereal fields. Grains in Senegambia are most frequently grown on "family" fields (most often the social unit is the compound), which benefit from relatively large amounts of labor depending on the size of the compound. Groundnuts and cotton are typically grown on individual fields, and the harvest is appropriated by the producer, male or female. However, these crops are also grown to generate cash for household expenses, such as taxes, food purchases, and clothing. For fields under the management of the compound head, labor is principally supplied by all compound members according to the gender division of labor. In most of the Guinean portion of the basin, this critical distinction between family and individual fields does not exist. In Senegambia, lowland rice production can be both individual or familial, but until very recently these fields have been worked only by women.

Throughout the basin livestock is an integral part of farming systems. Cattle, sheep, goats, donkeys, and horses are critically important. Animal traction, especially in less hilly areas, has allowed expanded cultivation and increased output for those who either own or borrow animals and equipment. Carts have become important for moving people and crops, to and from fields and for transporting water. Cattle raising was once primarily associated with the Fulbe, but this is no longer the case. All rural peoples, depending on means and availability of pasture (or other feeding resources), try to keep livestock, which for most basin inhabitants is the most important source of investment. Unlike money, it reproduces, and many regard it as a safe source of cash or food. Livestock ownership is quite differentiated, both ecologically

[16]Peter Weil, "Agricultural Intensification and Fertility in The Gambia (West Africa)," in W. Penn Handworker, ed. Culture and Reproduction: Reconstructing the Demographic Paradigm, 1984.

and by wealth. Cattle are preferred, but sheep and goats are most numerous among those without the means to buy and keep cattle and oxen. Horses remain the symbol of past noble or chiefly descent but now have a more mundane role.

The Gambia River remains critical for livestock watering, especially in areas where wells have not been dug or are insufficient for human and animal needs, and where populations travel long distances to seek water and pasture for herds. The in-migration of cattle is limited to the owners of trypano-resistant breeds.

Livestock also is an important source of manure. In Senegambia cattle are staked in fields after harvest and just before field preparation to restore fertility. In the Guinean portion of the basin, manure is used in the women's fields, which are intensively cultivated. The ownership of animals (or exchange relations with herd owners) implies the ability not only to cultivate larger areas but also herds to improve soil fertility in the absence of adequate amounts of chemical fertilizer.

A major source of conflict between herd owners and cultivators is livestock damage to fields and crops. The herd owners often are from the same or neighboring village and do not properly oversee their animals. The causes are multiple: more animals, less pasture, and less available adult labor to oversee herd movements. While no statistics were kept on the frequency of such incidents, the field staff noted many cases. Livestock damage was responsible for substantial crop loss.

Livestock may be sold for numerous reasons; to pay taxes, to buy food, to obtain cash for other purchases, to pay for travel, and to meet ceremonial obligations. People sell livestock to merchants who come to the villages or take them to market themselves. Sheep and goats are often raised with the intention of selling them. Cattle are regarded as a longer-term investment.

The potential consequences of the dams on livestock and herding practices are considered in Chapter 4. Irrigation programs entail the necessity for increased surveillance of herds, and development of alternative water resources and pasturage in areas no longer available to livestock. Thus far, livestock needs apparently have not been integrated into existing irrigation schemes, although animals are critical to the standard of living of many basin inhabitants. Livestock will continue to be a major source of investment. There currently are plans to incorporate them in Jahaly Pacharr.

In addition to agriculture and livestock, there are other important economic activities in the basin. These include essential domestic tasks (obtaining firewood, cooking, drawing water, childcare, building and maintenance of houses, and so forth); fishing, which is of greater importance in the downriver areas; hunting, of greatest importance in the Kekreti zone and Guinea; artisanal activities (blacksmithing, mat making furniture making, and so forth); commerce (both in manufactured items and foodstuffs); charcoal production; brick-making; gathering of wild fruits, palm oil, and wine and their processing into products (of particular importance in Guinea); and labor migration. In terms of labor allocation, agriculture, domestic activity and travel/miscellaneous are the most important on a daily basis. The essential point is that in discussions of available labor for shifts from rainfed and tidal agriculture to irrigated farming, agricultural activities are not the only ones to be considered. It is difficult to underestimate the importance (from the peasants' perspective) of nonagricultural sources of income, even if these do not constitute a high percentage of the total. In order to sustain existence, many households achieve a delicate balance through the multiple strategy approach.

The overall food situation in all three riparian nations has been deteriorating for two reasons: the inability of peasants to sell adequate amounts of food to urban consumers, and their decreased capacity to sustain household needs through their own production. Peasants must meet household food needs and obtain monetary income; the fact that many in the basin have not been able to do so has intensified labor migration. If peasants become dependent on the market (through commercialization of crops), there is a risk of decreasing the household's means for sustaining its survival; yet, enabling peasants to meet household and rural food needs will impede production for regional and national markets. The key is to balance the two without creating great risks for peasant households. The goals of improving subsistence crops, maintaining cash crop production (either cotton or groundnuts), and developing rice as a food and cash crop will pose a significant challenge for rural development well into the next century.

The rural exodus clearly demonstrates the lack of income opportunities and of schools, health facilities, and other services that rural populations seek. Development in the Gambia River Basin involves much more than improving income for agricultural producers. From a larger perspective, the situation mirrors the crisis in much of West Africa, except that the waters of the Gambia River provide the material possibility for a longer term resolution.

3.5. Farming Systems in Guinea

The Guinean portion of the basin is characterized by higher altitudes and more rainfall than is most of the Senegambian area. As already mentioned, the river itself is different -- swifter flowing -- and the terrain has fewer flat surfaces and in many areas is quite rocky. The agrarian crisis is the same here, but the farming systems are distinct from Senegambia, including reliance on different types of crops and a different system of production. In what follows, research results are presented by prefecture (region): Koundara, Mali, Koubia (see Table 3.9) and Labé. At times it is useful to contrast Koundara with the rest of the basin.

3.5.1. Cropping Patterns and Principal Crops

In general there are two types of cultivation: shifting cultivation, based on fields outside the villages; and permanent cultivation in close proximity to the compounds (called <u>sunture</u>). Agricultural production is divided between these two (with the exception of the Cognagui villages). On <u>sunture</u> land the principal crops are maize, cocoyams (taro), sweet potatoes, yams, and manioc. Outside the <u>sunture</u> the principal crops are fonio rice, groundnuts, millet, and sorghum. A major difference in the relative importance of field crops is found between Koundara and the rest of the basin. In the prefectures of Labé, Koubia, and Mali, fonio is grown on 95 percent of the fields,[17] groundnuts on 37 percent, rice on

[17]Figures for specific crops reflect an upward bias due to multiple cropping on many fields. They do, however, give an idea of relative importance.

TABLE 3.9.

POPULATION DENSITY OF THE VILLAGES
IN THE GAMBIA RIVER BASIN

Area	Village	Sous-Prefecture	Prefecture	Pop/ Km^2	Ethnic Group
I. Upper Watershed					
	Hoore Dima	Dalen	Labé	55-60	Fulbe
	Telire	Sannou	Labé	"	Fulbe
	Kinsi-Kimpa	Pilimini	Koubia	"	Fulbe
II. Middle Watershed					
	Nianou	Matakau	Koubia	30-35	Fulbe
	Souma	Matakau	Koubia	"	Diakhanke
	Simily	Fafaya	Koubia	25-30	Fulbe
	Liti Dian Boye	Dongol-Sigon	Mali	25-30	Fulbe
	Mayadine	Dongol-Sigon	Mali	"	Diallonke
	Fettore	Dongol-Sigon	Mali	"	Fulbe
III. Kouloountou Basin					
	Tabadel	Kamaby	Koundara	20	Fulbe
	Oudaba	Sambailo	Koundara	"	Fulbe
	Ithiou	Youkounkoun	Koundara	"	Cognagui

University of Michigan, Gambia River Basin Studies, 1985.

19 percent and sorghum on 8 percent. Millet is generally not cultivated except in Koundara, where there is a much more even mix than elsewhere among fonio, groundnuts, millet and sorghum. Each is cultivated in the range of 10-14 percent of total field area, and rice on approximately 60 percent of the fields.[18]

[18]The variation between villages within zones can be great. For example, in Koundara the village of Tabadel grows large amounts of rice and little fonio, while the village of Ithiou grows small amounts of rice and some fonio. Such extremes are less common in the other zones.

Little agronomic research is available on fonio despite its importance as a food staple in Guinea (in the entire Fouta area and parts of upper Guinea, not just the basin). Since it thrives on relatively poor soils, it apparently is grown where other crops cannot be grown.

Differences between Koundara and the rest of the basin also show up in cropping patterns. In Koundara 94 percent of the crops are in single stand fields. In the other areas only 57 percent of the field area involves single stand crops, fonio being by far the most important.[19] On multiple crop fields, parcels generally are devoted to different crops and most frequently include fonio on one of them. The only other significant crop association is rice and sorghum, but even these are often grown on fields that include parcels of fonio. Further study is needed to determine the extent to which multiple cropping is part of a risk-minimizing strategy in the face of labor and land shortages, or a function of the relatively specialized purposes of field crops other than fonio (for example, peanuts for sauces or rice for ceremonial purposes) outside Koundara.

Sunture fields constituted 18 percent of the total land under cultivation in 1984. These are worked by women, who at marriage receive a sunture adjacent to their home. Manuring and extensive mulching enable these permanent fields to be intensively cultivated and highly productive. Among 142 women surveyed, 78 percent claimed that their food production for consumption from the sunture was more important for household provisioning than the food from the other fields. The sunture are typically multicropped, the patterns varying with area and ethnicity. In general, maize is intercropped with a variety of roots -- taro where rainfall permits, manioc (less important than before because of disease), sweet potatoes, and yams -- plus other condiments and vegetables. Taro is more important in Labé than elsewhere because it requires substantial rainfall and relatively lighter, well-aerated and more humid soils than found in Koubia and Mali. (Taro is not grown at all in Koundara.)

[19]Groundnuts are the only other crop grown as single stand, but this accounts for only ten percent of all groundnut fields.

The sunture is well fenced against livestock. Fruit trees -- mangoes, papayas, oranges, and sometimes bananas -- are also cultivated within the sunture. The importance of root crops and fruits gives a different cast to the farming systems in the upper basin as opposed to elsewhere.

3.5.2. Planting Cycle and Seasonality

Taro is the first crop to be planted (in April and May) followed by corn, fonio, millet, sorghum, rice, and groundnuts. There is some regional variation in the combination of crops cultivated. Fonio is generally planted after the sunture, in late June to late July, followed by groundnuts and rice. Where taro is successfully grown, it can be harvested from October through March. Different crops are staples at different times: maize during the hungry season, replaced by fonio, rice, and other grains as they are harvested. Taro is often the staple during the late dry season and early rainy season.

The sunture is mulched after the planting of fonio and other field crops. Weeding is then carried out in the fields. Maize is the first crop harvested (in August and September). Fonio is harvested from October to late November, depending on the variety. The consumption period for fonio, or duration of fonio stocks, is related, of course, to the amount of land cultivated by a household and to field fertility, which is dependent on fallow time. This may account for the situation in Labé, where data for the 1981-1983 harvests indicate lower fonio yields than in the rest of the basin. In Labé the fallow period has either disappeared or been reduced to only two or three years, compared to seven or more years elsewhere, due to population density and land pressure.

3.5.3. Land Holdings

The Guinean portion of the basin is characterized by the absence of communal fields. While depending heavily on family and hired labor inputs, most fields are identified with an individual who controls the harvest and generally makes agricultural decisions.

The average amount of land per cultivator throughout the basin is 0.67 hectares. Only in the Koundara zone was the average more than one hectare, which cannot be attributed solely to the use of mechanized agriculture. In Tabadel and Ithiou (the latter village not engaged in mechanized agriculture) average holdings were 1.1 hectares. In the Labé and Koubia zones, the average was 0.53 hectares; in no villages, even in the less densely populated region of Koubia, did the figure exceed 0.6 hectares. Among villages studied in the Mali zone, the average was 0.62 hectares, but the sample size was too small to determine whether Mali actually has higher average holdings than the Labé-Koubia zone.

There are real differences in the sex distribution of land. While the total area cultivated by men and by women in Labé, Koubia, and Mali is roughly equal, the ratio of men's to women's holdings ranges from 1:4 in Mali to 3:1 in Koubia. The ratio for the entire Mali-Koubia zone is 2:3. Koundara is a special case: the ratio of men's to women's holdings is 1.1 in the village of Ithiou but 11.5 in Tabadel. The fact that men hold more land than women does not mean they produce more for household subsistence or are more important cultivators; the differences reflect the greater area of men's fields outside the village compared to women's sunture.

3.5.4. Division of Labor

As in most societies in the basin, there is a strong gender division of labor in the Guinean portion. In addition, the sunture mean that an extremely important dimension of agricultural production rests almost entirely in women's hands.[20] On fields away from the village, Table 3.10 gives figures for the total areas cultivated by men and by women and for the percentage of the total for which each accounts.

With the exception of Koundara, the overall importance of fonio in the basin is reflected in the fact that more than 90 percent of both men's and women's fields are planted in that grain. Groundnuts and rice are more important to men's than to women's field production. Groundnuts are cultivated on 24 percent of women's fields and on 47 percent of men's fields, where 76 percent of all groundnut cultivation takes place. Almost 90 percent of the field area for rice is cultivated by men.

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[20] Men worked on 4 percent of the sunture in Labé, 17 percent in Koubia, 9 percent in Labé, and 20 percent in Koundara.

TABLE 3.10.

FIELDS IN THE GUINEAN BASIN[a]

		Men	Women
Labé	Area Percent	193,278 49%	166,426 42%
Koubia	Area Percent	238,538 80%	49,571 17%
Mali	Area Percent	203,208 53%	181,592 47%
Koundara	Area Percent	507,686 80%	123,903 20%

NOTE: a) Percentages do not sum to 100 in Labé-Koubia because of fields tended by both sexes and by children.

University of Michigan, Gambia River Basin Studies, 1985.

In Koundara, the division of field crop production between the sexes is even more strongly pronounced: 94 percent of the field area of fonio cultivation takes place on women's fields; rice is cultivated exclusively on men's fields; and more than 95 percent of the field area devoted to millet and sorghum is cultivated by men. The only crop important to both is groundnuts, 60 percent of the field area cultivated by women and 40 percent by men. These figures do not refer to the actual work performed by men and women but to land holdings, that is the principal cultivator. Women work far more on men's land than men do on the sunture. There are also certain sex-related tasks: clearing and burning are performed by men, women do a greater share of the weeding, and men are responsible for building and maintaining fences around outlying fields and the sunture.

While the diversity of production constitutes an important part of agriculture in Guinea, the above figures show that men and women participate in different ways. Women's field crop production tends to be specialized in fonio and, to a somewhat lesser extent, groundnuts. Men's field crop production tends to be more diverse, especially in the regions of Labé, Koubia and Mali. No less important to diversity are the maize, roots, and other foodstuffs cultivated on the sunture, where women play by far the dominant role.[21]

3.5.5. Technology

Agriculture in the Guinean area of the basin is characterized by three general types of technology: mechanized production, animal traction, and the exclusive use of hand tools. While our study of 472 compounds throughout he basin indicates that 35 percent use plows, this figure masks differences in technique among zones. What use there is of plows is restricted to Labé and Koundara; animal traction predominates in the former, and a mix of mechanized production and animal traction in the latter. No tractors were used except in Tabadel. Two-thirds of the compounds in Labé use plows; in Koundara 85 percent use either tractors or animal-drawn implements. This compares with only 3 percent in Mali and 4 percent in Koubia.

The zonal differences in the use of traction cannot be accounted for solely on the basis of terrain. In Koubia, 82 percent of the fields in the survey under cultivation had slopes of 5 percent or less, and none in the sample had a slope of more than 10 percent. In Mali 44 percent of the fields had slopes of 10 percent or less, with 35 percent of all fields in the 1-5 percent range. The Koundara region is significantly flatter than the rest of the basin, which makes traction practical there, but only 35 percent of the fields in Labé (another zone of high plow use) had slopes of 5 percent or less, and roughly the same percentage had slopes of more than 10 percent. Although the significance of the hilly and often mountainous terrain of the Fouta cannot be ignored, the above figures suggest there may be more potential for animal traction in the basin than is commonly thought.

[21]A more thorough understanding of relative contributions requires an analysis of the labor studies to determine the allocation of male and female labor on the different fields. It would also require studies of the disposal of different crops by each sex: household consumption, ceremonial obligations, and market transactions.

3.5.6. Livestock

While the Guinean portion of the basin is reputed to be the home of vast livestock herds, this is much less the case now than before. The Fulbe of the Fouta have been sedentary since the middle of the 19th century; the Diakhanke, Diallonke, and Coniagui have always been so. The reasons for decline include: increased population and therefore land pressure with consequent loss of good pasture; the higher prices and, more important, hard currency found in neighboring nations; taxation policies; and the marketing of animals at official government prices, which discourage the raising of livestock.

In general, the integration between herding and agriculture, and the use of animals in agriculture is highest in the Guinean portion of the basin. Livestock are important in four principal ways (and other less important ones):

i) providing manure for the maintenance of sunture fertility;

ii) yielding milk and meat;

iii) generating income through the sale of milk, meat, and the animal itself;

iv) serving as a source of investment.

While several individuals surveyed apparently want large herds just for themselves, the overall trend is away from the keeping of herds for social prestige and power.

Livestock sales, primarily of small ruminants, were cited by nearly all those surveyed as the major means by which households can obtain cash. Livestock was also cited as the principal item in which heads of households were likely to invest any extra income. The division of labor extended to livestock as well. Women did the milking and often took cattle to and from pasture, as did men. Children were often assigned the responsibility of guarding the herds.

Although economically not as important as agriculture, livestock limits the agricultural system. Both the fields and sunture are protectively fenced, which involves large amounts of labor for construction and maintenance. Villages, or at least large kin groups, often decide on mutual cultivation in order to ensure labor to fence the fields. Furthermore, sunture fertility depends on adequate manure (as well as mulching and kitchen refuse). Manure has become more difficult to obtain, and many women gather it in the pastures if the household owns no cattle.

3.5.7. Nonagricultural Activities

As is true throughout the basin, agriculture does not provide enough income to satisfy the needs of inhabitants. An alternative is artisanal activities -- house construction and maintenance, clothing, jewelry, mats, bowls and so forth -- which provide for domestic consumption as well as income. Skilled artisans make tools, doors, furniture, and sandals to sell in the village and often attend weekly markets to receive orders or perform their craft. In addition, petty commerce is ubiquitous. Every village has its small merchants, who sell kola, cigarettes, and kerosene, as well as larger ones who bring goods to market. There are also specialized activities in a few zones. In Koubia, woodcutters fell trees and prepare large planks to be sold to Labé merchants. Many women buy unhulled fonio to pound at home and resell at market. In the less densely populated areas, hunting and gathering are very important. (Hunting is discussed in Terrestrial Ecology and Gambia River Basin Development.) The range of items collected includes shea butter (used as a cooking oil), materials for soap, palm wine, bamboo for mats, roofs, and so forth, and indigo (both for local consumption and for sale). As important as these activities may be, labor migration constitutes the most important means for achieving income objectives.

In sum, while the people of the basin make the most of existing opportunities, they are being overwhelmed by land pressure, on the one hand, and by competition with imported products, on the other. (A side-benefit of Guinea's former strict import policies was to force self-reliance on the part of its rural populations.)

3.6. Marketing of Foodgrains

Markets and marketplaces are central to the shift from extensive to intensive agricultural systems. Without an adequate marketing infrastructure, there will be substantial difficulties in the movement of commodities from urban areas to rural areas and vice-versa. In addition, current marketing patterns reflect current standards of living, ability of rural populations to purchase commodities, the flow of food to the cities, and nonagricultural activities as well. In this section, the focus has been restricted to the marketing of foodgrains since irrigation development forms the centerpiece of OMVG's developmental strategy. A relatively brief analysis is provided of how such markets currently function to indicate areas of strength in current performance and areas of weakness. For the case of Guinea, transport costs are discussed since the poor transport system has been a focus of attention. The transport costs however, are not as directly related to distance as one would expect.

3.6.1. The Role of Markets in The Gambia and Senegal

The private trade sectors in The Gambia and Senegal share many of the same characteristics. Foremost amongst these are the relatively limited role of private traders in the distribution of locally produced rice, the emphasis on retailing imported consumer goods, and the almost complete absence of any role in agricultural input markets. On the other hand, there are significant differences in price and import policies between the two countries.

In central and eastern Gambia, and in the adjacent Senegalese areas, there is an active cross-border retail trade. Many Gambian traders specialize in the reexport of consumer merchandise and imported rice to Senegal and Guinea-Bissau. This is possible because of The Gambia's liberal import regime, low import duties, and practically nonexisting border controls. The wholesale trade in The Gambia (especially in Basse and Bansang) is to a large extent, focused on the border trade with Senegalese merchants.

Part of the irrigation expansion zone does not have nearby daily or weekly markets. This is especially true on the north bank of the Gambia river from Georgetown to the border. The areas along the Sandougou bolon, on the south bank of the river between Basse and Fatoto, and in Senegal between the border and Gouloumbou do not have permanent daily markets. In these areas, rural weekly markets (lumos) are utilized.

Many are seasonal in nature, functioning between November and May, when farmers have cash from groundnuts to spend on consumer goods or small quantities of local produce to sell. The seasonality of the lumos reflects three characteristics of rural trade. First, the lack of disposible income of rural producers most of the year, and second, the part-time involvement of most rural traders, and third more difficult access during the rainy season. In The Gambia a number of government-built marketing facilities, many located in the irrigation expansion zone, are not being used to full capacity.

3.6.1.1. Rice marketing systems. The Gambian government has entrusted the Gambia Produce Marketing Board (GPMB) with control of all facets of interregional marketing of paddy and rice. GPMB purchases paddy from farmers through licensed buying agents (LBAs), including private traders and large farmers who bulk from several producers, or through crop produce marketing societies (CPMS). The latter are organized by local associations of the Gambian Cooperative Union (GCU). All groups make cash purchases on behalf of GPMB, then deliver paddy to GPMB depots.

The volume purchased by the CPMS has declined in recent years. They often lack storage and transportation facilities and have lost out to private traders concentrated near irrigated perimeters where large amounts are for sale. Private traders have dramatically increased their share of the market to the point where they bought nearly 100% of marketed paddy in 1982/83 (LRDC, 1983).

From GPMB depots, paddy is transported to the GPMB rice mill at Kuntaur. Milling capacity is 20,000 mt/yr. Presently, transport from the depots to the mill is a major problem. The mill operates at about 20% of capacity, which dramatically increases the fixed costs per unit of paddy milled. There is also a shortage of storage capacity at the mill itself. An FAO mission has recommended the complete replacement of the mill facility at Kuntaur and increased storage infrastructure (FAO, 1984).

The Gambian government controls prices; it sets maximum prices for paddy and rice at the producer, primary wholesale, secondary wholesale and retail levels. In the process the government has also set wholesale and retail margins. Imported and domestic rice are sold at the same price, irrespective of quality differences. This discourages the movement of domestic paddy into urban areas and any attempt to differentiate the quality of marketed rice.

Marketing paddy in "parallel" markets does occur, but to a very limited extent. Data collected in the IVS villages reveal that rice is considered a major subsistence crop, the bulk of which is consumed on-farm. Of seven IVS rice-producing villages only four had significant outflows of paddy outside the household. Of these outflows only 20-25% of total transactions represented market sales, the remainder being gifts, exchanges for other foods, or payment of production debts. Practically all farmer cash transactions were in the village to other households (70-90%) and in very small quantities.

Most private paddy purchases in The Gambia are simply from producer directly to consumer. When traders do participate they usually handle only milled rice because of the difficulty of reselling paddy on the private market. Resale of milled rice takes place in the same general area in which it was purchased.

Sales of Gambian rice take place in Senegalese weekly markets along the northeastern border. These are small-scale sales with producers transporting their own paddy to market. There are frequent exchanges of paddy all along the frontier between producers who have family ties. The flow is mostly from The Gambia into Senegal.

The major role currently played by private traders in the rice sector is that of purchasing agents for GPMB. The Government of The Gambia is now encouraging more entry of private traders by offering start-up credits and increasing the number of licenses to purchase paddy. The private sector can market rice in a localized area for less than the cost incurred by GPMB, provided small hulling machines are available at the local level.

After evaluating public sector marketing costs, the FAO concluded that an increase in the domestic rice supply as a result of increased irrigation will cause bottlenecks in the public system and negate the effect of increased productivity: "The system as it operates today may not be able to handle the additional quantities projected, or do it at ever-escalating costs which will make the ultimate price of (domestic) rice to consumers prohibitive" (FAO, 1983. Vol. 2, p. 164). The implication is that the private sector can do it more efficiently and less expensively.

The government's role in rice marketing in Senegal Oriental is somewhat more centralized. SODEFITEX has a legal monopoly over all wholesale marketing of paddy produced under its sponsorship and purchases paddy at official prices set by the government. There are no licensed buying agents and no quality control program has been established.

Output from the irrigated perimeters has been primarily consumed by rural producers or has gone for repayment of production credits. In 1984 farmers offered to sell additional paddy for the first time but SODEFITEX was unwilling to buy.

Theoretically SODEFITEX transports paddy to its rice mill in Kedougou, 260 km from Tambacounda, then delivers milled rice to the Caisse de Péréquation et de Stabilisation des Prix (CPSP) in Kedougou. The CPSP has sole authority to wholesale rice, both locally produced and imported, to a limited number of licensed retailers. Since the mill began operations in 1980, only 2,000 mt of paddy have been milled and transferred to the CPSP. (The capacity of the mill is 10,000 mt/yr.) All milled rice has been sold in Kedougou. The system suffers from many inefficiencies, most related to the high costs of transport and milling. Transport and milling costs are estimated to amount to 47% of the delivered price.

Like the Government of The Gambia, the Government of Senegal controls prices of paddy and rice at the producer, wholesale and retail levels. Retail prices are set lower in Tambacounda than in Kedougou, but imports and domestically produced rice are sold at the same price.

Private marketing of rice has always been limited in the region, even before the introduction of pump irrigation. Very little paddy from irrigated perimeters is marketed through the private trade sector because relatively small amounts are left to producers after production costs have been met. In years where rainfed cereal production is adequate for family needs, producers are apt to market some paddy via local traders. In years of shortfalls they will only sell to other farmers after making debt repayments.

Some advance sales to private traders take place at prices far below the official level. Halfway through the growing season, part of the paddy crop will be sold for 30-50 FCFA/kg by farmers who have urgent cash needs.

Private market prices for paddy at harvest ranged between 52 and 58 FCFA/kg in 1984. Farmers who wait until the rainy season to sell get 60-75 FCFA/kg. Despite increases in local production, large quantities of imported rice are still sold. In the short- to medium-term, both farmers and traders believe that market expansion will be limited to areas adjacent to the perimeters and to Tambacounda.

Although producer prices have been increased over the last few years, they have had a negligible effect on the amounts of paddy offered for sale. There are basically two reasons: increasing costs of production due to diminuation of input subsidies, and the lack of a market for large quantities of paddy other than SODEFITEX. With the high cost of production and increasing prices for imported rice (as much as 145-150 FCFA/kg in some producing villages in 1984), farmers find it is more advantageous to hold paddy for home consumption than to sell it.

The lack of rice hulling facilities is a possible constraint to increased marketing. Private traders have expressed little interest in entering the paddy market until milling equipment to handle larger quantities becomes available.

3.6.1.2. Marketing systems for millet, sorghum, and maize. In The Gambia coarse cereals, or coos, are traded entirely under free market conditions, while in Senegal the government maintains a regulatory role.

As is the case for paddy, little is known in detail of the coarse cereal trade on parallel markets in Senegal Oriental. Producers can market their cereals through public channels, which vary by crop. Farmers will market maize for instance, through SODEFITEX, but will sell millet and sorghum through producer cooperative societies which have received input credits from SONAR. Private systems handle cereal crops as well since there is no formal government monopoly for either local or long distance trading.

Since 1981 private traders have been allowed to participate in the wholesale and retail marketing of all cereal grains. However, their participation is still limited by government regulations which encompass control over storage of large quantities of grain; setting official producer, wholesale, and retail prices; licensing traders; and maintaining a system of quotas for cereals purchased from government sources.

In years of low rainfall and limited production producers will keep most sorghum, millet and maize for home consumption. The little they may sell goes to the private market to avoid having to repay input credits. Farmers may market a portion of their production through another cooperative member who has repaid his own debt.

SODEFITEX serves as the official market outlet for maize, mainly for the purpose of collecting debts. However, it has not purchased any maize since the 1981/82 harvest and then only about 2,000 tons. In the past few years farmers have marketed only small quantities of maize.

Farmer decisions to market very little sorghum, millet or maize in a drought year are reflected in the data collected from the IVS villages. Of total market transactions (farmer sales), nearly all (90-100%) took place in the same village with other households. Maize and sorghum were the crops most frequently sold. Nearly all sales took place in Adiaff and Sankagne. Nothing was sold from the Medina villages, and in Pakeba only 5% of total maize transactions were recorded as sales. No early or late millet was sold in any of the villages.

With a decrease in marketed surpluses, the role of the private market has changed considerably. Pre-drought marketing systems were very active and widespread. Traders at secondary marketing points (Mereto, N'Doga Boubacar, Nèteboulou, Missira, and Gouloumbou) would finance grain purchases or buy directly from village intermediaries (mostly producers) who would make small purchases, bulk them, and wait for traders to furnish transport. Sometimes traders in secondary markets would themselves be financed by larger merchants located in Dakar or Kaolack.

From the village, local traders would transport cereals either to secondary marketing points or to primary market outlets (Tambacounda, Goudiry, Sinthiou Maleme, Koussanar, or Koumpentoum). Here, supplies were again bulked for sale later in the year, or more frequently purchased by traders coming from Dakar or Kaolack. This "traditional" marketing system remains intact in areas where production is still sufficient to warrant it. However, its reappearance is very irregular because of the extreme unreliability of surpluses from one year to the next.

The parallel system as it exists today is generally characterized by farmer sales of small quantities of grains in surrounding villages or weekly markets. Maize is marketed before sorghum and millet because it is the first crop harvested. Sorghum and millet are marketed next, but only in the event that there are immediate cash expenses that need to be met and providing that there is enough set aside for family consumption through the dry season. The outlook for the groundnut crop, the prices offered, and the amount of on-farm storage are equally important determinants of how much producers are willing to sell.

Aside from current low production levels, producers indicated that a number of constraints influence their marketing behavior. These constraints include lack of transport, transport costs, lack of market outlets, inadequate on-farm storage, too much price instability and limited capacity of private traders to purchase large quantities in good production years.

In years of adequate production, demand in rural areas is limited because the primary clientele, other farmers, are also producers. In the absence of a reliable official market outlet, producers turn to private traders. By doing so they readily accept prices lower than those set by the Senegalese government. However, traders are in turn constrained from purchasing large quantities because of official regulations disallowing storage of such quantities.

In normal production years producers try to hold on to some of their production to take advantage of higher private market prices later in the year. However, farmers stated that cereals could be stored on-farm for only 4-6 months after harvest because of pests, moisture and mold. Consequently, in years in which surpluses are available, they are forced to sell early. Private market prices for millet and sorghum range between 40-50 FCFA/kg just after harvest to 100-110 FCFA/kg during the rainy season.

The trade season has become more limited and intense, beginning in October or November and lasting only through the end of December. Part of this seasonal contraction is due to trader strategies to maintain a quick turnover and avoid the need for storage permits. Many traders in the smaller weekly markets have not renewed or even sought storage permits because of the small and irregular amounts sold by producers.

Village-based traders no longer go to into surrounding rural areas villages to make purchases, nor do they finance intermediaries to make purchases for them. Traders in the larger market towns (Goudiry, N'Doga Boubacar, Mereto, and Koumpentoum) continue to do some speculating and hire intermediaries to purchase and bulk cereals right after harvest. These market towns continue to serve as secondary bulking centers, albeit with less overall activity. By employing intermediaries, the trader purchases only small quantities at any one time and therefore avoids the need to obtain a storage permit. Even the larger traders, however, are abandoning this speculative, high-risk, high-cost trade.

With increased production of irrigated cereals, traders foresee resulting benefits and constraints. On the benefits side, the trading season would last longer, there would be more entry into the market, transport costs would be lower, and prices would be more stable. Secondary benefits would include increased grain storage and an increase in producer income and purchasing power.

Constraints include the bad state of road infrastructure in the development zones, lack of storage capacity, limited means to process cereals for urban markets, and current government regulations affecting the cereals trade.

If maize is to be extensively irrigated and surpluses generated above on-farm consumption needs, the lack of shelling equipment will prove to be the first major bottleneck. Traders themselves indicated that if such equipment were not available, either to themselves or to producers, they would be hard-pressed to find any markets in which they could sell, and hence would avoid trading in it.

The Gambia is somewhat unique in West Africa in that it is one of the few countries in which there is no government control or regulation of the millet, sorghum, or maize trade. Marketing systems are essentially run by private traders. There are no enforced official floor prices at the producer, wholesale, or retail levels except an official producer price for maize offered by GPMB. However, the GPMB's price is so far below the free market price that little or no supplies are reported to go through this channel.

Gambian producers are estimated to market off-farm roughly 10% of total yearly production (FAO/UNDP, 1981). In years of mediocre production, most transactions take place either in or very near the producing village. According to the IVS survey data, nearly all early and late millet, sorghum and maize (90-100%) transactions were in the form of gifts between households in or adjacent to the producing village. The survey data also revealed that very few sales took place in market towns, roughly 2-3%. These findings are consistent with other investigations and confirm that producer sales represent a small proportion of total crop disposal patterns and that most sales take place within the immediate vicinity of the village. However, the data do not confirm that farmer-trader transactions take place in weekly markets (lumos), although most of the survey villages were in very close proximity to either weekly or permanent markets.

An exception to this generalization was the survey village of Bati N'dar where practically all coarse cereal sales transactions took place with the village retailer. The percentage of transactions varied by crop: for early millet, 94% of producer sales were to the retailer, 80% for late millet, and 91% for maize. The village retailer and farmers basically barter small quantities of grain for onions, tomato paste, or other condiments. Once the retailer has collected a few bags of grain he goes to the nearest market and sells to another local trader. This barter system is one means by which a village trader has overcome the problem of financing grain purchases.

The vast majority of sales are immediately following harvest. Even though prices are lower, very few farmers have adequate means to store large quantities to wait for higher prices later in the year. Some Gambian villages have reported storage losses of up to 30% due to rodents, insects, and mold.

Millets and sorghums are sold in threshed, unhulled form or occasionally in a cluster of heads (pakanko). Maize is sold either in tassles of 4-6 ears (tokals) or fresh unripened form. Rural and nearby urban consumers put a premium on fresh maize because it is the first crop marketed and is strongly preferred grilled. Fresh maize sales are direct from producers to women retailers who grill the maize and sell it.

Despite the small quantities marketed, there is an active private trade sector which supplies the major consumption center: Banjul and its suburbs. The same traders also participate in the cross-border trade with Senegal.

There are two ways by which grains make their way from rural to urban areas. First, producers will sell directly to a village trader who carries out a bulking function for resale in a nearby town. Traders like these buy and sell very rapidly to avoid storage losses and costs. Second, traders from outside the village may come to buy cereals by prearrangement, transport them to nearby weekly markets, and resell to other traders. Many of these traders act as buying agents for the larger wholesale houses in the Banjul area and serve as outlets for imported consumer goods.

The Banjul-Kombo area market receives most of its grains through wholesalers who have sponsored buying agents in the field and have storage facilities in the major towns. Some is also brought in by individual retailers who have bulked grains in the rural areas themselves. The urban wholesalers serve an assembly and distribution function, but the number will vary according to the season and from one year to the next depending on production levels. According to one source there are about 3 large traders in the Banjul area with numerous others that operate on a smaller scale (FAO, 1983). One large wholesaler indicated that he had about 50 purchasing agents in rural areas, most of whom also served as retailers of consumer goods he furnished. It is interesting to note that this is almost the exact system which existed in Senegal Oriental before production levels fell and before government intervention was instituted.

In urban areas, <u>coos</u> compete with rice. The competition is most extreme at postharvest, but as prices steadily rise for millet, sorghum and maize, most urban dwellers switch to imported rice. Consumption in both rural and urban areas is inhibited not only by inadequate supply and high prices, but also by the difficulty in processing and conserving <u>coos</u>.

3.6.2. The Role of Markets in Guinea

This discussion is based mainly on work done after the death of President Touré. Most of the patterns described seem to have been in existence during the latter years of his regime. Although there were efforts to set official national market prices and establish stores for the distribution of basic commodities, apparently these steps were unsuccessful. The provision of essential agricultural inputs to small producers was never a priority in this zone. Even at the FAPAs, days and weeks were lost while attempting to obtain fuel or tires for tractors.

The marketing system in the Guinean portion of the basin consists of trade networks that provide varying degrees of local, regional, national, and international integration. The central market in this system is Labé, which dominates international trade channels and only to a somewhat lesser extent, the national, regional, and local channels. The system also has a number of secondary urban markets such as Koundara, Mali, and large rural markets, such as Matakau (in the region of Koubia). Surrounding these are local rural markets which, despite the sometimes low frequency of transactions, small quantities purchased or sold are crucial to the economic survival of the overwhelming majority of people in the basin.

Grains and roots produced in the upper basin are marketed in local weekly markets for local consumption, or purchased by smaller or larger traders for resale in urban areas, principally but not exclusively, Labé. The most important grain to be marketed is fonio. In Koundara, the most important grain sold is rice. The most important root has been manioc. In addition, fruits, particularly oranges, are also sold. Overall, the marketing of food crops is an important source of income for those who remain on the land. While the volume and income earned are low compared to other portions of the basin, nonetheless it is essential for maintaining current standards of living.

Most of the sellers in the local markets are village producers, but almost all markets are frequented by merchants from Labé and/or one of the secondary centers. These outsiders are predominantly petty traders who also are involved in the retail or wholesale trade in the central or secondary markets, but there is a smaller number of medium-scale merchants who work independently or on commission for wholesale merchants in Labé. One-way trade is not the major characteristic of local markets, but it is more likely to occur with medium-size merchants than with petty traders. Although access to local markets is severely constrained by the poor quality of the roads, significant numbers are serviced by trucks belonging to independent transporters or merchants in Labé, Koundara, and more rarely, Senegal. Many goods imported from Senegal pass through Koundara on their way to Labé before returning to Koundara itself and the surrounding markets.

Of the secondary urban markets in the Guinean portion of the basin, Koundara is most extensively developed. It is the only one that operates daily. (Labé has the largest daily market, but it is technically outside the basin.) Unlike other rural (Matakau) and urban (Mali) large weekly markets, Koundara has its own vehicular fleet that services all the local markets in the region. Labé merchants are very active in the wholesale trade to Koundara but they do not generally participate in the local markets. Distribution networks around Mali and Koubia are serviced almost entirely by Labé. Some of the rural markets specialize in particular commodities, such as livestock in the Matakau markets. They serve as rural bulking markets linking them to urban markets, but not to other rural markets.

The influence of Labé in national and international trade channels is quite pronounced. Only the links connecting Koundara directly to Gaoual, Boke, and Conakry are not controlled by Labé merchants. In international trade, the role of Koundara merchants (even along the Senegalese trade route) is minor. Larger-scale merchants tend to be a major force in these channels, but medium-scale and even small-scale merchants play an important role in terms of the wholesale and retail trade networks in Labé.

3.6.2.1. Transport costs. There is considerable variation in the system of transport costs in the Guinean portion of the basin. This variation is conditioned not only by differences in the quality of roads (which are expensive to construct, difficult to maintain and currently in very poor condition) but also by the structure of the different marketing networks. The cost of transporting a 100 kg sack of grain, for example, ranges from 2.7 sylis to 7.7 sylis per kilometer. The largest variation is found in the short-distance trade routes between central or secondary markets and their surrounding local markets. Long-distance charges show less variation and remain generally lower than the 7.8 syli average of the markets surveyed.

In spite of the lower per kilometer charges on long-distance trade routes, total transport charges still increase with distance traveled. At the same time, differences in total transport charges are not entirely reflected in retail prices. A survey of prices in eight markets throughout the basin showed that variations in retail prices across markets were more closely correlated with weekly fluctuations in the number of buyers and sellers than with distance from Labé and/or Koundara. This would suggest that transport costs contribute more to differential profit margins in different markets and commodities than they do to price differences across markets.

The structure of marketing channels in the basin also plays an important role in the system of transport costs. Due to economies of scale, larger merchants are able to operate at lower average costs than petty traders. More importantly, the ratio of unit transport costs as a percent of purchase price for petty traders to those for large scale merchants increases directly with distance. While large-scale merchant costs can add up to 10 percent to the purchase price of agricultural commodities on short-distance routes, 25 percent on long-distance routes, and 25 percent or more on international routes, costs for petty traders add only 13 percent on short-distance routes but 50 percent or more on long-distance and international routes. The result is that the profit margin differentials between large-scale and small-scale merchants are considerably less along short-distance trade routes than along long-distance and international routes. While this has not resulted in the total exclusion of petty traders in the long-distance and international trade networks, their number is sharply reduced by the fact that for many commodities, it is cheaper to purchase in Labé than to travel long distance to procure those goods on their own.

The greater number of merchants in short-distance trade routes has helped create more competitive market conditions in the weekly markets. At the same time, the system of transport costs makes the potential for market control more clearly pronounced in the long distance and international trade routes.

4. DAM IMPACT ANALYSIS OF THE GAMBIA RIVER BASIN

Dam construction will change the face of the Gambia River Basin. In this chapter the potential impacts of the different dams and some strategies for mitigating their adverse consequences are considered. The emphasis is on the perspective of the populations in the area, who can appreciate the larger national concerns necessitating the dams but nonetheless will not be the primary beneficiaries of irrigation nor will most of them have the resources, skills, or education to benefit from dam construction. Experience in other parts of Africa suggests many difficulties imposed upon those who will lose lands, homes, or both unless appropriate measures are taken.

The various zones are treated separately since the major effects will be felt individually and will not be greatly altered by the combination of dams. Local socioeconomic dam impacts are considered here. The major regional and national expected impacts are to be found in the Indicative Plan of OMVG.

4.1. Definition of the Affected Zones

The dam impact zones are defined as those in which the modes of livelihood of the people near the Gambia River and its tributaries will be altered but in which there will be no irrigation development (at least according to current plans). The repercussions produced by construction and completion of the dams are treated separately from those of irrigation projects throughout the entire Gambia River Basin. The focus here is on the zones above the dams. The greatest effects are likely to occur downstream from Balingho to around Tendaba, where there will be increased tides and salinity; upstream from Balingho in areas where tidal rice is grown (which includes such major tributaries as the Sandougou bolon); the section upstream of Kekreti, which will be inundated; and the land to be flooded behind the dams of Kogou Foulbe, Kouya, and Kankakoure (Figures 4.1 and 4.2).

Reservoirs, flooding, and either cessation or augmentation of tidal action are the most dramatic direct dam impacts. More subtle and less predictable consequences will result from the regulation of water flow:

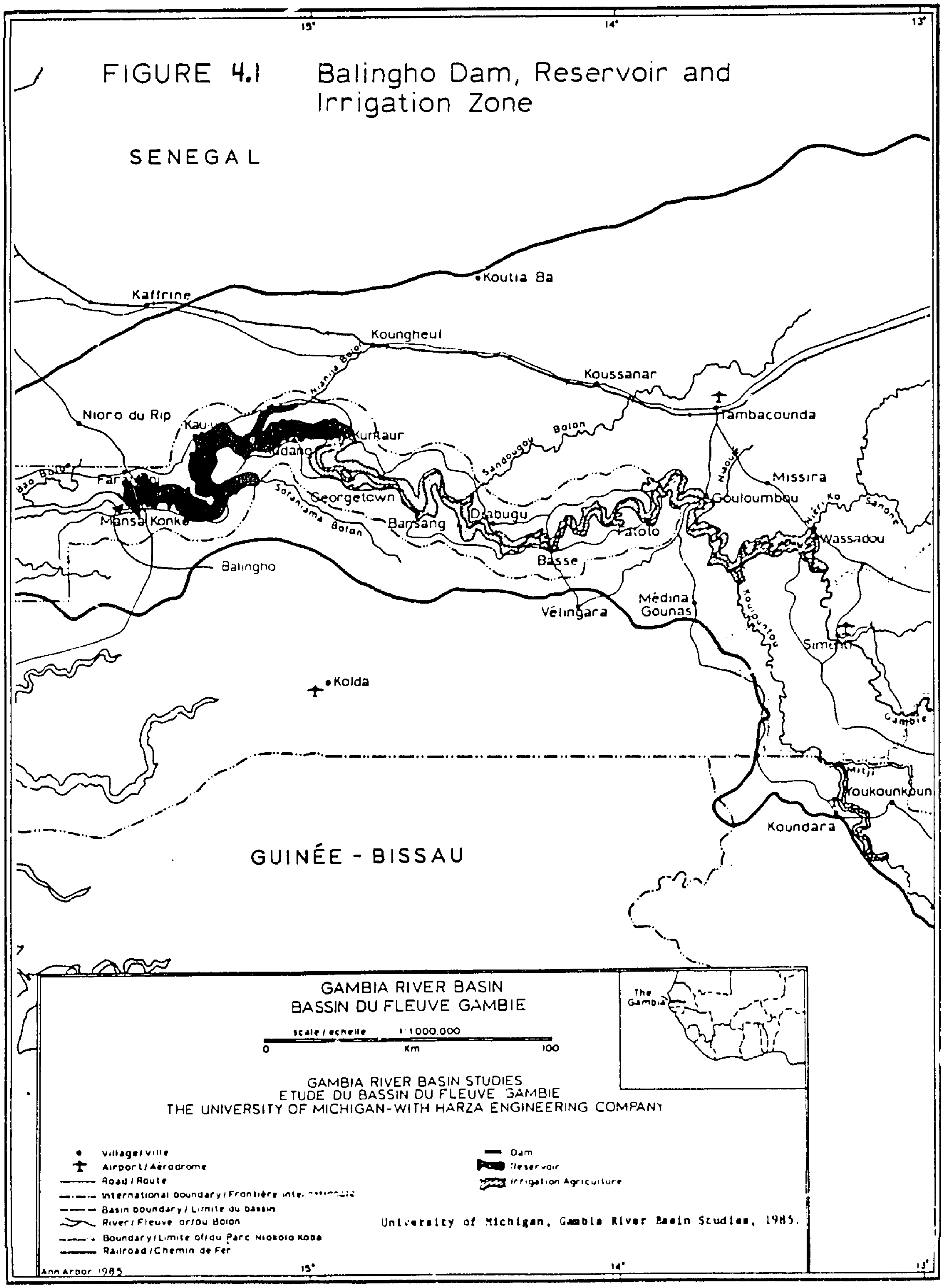
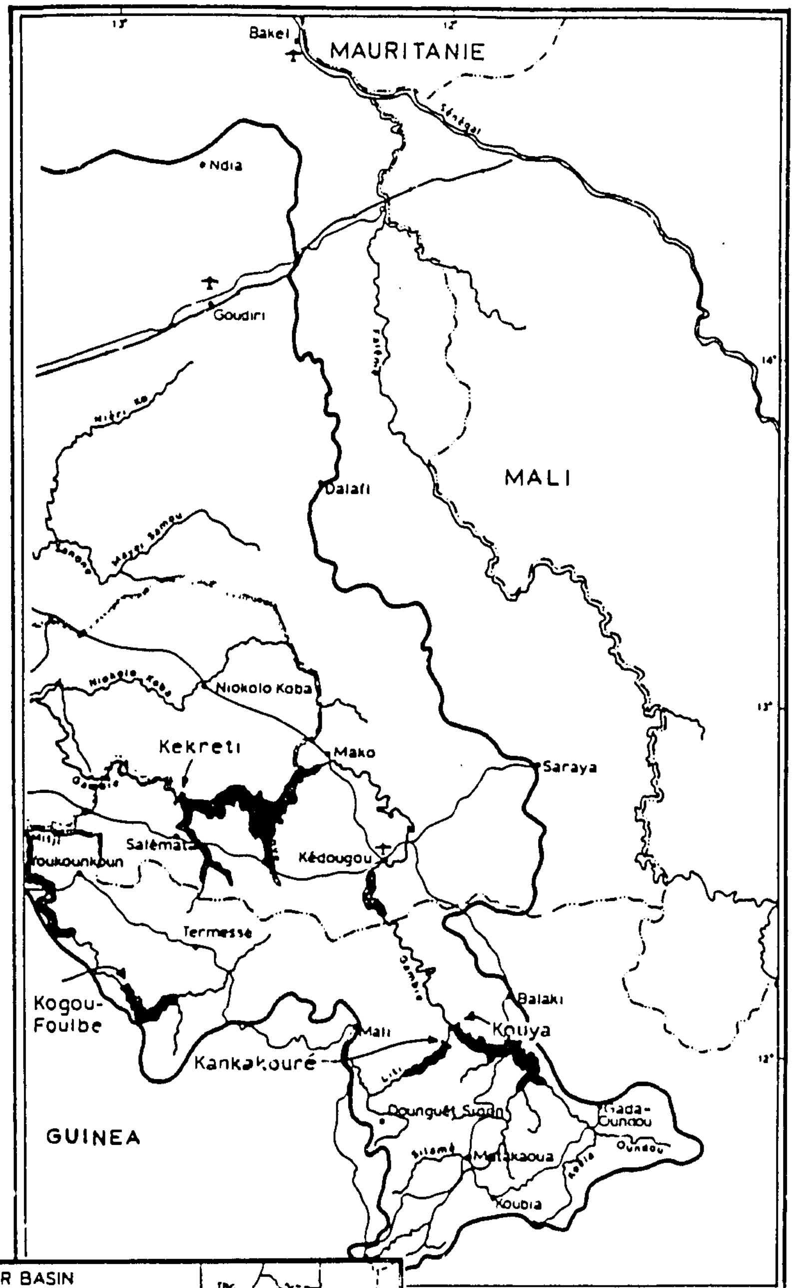
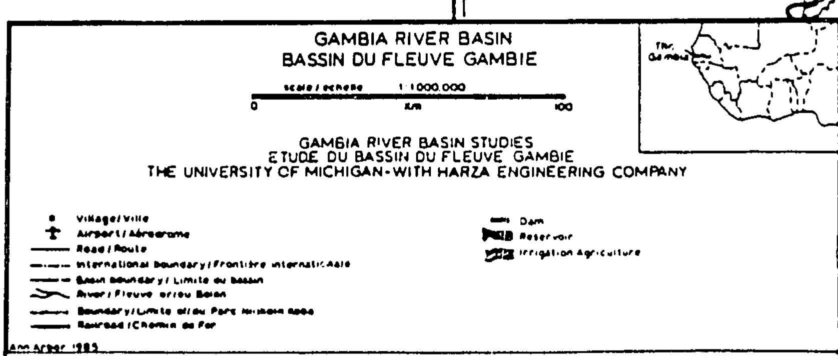


FIGURE 4.1 Balingho Dam, Reservoir and Irrigation Zone
SENEGAL
Kaffrine
Koutia Ba
Koungheul
Koussanar
Tambacounda
Nioro du Rip
Kau-ur
Kuntaur
Kudang
Farafenni
Mansa Konko
Georgetown
Bansang
Diabugu
Fatoto
Basse
Gouloumbou
Missira
Wassadou
Balingho
Vélingara
Médina Gounas
Simenti
Kolda
Youkounkoun
Koundara
GUINÉE - BISSAU
Sandougou Bolon
Sofaniama Bolon
Nianija Bolon
Bao Bolon
Niokolo Koba
Nieri Ko
Sandougou
Koulountou
Gambie
GAMBIA RIVER BASIN
BASSIN DU FLEUVE GAMBIE
scale / echelle 1:1000.000
0 Km 100
GAMBIA RIVER BASIN STUDIES
ETUDE DU BASSIN DU FLEUVE GAMBIE
THE UNIVERSITY OF MICHIGAN-WITH HARZA ENGINEERING COMPANY
The Gambia
Village / Ville
Airport / Aérodrome
Road / Route
International boundary / Frontière internationale
Basin boundary / Limite du bassin
River / Fleuve or / ou Bolon
Boundary / Limite of / du Parc Niokolo Koba
Railroad / Chemin de Fer
Dam
Reservoir
Irrigation Agriculture
University of Michigan, Gambia River Basin Studies, 1985.
Ann Arbor 1985
15°
14°
13°

FIGURE 4.2
Kekreti and the Dams in Guinea





University of Michigan, Gambia River Basin Studies, 1985.

more during the dry season and less during the rainy season. One can expect a series of unforeseen and unintended consequences of changes in the river flow, particularly given the complications of tidal action. In addition to changes in river flow and tidal action, there will be changes in human settlement, both emigration and migration, as well as shifts in agricultural practices and other economic activities which will alter the ecology of the basin.

The populations studied are precisely those who will benefit least from the construction of the dams unless specific provision is made for some combination of resettlement, compensation, economic alternatives, employment, and a voice in the future. An emphasis is placed on the zones as dynamic areas with different kinds of potential problems and with populations actively engaged in trying to meet them. The problems are quite varied: for Balingho, increased duration of salt in the river and population pressure in the adjacent highlands; for Kekreti, declines in rainfall and shifting cropping patterns; at the Guinean dam sites, isolation and poor or nonexistent roads.

The five dams and the size of their most likely impoundment zones are: Balingho, 716 km^2; Kekreti, 338 km^2; Kogou Foulbe, 38 km^2; Kouya, 116 km^2; and Kankakoure, 8.3 km^2. The total area affected will encompass 1,216.3 km^2.

4.1.1. Balingho

The proposed antisalt barrage at Balingho, to prevent saline water from moving farther upriver, is 128 kilometers from the Atlantic Ocean. A bridge will be part of the barrage structure. Because of the flat terrain there will be a large impoundment area upstream, currently assumed to be 716 km^2, but the actual size will vary with the releases from Kekreti and other tributaries downstream from there. The reservoir level will be kept between 1.3 and 1.7 M GD, a height based on the need to prevent transformation of acid-sulphate soils and to limit flooding.[1] The inundation may cover the entire alluvial plain up to Kuntaur, which used to be the farthest reach of the seasonal saltwater

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[1]The acid-sulphate soil problem is treated in the <u>Aquatic Ecology and Gambia River Basin Development</u> report.

tongue. In 1984 the saltwater tongue extended to within five kilometers of the pumps at Jahaly Pacharr. This movement has been associated with decreased rainfall and increased use of the rivers for irrigation. Downstream of Balingho, the salt tongue is pushed back to Tendaba (kilometer 70) during the rainy season, permitting the use of river water for rice cultivation.

4.1.2. Kekreti

The high dam (67.8 meters) will create a reservoir of 338 km^2, extending to just before Mako (and its bridge) and along the tributaries Diara, Thiankoye, and Thiokoye. The Kekreti Dam will regulate the flow of the Gambia River and store the necessary water for irrigation during the dry season. Turbines will also be installed, which require a certain flow (depending on irrigation requirements) year-round to maintain electricity (see AHT figures).

4.1.3. Kogou Foulbe

The proposed dam near the villages of Boussoura, Kifaya, and Kogou Foulbe on the Koulountou River (known as the Koureniaki until it enters the sous-prefecture of Koundara center) would store water both for hydroelectricity and irrigation. The dam would be built in a remote area, currently unreachable even by four-wheel drive vehicles. The irrigation zones are downstream, particularly on the plains of Oudaba.[2]

4.1.4. Kouya

The largest of the Guinean dams is on the Gambia River, 6 km upstream from the confluence with the Liti. The only information available is given in the Polytechna report, although more studies will shortly be underway. The purposes of the dam are for hydroelectricity and the general control of flow. In addition, water could be provided for some irrigation upstream of the Kekreti Dam. It appears that little land in Guinea itself would be suitable for irrigation between Kouya and the border with Senegal.

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[2]The characteristics of the plains of Oudaba, Koundara, and Kerouane and their suitability for irrigation can be found in Etude Agropédologigue de la Vallée de la Koulountou, an OMVG/FAO project directed by Luis Cueto with SENASOL (Conakry, 1984).

4.1.5. Kankakoure

The dam as described in the Polytechna report will be about 4 km upstream from the Liti's confluence with the Gambia. The dam would retain a relatively small amount of water. The powerhouse would be downriver from the dam.

4.2. Purpose of the Studies

4.2.1. Balingho

The Balingho case study sought: to provide an overview of existing lowland farming systems since these are the ones placed in jeopardy by the dam; to determine the effects of barrage construction, particularly hydrological and salinity changes, on the existing agrarian systems and modes of livelihoods; and to suggest mitigative measures for the possible negative consequences of construction.

4.2.2. Kekreti

There were four purposes of the Kekreti study. The first was to provide descriptive and baseline socioeconomic information on the zone to be most affected, particularly on the lake which would develop behind the dam. The second was to define the probable effects of this project on the social and economic organization of the region. The third was to assess the relative importance of these effects. The fourth purpose was to define possible strategies both for mitigation of negative consequences and for exploitation of positive ones.

4.2.3. Guinea Dams

The purposes of the Guinea study were to provide descriptive and baseline socioeconomic information on the zone, to indicate the probable effects of dam construction, and to suggest mitigative measures where appropriate.

4.3. Brief Description of Methodology

Each study was delineated by available information and hypotheses about the major effects. Therefore, somewhat different research strategies were followed in each.

The Balingho investigation is based more on available literature because the documentation on this zone is greater than for Kekreti. Discussions were held with organizations already engaged in economic interventions; site visits were made to some of these projects; a number of villages were visited; and a questionnaire was administered to people in ten villages. Of the villages included in the Intensive Village Studies (IVS), two are in the impact zone and three others in The Gambia and two in Senegal will lose their tidal rice. Emphasis has been placed on the responses, particularly concerning the adaptations farmers have been making over the last fifteen years to changing climatic and economic conditions.

In the case of Kekreti, due to the lack of literature, much primary research was undertaken. Subzones were defined within the areas to be flooded: i) the Diarha River, which flows into the Gambia just upstream from Kekreti and rises in Guinea; ii) the Thiokoye River, east of the Diarha; and iii) the flooded portion of the Gambia River itself. Another affected tributary is the Thiankoye, but it was not studied because of the few villages along its banks. In each zone, representative villages were chosen, eleven in all. A survey was done at the conclusion of the study to verify the generalizability of the results. A series of four questionnaires were given to selected households in each of the villages. An effort was made not to duplicate the AHT study, which grouped villages into primary and secondary categories based on the degree of loss through inundation.[3]

The Kogou Foulbe, Kankakoure, and Kouya studies in Guinea were based on surveys carried out in many of the villages in the projected inundation zones. Much of this work had to be carried out on foot, moving between villages without a vehicle. The research consists completely of primary data since there is virtually no literature for these zones.

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[3]AHT Annex D. Socio-Economy, 1984.

4.4. The Zones of Study: Balingho

4.4.1. Background

The major effect to be produced by Balingho will be to stop tidal influences above the barrage and intensify them below. The affected zone is virtually the entire length of the Gambia River in The Gambia, except for the portion below Tendaba, where tides and salinity will not be greatly altered. While it is difficult to state the extent of effects away from the river, there is a clear distinction to be made between villages which have lowland ricelands that potentially will be lost and those which do not. The differentiation between upland and lowland villages can sometimes be arbitrary and does not reflect the actual location of fields. If a strip one kilometer from the floodplain of the river is defined as the most directly affected zone, then between Balingho and Kuntaur 108 villages with populations of more than 100 are involved. In 1973, these totaled 44,337, not counting people in settlements of fewer than 100, a reasonable zone estimate would be 50,000. Assuming an annual growth rate of 3.5 percent, the current figure is about 75,000, but this is a gross underestimate of the affected population since it is known that people will travel at least five kilometers to use swamp fields.[4] AHT calculated that within five kilometers of the river and between Kuntaur and the Senegalese border there were 97,261 Gambians in 1973 (that is, within the priority irrigation zones).

The zone between Tendaba and Kuntaur is the very heart of The Gambia. All the peoples of The Gambia are represented, but the Mandinka predominate. The basic agricultural and migration patterns were summarized in Chapter 3. Of particular interest for this discussion is the change in rice production upstream and downstream from Balingho, as well as the pressures that are being and will be placed on upland agriculture due to the decline in rice output. The decrease documented

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[4]A survey of sufficient scope to determine actual land use and land tenure for compensation was beyond our resources but will need to be done prior to barrage and bridge construction.

here for 1983 continues a pattern associated with increasing salinity in the river. Upland crop production has also suffered, particularly in 1983, because of poor rainfall. The dam at Balingho will greatly augment the pressure on upland zones due to the loss of swamp rice resulting from upstream impoundment and increased salinity downstream. If more dependence on imported rice is to be avoided, at least in the short run, considerable emphasis will have to be given to increasing rainfed grain production.

4.4.2. Agriculture

The general agricultural picture in The Gambia is relatively well described.[5] The greatest potential affects of the Balingho Dam on agriculture will be on rice cultivation and associated consequences to upland cropping. The major rice ecologies in The Gambia, taking into account water regime and land type, and not considering irrigation, are as follows:

- Swamp
  - a. Freshwater
  - b. Saline-affected _bafaro_
  - c. Mangrove
- Rainfed
  - a. Upland _tendako_[6]
  - b. Upland depressions or colluvial slopes _bantafaro_

In the Balingho zone _bantafaro_ and swamp rice are the most important. _Tendako_ rice is no longer widely sown in the uplands, and currently there are no irrigated rice schemes due to salinity during the dry season.

4.4.2.1. _Types of swamp rice_. Swamps with freshwater year-round are not found in the affected zone but farther upriver. These areas are double-cropped. It is these upstream double-cropped swamp rice areas that are intended for irrigation development. In addition to the benefit of increased yields through irrigation, the dam would alleviate the

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[5]LRDC 22, 1976; Jenny Dey, 1980, 1981; Margaret Haswell; Peter Weil, 1980; CILSS; World Bank, et al.

[6]Mandinka terms are given for the different ecologies. These are relative and subject to some variation depending on location in The Gambia.

concern that these swamps would be ruined if and when the salt tongue moves farther upriver.

In saline-affected swamps, or bafaros, hand-hoeing is used, and seedlings are transplanted after the salt has receded. This contrasts with cultivation in the uplands, where rice seeds are planted on the bautafaros or lendakos once the rains commence.

Reclaimed areas previously overgrown by mangroves are saline at least part of the year. For them to be made suitable for rice cultivation, the salt must be flushed out and its intrusion prevented through bunds.

4.4.2.2. Upland cultivation. The Balingho zone reflects the general upland pattern of groundnut, millet, and sorghum cultivation. There is some variation in the gender division of labor; Wolof and Sarakole women tend to grow groundnuts, whereas Mandinka women do not. There is considerable reliance on animal traction. To some measure upland cultivation has become more important because of the problems of salinity and rainfall for rice cultivation. In general, most villages have access to both lowlands and uplands for cultivation and combine the two. Those settlements close to the river and with access to rice land most frequently rely on rice as a staple. In the uplands, millet and sorghum replace rice as the staple. In the two lowland villages studied by Phillips et al.,[7] rice was the main food at 70-90 percent of the meals. (This includes both local and imported rice.)

4.4.3. Livestock

Farmers in the Balingho zone tend to accumulate livestock both for agricultural labor and for transport. As a food, meat is quite clearly a luxury beyond the resources of most households. Not all of those who would like to have livestock do, and many farmers rent or borrow equipment or animals to plow, weed, and transport crops. In this area and throughout the basin, livestock continue to be an investment for ceremonial expenses, taxes, and food purchases if harvests are inadequate. Animal traction is not used in the rice fields but is of key importance in groundnut and millet cropping.

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[7] Op. cit., p. 79.

The OECD and CILSS have estimated that within the Lower River Division (LRD) of Gambia there are 22,224 cattle; in North Bank Division (NBD), 45,518 and in the MacCarthy Island Division (MID), 82,532. The precise numbers in the affected zone are unknown. Cattle per capita increase from 0.52 in the LRD to 0.99 in the MID. Already there are pasturage problems due to increasing amounts of upland devoted to groundnuts and to population growth. Water has also become a critical constraint at the end of the dry season in that portion of the river where salinity is elevated. During May 1984, for example, for the first time villagers of Chamen, Bati Ndar, Bati Hai and surrounding villages were unable to water their animals in the Gambia River and the adjacent bolon because of salt present in the water. A system was developed within each village to balance animal and human needs through well water, and the wells were continuously used from dawn till dusk.

4.4.4. Fishing and Other Riverine Resources

Fish is a vital protein source in the zone, generally more important than meat. (The importance of fishing is covered in the Aquatic Ecology and Gambia River Basin Development report.) In the two survey villages (Bati Ndar and Chamen), it was purchased frequently and regularly from both local and visiting fishermen. In the five villages studied by Phillips et al., fish were eaten at more than 40 percent of the meals. In Bati and Chamen a number of people fished part-time, and in this respect, these villages are typical of those close to the river. At Carrol's Wharf, Toucouleur families fished and smoked and dried the catch to sell in the villages and at the Kuntaur and Kau-ur markets.

Mangroves are widely used by villagers in the affected zone for roofing materials and firewood. The trees also are an important habitat for species used for human consumption. Mangrove resources and their use are to be found in the Terrestrial Ecology and Gambia River Basin Development and Aquatic Ecology and Gambia River Basin Development reports.

4.4.5. Nonagricultural Activities

Due to the unpredictability and lowered rainfall, nonagricultural income has become more important to households. These include minor commerce, crafts, bakers, wage labor in the towns, cutting and sale of firewood, et al.

4.4.6. In-migration and Emigration

There has been a decline in in-migration to the older peanut areas on the north bank. There has also been a longer term shift of populations to the south bank road and one would expect the same when the north bank road is paved. There has been some in-migration to the Farafeni-Jenoi-Mansa Konko area as truck traffic and trading has grown in importance. Many Guineans are established in commerce at the ferry along with Gambians and Senegalese.

4.4.7. Marketing

There are no unique characteristics to marketing in the Balingho zone that are not true for all of The Gambia. There is the "trade season" when farmers sell primarily groundnuts and purchase needed commodities for the year. Commercial activity has a strong seasonal dimension. Appleby's observations on the relatively late development of rural marketplaces following the withdrawal of European firms from peanut marketing hold in the central part of The Gambia, as well as in Upper River Division. In 1953, for example, the United African Company imported rice, cigarettes, sugar, flour and tobacco; striped material, handkerchiefs; hessian bags, cement, sewing machines, enamelware, iron and steel sheets, singlets, footware, shirts, packed medicines, perfumery and soap (Haswell 1975: 78). As Appleby observes, the goods involved in this trade constitute an inventory of basic rural purchases in 1985 as they did twenty-five years ago.[8] The difference now is that more of the trade takes place in rural markets or small stores than in the branch stores of large companies.

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[8]"Marketplace Development in the Gambia River Basin," by Gordon Appleby, in Markets and Marketing, Monographs in Economic Anthropology No. 4, edited by Stuart Plattner (Lanham, MD: University Press of America. 1985).

4.5. The Zones of Study: Kekreti

The entire affected zone around Kekreti lies within the Department of Kédougou (within Senegal Oriental): the most affected arrondissements will be Bandafassi and Salemata. Clearly, effects will extend beyond the impoundment zone because of construction, employment not only at the dam itself but also for worker housing, new roads, communications, and power lines, as well as other related activities. Particular attention is paid here to agriculture because it is currently the most important economic activity and is a major focus of these studies.

4.5.1. Population Characteristics

The Department of Kédougou has a population of 71,962, a density of slightly under 6 persons per km^2 (not including the area within the national park). People are concentrated in two zones. The first is the narrow U-shaped strip from the subprefecture of Saraya south along the western slope of the Faleme escarpment to the Guinea border, west through the foothills of the Fouta-Djallon, and north through the hills of Salemata. The second and smaller section follows the banks of the Gambia River and various tributaries to the north and west of the town of Kédougou, and this is the primary impact zone. The respective population densities for the two affected arrondissements are 6.5 km^2 and 7.6 km^2. SONED/AHT gives a density of 12.6 persons per km^2 in a generously estimated direct impact zone of 880 km^2.[9]

As shown in Table 4.1 the ethnic composition of Bandafassi and Salemata is quite distinct both from Kédougou and the rest of Senegal. The strong Bassari presence in Salemata combined with the numerically predominant Fulbe contrasts this arrondissement with Bandafassi, where the Malinke are the second largest group after the Fulbe. Others are represented, such as the Bedik, which gives the Department of Kédougou a character different from the rest of the basin. The one exception is the Prefecture of Koundara (and the arrondissement of Koundara) in the Republic of Guinea, where one finds many of the same ethnic groups along the Koulountou and its tributaries.

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[9] SONED, p. 13.

TABLE 4.1.

ETHNIC DISTRIBUTION IN THE DEPARTMENT OF KEDOUGOU, ARRONDISSEMENTS OF SALEMATA AND BANDAFASSI (in percentages of population)

Group	Kédougou	Bandafassi	Salemata
Fulbe	41	52	53
Malinke	27	20	1
Sarakole	2	11	6
Bambara	1	1	0.5
Diakhanke	7	7	7
Diallonke	7	2	2
Bassari	6.5	1	27
Bedik	3	13	0
Other	3	1.5	3

University of Michigan, Gambia River Basin Studies, 1985.

4.5.2. Settlement Patterns

The basic settlement unit is the village, ordinarily distinct but rarely isolated from others. The Kédougou map is scattered with clusters of villages concentrated around water sources, valleys, and low-lying areas which contain much of the region's productive land. In recent years, isolation from relatively good communication routes has caused some otherwise suitable sites to be abandoned. Below are classified the types of settlement found in the Kekreti zone. They are listed to indicate the kinds of factors which must be taken into account in resettlement. As elsewhere, the hierarchy of rural settlement has important implications for understanding and mitigating dam effects.

- Permanent Villages

Towns, or villages likely to become towns over time, are usually multiethnic, provide central place services to the surrounding area (the most important being stores, craftsmen, markets, schools, and access to public transportation), and contain a number of facsimilies not primarily dependent on agriculture for their livelihood.

In center villages, the chief is recognized as having authority over a number of surrounding settlements. This may be owing to the decision of the satellites' inhabitants, who have historical or social ties to the center, or to administrative fiat (often to simplify tax collection and communications). In the latter case, a satellite often does not respect the authority of the center village and is for the most part autonomous.

Satellite villages (see above) are subordinate to center villages.

Autonomous villages are neither central nor satellite, although they are often tied by a network of social relations to other settlements in the region.

Temporary villages arise when a site is tried out in the establishment of a new settlement. The inhabitants will not invest in permanent structures and other improvements until the final decision is made. Included are villages in this transitional state as well as those whose inhabitants have decided to abandon a permanent site.

Hamlets may be one of three distinct types: i) formed for farming or herding purposes, farm hamlets include inhabitants from one or more villages. Sites are too distant from home villages for daily travel; ii) transitional hamlets attract inhabitants who begin the process of permanent occupation; iii) transhumance hamlets are occupied during the dry season by herders who bring their cattle to the rivers for forage and water.[10]

4.5.3. Agriculture

The principal wet season staple crops are maize, rice, and early millet. Secondary crops are fonio, sorghum, and late millet; groundnuts are the principal cash crop (but an essential ingredient for sauces). Subsidiary root crops are taro, cassava, wousse, and the earth pea (among the Bassari). The prevalence of maize as a staple and cash crop, rather than millet, is one characteristic, distinguishing the affected zone from the surrounding region. Upon questioning, inhabitants stated that they shifted from millet to maize when they cultivated low-lying, well-watered

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[10]For the details of this classification and how it helps illustrate the nature of settlements in the Kekreti zone, the reader is referred to GRBS Working Document No. 30.

land. In the view of informants, maize is attractive because of its commercial value and relatively high yields. In addition, animal traction can be used in the riverine maize fields but not in the uplands.

4.5.3.1. Land tenure and land use. Land is never uniform in quality, and any village territory contains large areas unsuited to agriculture. In Kédougou three types are found: Plains with laterite rock pan at, or just under, the surface; steep hillsides, with relatively infertile soil; and land that is frequently flooded. Agriculturalists in the region tend to prefer the more fertile alluvial and valley bottomlands over the less productive plateaus and lower hillsides. These trends reflect not only natural conditions but also changing choices about crops and technology, such as the shift from millet, fonio, and earth peas to maize, as noted earlier. Indeed, shifting agriculture characterizes the zone. Within the past few years there has been a growing importance of rice and other lowland crops such as bananas, which require even more specific ecological conditions than does maize. There is also increasing dependence on oxen, which cannot be used for plowing where the terrain is too rocky or the slope too great.

Informants agreed that a three-year rotation is necessary to retain fertility, but pressure is such that the time land lies fallow is diminishing. The average for Kédougou is 0.625 hectares per person (calculated by SODEFITEX, which corresponds to our estimates). This means that each person has in fact almost two hectares of roughly similar quality (including fallow land).

In the three study areas, there was one group in every village which felt another group was manipulating the land tenure system and monopolizing the better lands; this kind of tension seems to have been endemic for a long time. While some complaints were undoubtedly exaggerated, the general issue of access to land both within and between villages and ethnic groups warrants attention.

4.5.4. Livestock

The characteristics of livestock in the Kekreti Dam area are as follows: integration with the agricultural economy; widespread ownership by households of individual herds; numerical dominance of trypano-tolerant sheep, goats, and cattle; free range and/or seasonally herded animals; and a low but steady rate of take-off for sale.

Even populations which entered the zone as herders now practice agriculture, but in every village identified animals were raised. The Service d'Elevage in Kédougou estimates there are at least 17,000 bovines and 47,000 goat and sheep in the Salemata and Bandafassi arrondissements. Within the affected zone livestock are important at both the regional and household levels. Regionally, the trade in livestock particularly in the Thiokoye and Salemata areas attracts buyers from all of Kédougou, northern Senegal, and northern Guinea. For households, livestock serve as a cash reserve as well as an important source of income through the sale of milk and milk products prepared by women.

As can be seen in Tables 4.2. and 4.3., relatively large numbers of households own livestock. There is some variations among ethnic groups in types of animals held; for example, Bassari tend to own goats and not cattle. Surprisingly, a high percentage of women own animals.

4.5.5. Nonagricultural Activities

As shown in Table 4.4., the diverse nonfarming activities in the zone offer earning potential. Compensation might be necessary for income losses from agricultural, livestock, and nonagricultural activities. Fishing is not commercially important for permanent zone residents, usually done part-time for family consumption, but fishermen from the Senegal River reside in the area during the dry season and sell fish (fresh and dried) to inhabitants. There is a relatively permanent community of fishermen at Mako and at other villages along the Gambia River (but not along its tributaries).

4.5.6. In-migration and Emigration

In-migration to the zone is relatively recent (with the exception of the highland groups), and the rate has increased over the years, particularly since 1970. Prior to 1940 the major, but not exclusive, influx came from Guinea from which different groups left for specific

TABLE 4.2.

LIVESTOCK: OWNERSHIP OF LIVESTOCK BY ETHNIC GROUP AND BY SEX OF OWNER

			Total Number Owned	% of Owners	% of Adults in Category	Mean Herd Size Per Owner
Fulbe	Women	Cattle	304	71	33.6%	4.3
		Sheep	79	23	10.9%	3.4
		Goats	109	34	16.1%	3.2
	Men	Cattle	332	42	24.7%	7.9
		Sheep	110	27	15.9%	4.1
		Goats	209	34	20.0%	6.1
Malinke	Women	Cattle	32	16	22.9%	2.0
		Sheep	25	10	14.3%	2.5
		Goats	7	5	7.1%	1.4
	Men	Cattle	49	16	27.6%	3.1
		Sheep	43	14	24.2%	3.1
		Goats	27	7	12.1%	3.9
Bambara	Women	Cattle	11	5	13.5%	2.2
		Sheep	7	2	5.4%	3.5
		Goats	22	4	10.8%	5.5
	Men	Cattle	46	11	32.4%	4.2
		Sheep	18	4	11.8%	4.5
		Goats	32	10	29.4%	3.2
Sarakole	Women	Cattle	32	10	28.7%	3.2
		Sheep	5	2	5.7%	2.5
		Goats	2	1	2.9%	2.0
	Men	Cattle	144	15	31.3%	9.6
		Sheep	68	10	20.1%	6.8
		Goats	68	8	16.7%	8.5
Bassari	Women	Cattle	7	2	3.5%	3.5
		Sheep	33	7	12.3%	4.7
		Goats	86	11	19.3%	7.8
	Men	Cattle	42	2	4.4%	21.0
		Sheep	29	4	8.7%	7.3
		Goats	118	15	32.6%	7.9

University of Michigan, Gambia River Basin Studies, 1985.

TABLE 4.3.

LIVESTOCK: OWNERSHIP OF LIVESTOCK OF SAMPLE HOUSEHOLDS BY ETHNIC GROUP AND BY STUDY AREA

	Species	Total Number	Average Household Herd
I. Ethnic group (n):			
Fulbe (72)	Cattle Sheep Goats	553 177 301	7.68 2.46 4.18
Malinke (21)	Cattle Sheep Goats	80 70 37	3.81 3.33 1.76
Bambara (17)	Cattle Sheep Goats	98 43 58	5.76 2.53 3.41
Sarakole (19)	Cattle Sheep Goats	226 76 80	11.89 4.00 4.21
Bassari (23)	Cattle Sheep Goats	42 47 197	1.83 2.04 8.56
Sample (152)	Cattle Sheep Goats	999 417 680	6.57 2.74 4.47
II. Study area (n):			
Mako (36)	Cattle Sheep Goats	206 89 61	5.85 2.15 1.69
Koumafele (39)	Cattle Sheep Goats	228 84 126	5.85 2.15 3.23
Hamdallahi (33)	Cattle Sheep Goats	347 117 153	9.38 3.16 4.14
Diarha (40)	Cattle Sheep Goats	218 123 333	5.45 3.08 8.33

University of Michigan, Gambia River Basin Studies, 1985.

TABLE 4.4.

INCOME: MONEY-EARNING OCCUPATIONS CITED BY RESPONDENTS IN SURVEY, BY ORDER OF FREQUENCY

	Count	Percent		Count	Percent
Minor commerce	25	19.4%	Gold	21	16.3%
Plowman	14	10.9%	Mats/lits tara	11	8.5%
Sell beignets	9	7.0%	Palm wine harvest	8	6.2%
Dyer	8	6.2%	Meat/livestock com	7	5.4%
Marabout/healer	5	3.9%	Blacksmith	5	3.9%
Weaver	5	3.9%	Labor not in village	4	3.1%
Sell cola	4	3.1%	Fisherman	3	2.3%
Sell cloth/indigo	3	2.3%	Repairman	3	2.3%
Storekeeper	3	2.3%	Tailor	3	2.3%
Schoolmaster	3	2.3%	Ag labor	2	1.6%
Cutwood/bamboo	2	1.6%	Boatman	2	1.6%
Maid	2	1.6%	Mason	2	1.6%
Baker	2	1.6%	Welldigger	2	1.6%
Other salaried	2	1.6%	Labor in village	1	0.8%
Herdsman	1	0.8%	Hairstylist	1	0.8%
Leatherworker	1	0.8%	Restaurant owner	1	0.8%
Nurse	1	0.8%	Weigher sonacos	1	0.8%
President coop	1	0.8%			

Proportion of sample citing:

no first occupation	22	17.1%
no second occupation	85	65.9%
no third occupation	114	88.4%
no fourth occupation	127	98.4%

Proportion of households citing <u>no</u> occupation, by ethnic group:

Fulbe	15		25.0%	
Bassari	6		27.3%	
Bambara	1		8.3%	
Sarakole			0	0.0%
Malinke		0	0.0%	

University of Michigan, Gambia River Basin Studies, 1985.

grievances. Throughout the 1940s the newcomers were Manding and Fulbe, with neither dominating. Conditions changed in Kédougou after World War II; agriculture expanded and diversified, and began to flourish. Several communities in the affected zone -- Salemata, Hamdallahi, Diakately, and Thiankounoume — developed because of the specific site advantages in regard to trade particularly with northern Guinea. Recently the primary in-migration has been the Fulbe, altering the area's ethnic composition and reflecting the general change in western Kédougou. This process has modified the geographical subdivisions into ethnic territories and engendered tensions between the Fulbe and other groups. The mistrust is partly historical but also attributable to the Fulbe tendency to take over commercial circuits and to the increased competition for land between livestock and agriculture. Pressures have intensified with growing population and decreasing availability of water.

The affected zone not only receives migrants (both permanent and seasonal) but also sends labor. Temporary or longer-term emigration is evenly spread among ethnic groups and has been growing in importance. The implications of these patterns, already well established prior to the construction of the Kekreti dam, are discussed below.

4.5.7. Marketing

The significance of trade to the zone has increased due to regional economic growth and the proximity to Guinea. Commerce is a primary specialization for some, but almost everyone buys and sells in the smaller weekly marketplaces (Koumafele, Salemata, Mako, and so forth) and attends at least occasionally the larger daily market at Kédougou. Trade across the border and between the local markets and those in Kédougou or Tambacounda is a major dry season activity for many Fulbe and Sarakole men and some women. This is a significant channel for selling products from the zone and for provisioning local markets. The most important cash crops are maize, rice, and groundnuts; there is also a brisk trade in livestock and milk products. Markets are relatively recent with the first ones established during the 1940s and many founded during the 1970s.

4.6. The Zones of Study: Guinea

4.6.1. Kouya

The Kouya damsite[11] is approximately 5 km upstrem from the confluence of the Liti with the Gambia River. The highly rugged topography is marked by extensive gallery forest along the waterways. The Gambia River separates the subprefectures of Madina Salambande and Balaki in the Prefecture of Mali. The subprefectures of Fafaya and Gada Cundou in the Prefecture of Koubia will also be affected upstream of the confluence of the Gambia and its major tributary, the Oundou. The wildlife and vegetation study has calculated that if the maximum area were flooded (116 km^2), the types of land inundated would be approximately 88 percent (102.5 km^2) of dense forests, 11 percent (13 km^2) of open forest or wooded savannah, and one percent (.5 km^2) of barren lands and rock outcrops.[12] These figures do not take into account villages and their productive lands adjacent to the river.

The four subprefectures in the affected area have the following populations: Balaki, 6,298; Salambande, 7,244; Gada Oundou, 3,812; and Fafaya, 15,878. The total is 33,232.[13] A minimum of 54 communities with a population of 3,524 will be directly affected by the dam, being within 10 km of the approximate reservoir. From the Polytechna diagrams it appears that four of these (a population of 665) will be entirely flooded.

The ethnically diverse region includes Fulbe, assimilated Fulbe, Diakhanke, and Diallonké, the majority of the latter in the Balaki subprefecture. Historically, the Gambia River has been the boundary

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[11]The maps available for the affected areas in Guinea date from the colonial period. Aerial photos were not very useful for identifying villages in this highly forested and rugged terrain. The location of the reservoirs and the areas they will inundate are not as precisely known as one would like.

[12]See the Terrestrial Ecology and Gambia River Basin Development report.

[13]These figures were obtained from the subprefectures.

between the Diallonke and Fulbe, but recently Diallonke have settled in the villages of Kirita and Kenende in Madina Salambande, leaving their natal village in Kounsi (Balaki). Overt conflicts have ended between the two groups, but tensions continue. On the east bank of the Gambia River there is one relatively large Fulbe village, Simbaya. Farther east, in the subprefectures of Gada Woundou and Fafaya, the Fulbe are numerically dominant.

4.6.1.2. Agriculture, livestock and nonagricultural activities. The patterns in the Kouya zone are similar to those discussed in Chapters 2 and 5. Agriculture, with very limited animal traction, is the primary economic activity. There is the division between women's fields adjacent to compounds and the larger fields farther from the village. Cultivation is shifting on the latter and intensive on the former. In some villages with steep slopes there is terracing. Unlike the situation at the headwaters of the Gambia and its tributaries, there is no perceived land shortage here, and fallow times are quite high. Crops vary with the kinds of soils available and include fonio, rice, groundnut, maize, manioc, sweet potatoes, taro, cotton, pepper, and okra. There are orange, mango, lime, and papaya trees.

Cattle, sheep, goats, and chickens are found in virtually all communities in the Kouya area. Again, the importance of livestock for revenue, ceremonies, investment, and manuring reflects the general patterns in the rest of the basin. There was no indication of any transhumance, although during the dry season herders bring their animals to the tributaries for water and pasturage.

Gathering natural resources, artisanry, hunting, and fishing are the most important nonagricultural local activities. The first type include the gathering of the nere and other fruits, the manufacture of soap from local plants, and the making of a cooking oil from the karite tree. Artisans spin and weave cotton, make bamboo and palm products, and make doors, frames, and furniture. Hunting seems to be more important than fishing in the local economy.

As in most other parts of the Guinean portion of the basin, markets are a very important dimension of social and economic life. In the Kouya region there are only weekly markets, one of which functions only during the dry season. In general, the largest market is at the administrative center for the subprefecture and is of sufficient size to draw truck traffic. Interestingly, the subprefecture of Balaki, which is one-third the size of the prefecture of Mali, does not have a single year-round market. People from Balaki go to Medina Salambande, Matakaou, Hidayatu, or Dongol Sigon.

The people in the Kouya area have few educational and medical facilities, due to low population density, dispersed population, and isolation.

4.6.2. Kankakoure

The proposed site on the Liti River is characterized by plains, savannah, and open woodland except for some gallery forest on the riverbank. There is also some dense closed forest on the left bank downstream from the site (near Donde Diabi and on the hillsides along seasonal streams). The river puddles during the dry season (and seems not to flood extensively). The last inundation that reached agricultural fields occurred in 1976. In recent years crop damage apparently has not been great since peasants cultivate the plain on both sides of the river.

From the damsite to the reservoir's projected end near the village of Dombi Dukere, there are at least 20 communities within a 10 km strip along the river. They are part of two subprefectures, Telire and Hidayatu, in the prefecture of Mali. Of these communities, population figures were obtained for five (totalling 686), each averaging 137 (the range is between 30 and 262). Since many of these communities are said to be small, an average village size of 100 was used, yielding a minimum estimate of 2,186 people in this area. The two largest, Samekouta and Kabata (a total population of 486), would need to be resettled.

4.6.2.1. Agriculture, livestock and other nonagricultural activities. The agricultural systems are similar to those described for Kouya, except there are more plains along the Liti. In the Diakhanke villages one finds more animal traction due to the greater commercialization of their peanut production. Livestock patterns are also the same, except there are some very large herds which depend on the Liti for dry season water and pasture. Hunting and fishing are relatively important, along with the gathering of nere and karite. Craft production is widespread. In the recent past there was an effort to establish a FAPA (Ferme d'Arrondissement Agro-Pastorale) at Kankakoure, close to the river, but the project apparently was not viable. In the same village there is a school as well as a large weekly market attended by people from both banks of the Liti.

4.6.3. Kogou Foulbe

The Koureniaki originates in the highlands of the Termesse-Guingan zone, within the prefecture of Koundara (not far from the Senegalese frontier). Seasonal tributaries flow into the Koureniaki (which then becomes the Koulountou). The area along the Koureniaki/Koulountou is sparsely populated for unknown reasons. The terrain between Boussoura and Lanpoekenn on the north bank, and around Touba to the east, is predominantly open forest or wooded savannah. There is some closed dense forest and some gallery forest along the river.

The river puddles during the dry season, although there are very large pools, such as on the plains of Oudaba. During 1984 the river still had not begun flowing by the end of June. There are four subprefectures in the affected area: Termesse, Guingan, Touba, and Kounsitel. The total population is approximately 24,000. Along the river between the proposed dam site and the end of the reservoir there are at least 29 communities within a 10 km strip. The settlements range between 52 and 600, and eight have a total population of 1,398, or a median of 174 per community. The larger communities are close to the end of the reservoir, and among the approximate population of 5,046 it appears no one would be made homeless on the basis of current information.

The major populations are Fulbe, Bassari, Boin (Islamicized Bassari who no longer view themselves as such), Diakhanke, and possibly Cognagui. The majority of communities visited were on slopes, with fields both on the hills and on the bottomlands. The use of the alluvial soils adjacent to the river varies between and within communities because of flooding.

Because of lower rainfall, millet is more important in the farming systems here than in other parts of the basin. Peanuts as both food and cash crop are widely grown. Women's fields are often smaller and not fenced (as is the pattern in most of the basin outside Koundara prefecture). Potatoes and bananas are grown and sold in the markets of Termesse, Guinean, and Kifaya. A significant amount of these find their way into Senegal.

The Bassari and Boin keep few cattle and specialize more in goats and sheep. The Fulbe and Diakhanke have relatively significant cattle herds. Indeed, herd owners at Koundara keep some of their animals with kinfolk in the area.

Bamboo is widely available, is utilized by craftsmen, and is sold for house construction in other parts of the Fouta. Palms are exploited for both wine and oil. Karite and nere trees grow here, important for both domestic consumption and sale. Much of the nere (called sumbara in processed form) is sold for markets in Senegal and Mali.

The largest weekly markets are at Termesse and Guingan, both more than 30 km from the construction site (a third, Kifaya, is closer). There are several smaller markets.

4.7. Impacts Associated with Dam Construction

4.7.1. Loss of Homes and Villages

4.7.1.1. Balingho. The Terrestrial Ecology and Gambia River Basin Development report concludes there is insufficient cartographic data to specify definitively the boundaries of the Balingho inundation area. Intuitively and from observation, most population centers are not located in the old flood plains between Balingho and Kuntaur. It has therefore been assumed that no towns or villages will be flooded (although given its lowness, Kuntaur could be). It is difficult to assess exactly how wide the reservoir will be at different times and under different conditions of water release from Kekreti. More studies are required to delineate the new reservoir precisely, both seasonally and at different flow levels.

Assuming no large villages or towns will be inundated, there are still 108 communities of more than 100 people within one kilometer of the old floodplain presumably the limit of the reservoir, or a population of at least 75,000 but more likely to be around 100,000. Similarly, between Balingho and Tendaba no villages *per se* may be inundated, but settlements currently with rainy season tidally flooded rice fields will lose those lands due to the decline in freshwater flow in the river.

Another category for whom no population estimates are available are those who will lose their dry season swamp rice due to tide cessation. These people live upstream from Kuntaur and many (although an undetermined number) may have access to the irrigated perimeters. How the phasing takes place between potential loss of their dry season swamp rice and new irrigation perimeters is quite important. Another unestimated category are the people who live along the tidally influenced bolons and who cultivate dry season swamp rice. They will lose all their dry season rice without access to irrigated perimeters unless they are resettled. For example, the Sandougou bolon is cultivated the entire width of the river during the dry season from where tidal action ceases in Senegal to confluence with the Gambia River (on the north bank not far from Bansang). The 1984 dry season yields were particularly good despite the poor rains of 1983.

4.7.1.2. Kekreti. AHT has defined two priority categories in Kekreti zone: those who face significant loss of land and homes and those who will lose some of either. In both categories, 46 percent of

TABLE 4.5.

AFFECTED POPULATION IN KEKRETI ZONE
(Priority 1)

Subdistrict	Total Population March 1983	Affected Number	Population Percent
Salemata	13,050	6,049	46
Bandafassi	17,310	4,595	27
Total	30,360	10,644	35

SOURCE: AHT, 1984. Annex D, p. 4.

University of Michigan, Gambia River Basin Studies, 1985.

the people in Salemata subprefecture (6,049) and 27 percent in Bandafassi subprefecture (4,595) would be affected. AHT lists 22 villages as Priority 1.[14]

With the exception of the stretch along the Gambia River between the Thiokoye and the Diarha, the entire inundation zone can be considered agricultural land lost. Not all is currently cultivated, but if past population movements and growth continue, it soon will be. This would occur despite relatively high levels of onchocerciasis in the area which has probably limited population. To measure the short-term affect of the inundation we would need to compare what those who lose their land can achieve on resettlement land. The longer-term effect is permanent loss of these areas to cultivation and intensification of land pressure around Salemata and Bande. The latter will lead to greater cultivation in the remaining valley or bottomlands and the use of more marginal lands on the hillsides and plateaus. The negative ecological consequences on forests and in terms of erosion has not been fully explored. The Kédougou area will cease to attract those seeking better watered agricultural lands unless irrigation is available upstream of Kekreti through the construction of Kouya. New settlements along the lake will begin and their economic base is less likely to be agriculture.

The AHT estimates of populations to be affected by the reservoir are probably low because of the rapidity of the survey and the fact that the valleys and bottomlands are currently the most important agricultural areas due to the recent years of poor rainfall. Because of such population movements, work to date will have to be verified as the time for actual resettlement nears.

4.7.1.3. <u>Kouya, Kankakoure, and Kogou Foulbe</u>. Unlike the situation for Balingho and Kekreti, fewer people and communities are involved in the Guinean portion of the basin. The best approximation is six villages and 1,141 people for Kankakoure and Kouya. Given present assumptions, no villages would be inundated by a dam at Kogou Foulbe. Even assuming that some productive land will be lost, pressure is relatively low here, and alternative acreage could be found in the surrounding area.

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[14]See p. 6 of AHT Annex D for a list of Priority 1 and 2 villages.

4.7.2. Loss of Land

Four major kinds of losses can be anticipated: i) those resulting from the flooding of land upstream from the proposed dam sites; ii) those resulting from the ending of the annual flood when Kekreti is completed and the flood will be primarily stored for dry season power and irrigation releases; iii) those due to the amplification of tides and lack of freshwater downstream of Balingho; and iv) those due to the alteration or ending of tidal action upstream of Balingho.

In addition, there is the interaction of tidal action with the annual flood (or just the high waters without flooding) during the rainy season due to the combination of high waters and tidal action. The amount of land in cultivation and tidally/flood irrigated varies from year-to-year depending upon rainfall. The amount of area to be flooded by the dams on the one hand, and the area lost from the ending of tidal action and the annual flood have not been fully estimated. This was due to the lack of availability of the Marc Hurd aerial photos and the necessary ground truthing that would have to be done prior to mapping those areas most likely to be flooded or which would no longer be tidally irrigated.

The actual amount of land loss will depend upon the actual operation of dams, the size of the reservoirs, the productive potential of the draw-down zones, the amount of land under irrigation, patterns of rainfall and the water available in the upstream reservoirs. If, as currently proposed in the Rhein-Ruhr feasibility studies, Balingho were to remain closed all but twenty to thirty days a year thereby preventing salt from moving upstream, all tidal rice lands would be lost through the ending of tidal action. The feasibility of hydrological manipulation of the dams to simulate tides through gate closings, or leaving the gates open to permit tidal action will be determined by hydrologists, engineers and planners consonant with the goals of OMVG and Member States and their costs. The loss of tidally irrigated lands in The Gambia does not stem solely from Balingho but from Kekreti as well. During the rainy season, most of the rainfall above Kekreti will be stored for dry season use. This will end much of the annual flooding of the river as well as reducing the amount of river flow reducing tidal lands. To our knowledge, no one has yet calculated the loss of tidally irrigated lands in The Gambia if Kekreti were to be built first. Lastly, without the operational scenario for Kouya, the full picture of the socioeconomic impacts of different dam operations cannot be drawn.

4.7.2.1. Balingho. Agriculturally, the major effect will be on the loss of tidally grown rice. The downstream area at risk extends 50 kilometers, where there will be an increase in the tidal amplification of 0.4mGD. This rise will flood most of the rice areas presentl cultivated. In addition, with the loss of flushing, salinity levels will build up. However, giving current rainfall and river flow characteristics much of this land cannot now be cultivated. Upstream, tidal rice lands along the alluvial plain will be flooded from Balingho to Kuntaur when the reservoir is at 1.7mGD or above. In addition, lack of tides during the dry season would prevent most swamp rice cultivation the length of the Gambia and in its tributaries.

The hectares of swampland currently cultivated that would be lost are provided in Table 4.6.[15] They do not include bolons or land upstream of Kuntaur. The estimations are rough because they were made prior to the availability of the one-meter interval topographic maps.[16]

Increased salinity due to climatic changes has already rendered dry season tidal rice cultivation downstream of Balingho impossible; it has increasingly negatively affected rice production in the area between Balingho and Carrol's Wharf.

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[15]Carney, using the Gambian-German Forest Project Land Use Photo Map Data, obtained a different figure for the amount of tidal rice land lost than found in both the Water Resource Management and Gambia River Basin Development and Terrestrial Ecology and Gambia River Basin Development reports. These figures are in GRBS Working Document No. 46.

[16]There are other estimates of the land area involved. Thomas et al. (1979) state that there are 44,000 hectares of tidally effected plain between Yelitenda and Carrol's Wharf. Of this total 12,900 is likely to be adversely affected by the formation of acid sulphate soils and 21,900 are good for rice (much of which is already under cultivation). The remainder are primarily in mangrove -- although some mangroves have been turned into rice fields, and some overlap with the acid sulphate soils. This figures does not include the tidal land between Carrol's Wharf and Kuntaur, the approximate end of the Balingho reservoir. It is clear that a new and updated study needs to be made of the totals of tidally irrigated land that would be affected by both Balingho and Kekreti.

TABLE 4.6.

HECTARES OF SWAMPLAND CURRENTLY CULTIVATED THAT WILL BE LOST

Tendaba to Balingho	1,930
Balingho to Kuntaur	11,000
Total Hectarage Lost	12,930

University of Michigan, Gambia River Basin Studies, 1985.

Even in serious drought years such as 1983, when all flood recession rice failed downstream of Balingho, significant upstream cultivation continued, although reduced in some areas but not in others. It is difficult to calculate the amount of production that will be lost. One way to estimate is to assume an average size field per woman (since most are cultivated by women) and an average yield per hectare (see Table 4.7.).[17] The figures in Table 4.8. allow for different yields that have been registered for swamp rice.

TABLE 4.7.

NUMBERS OF WOMEN WHO WILL LOSE THEIR RICE FIELDS

	Hectares	Number of Women
Tendaba to Balingho	1,930	6,433
Balingho to Kuntaur	11,000	36,666
Totals	12,930	43,099

University of Michigan, Gambia River Basin Studies, 1985.

[17]The benefit-cost chapter in the Water Resources Management and Gambia River Basin Development report assumes the following: 30 percent loss below Balingho; 100 percent loss in the reservoir area; 50 percent loss from Kuntaur to Bansang; and 25 percent loss along the Sandougou bolon.

TABLE 4.8.

POTENTIAL LOSS OF RICE PRODUCTION

1. Downstream		
Yield per hectares (measured in tons)	Swamps Cultivated: Paddy (tons)	1,930 ha Milled (tons)
0.8	1,544	1,034
1.2	2,316	1,552
2. Upstream		
Yield per hectare (in tons)	Swamps Cultivated: Paddy (tons)	11,000 ha Milled Rice (tons)
0.8	8,800	5,896
1.2	13,200	8,844
2.0	22,000	14,740
2.2	24,200	16,214

NOTE: Yields range between 0.8-2.2 tons/ha. according to FAO, 1983. The average relation between paddy and milled rice, hand pounding, is 0.67.

University of Michigan, Gambia River Basin Studies, 1985.

From 6,930 to 17,766 tons of milled rice would be lost to production once tidal action ceased. This would be only for the area from Tendaba to Kuntaur, not upstream of Kuntaur and in the bolons (creeks). There are currently no sound estimates for total swamp rice production for all of The Gambia. PPMU estimates that it has varied from 11,000 to 30,000 tons per year. Swamp rice accounts for at least 70 percent of Gambia's total rice production. During recent years about 6,600 hectares of swamp rice lands have been lost to salinization and would be permanently lost with the construction of Balingho. In addition, areas currently not cultivated but which could be placed in cultivation could not be until the establishment of irrigated perimeters. According to the Gambian-German Forestry Project, the swampland remaining uncultivated is as indicated in Table 4.9.

TABLE 4.9.

SWAMPLAND UNCULTIVATED IN THE GAMBIA, BY DIVISION, 1980

Division	Hectares
Western Division	1,249.4
Lower River Division	11,234.3
North Bank Division	15,769.4
MacCarthy Island Division	29,796.7
Upper River Division	12,712.4
Total	70,763.2

University of Michigan, Gambia River Basin Studies, 1985.

From the village studies the average size of an adult woman's rice field holding is 0.3 hectares.[18] Table 4.7. indicates the number of women and hectarage potentially affected. These figures need to be augmented by upstream losses of tidal rice lands, some of which will be permanent (along the Sandougou, for example), some temporary until irrigated perimeters are developed. The magnitude of potential social disruption from the loss is nonetheless great, intensified by the tremendous resources -- human and material -- that will be diverted to the development of irrigation.

The shift from millet and sorghum to rice as a food staple is well documented (for all of the Gambia, not just the affected zones). A study done for the International African Institute (IAI) in 1979-1980 attempted to determine local grain consumption and the percentage of domestic grain consumption of household-produced rice. In the villages

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[18]This is a high figure. For Bati Ndar it is 0.27 hectares; for Chamen, 0.29 hectares; and for Tuba, 0.30 hectares.

[19]The sample size was ten households per village. The full study is being revised by its principal author, Denzil Phillips. These calculations are thus subject to amendment.

of Sankwia, Bureng, and Jassong (all in the upstream zones), the former figures were respectively, 38 percent, 54 percent, and 35 percent.[19] The percentage of household-produced rice in the household rice total was 48 percent for Sankwia 73 percent for Bureng, and 54 percent for Jassong. There is no reason to believe that these statistics do not represent the importance of household-produced rice for home consumption in villages where applicable.

If the lowland tidal rice areas are lost, there will be multiple effects on all dimensions of current production systems. Unfortunately, it is not possible to quantify all probable changes. Given the orders of magnitude presented above, there will be increased pressure to make up the difference through labor migration and increased upland cultivation. There may be a decline of nutritional levels in households that lose rice lands. In the two villages directly in the affected zone, Bati Ndar and Chamen, there are no more upland fields to put into cultivation. Rice will continue to be cultivated where possible (and with the potential return of good rains, other forms of rice cultivation might help compensate for the loss of swamp rice). However, given the already heavy pressure on uplands for millet and groundnuts, the loss of rice cannot be made up, especially by land short households. These exist in virtually all villages in the affected zone and will be at greater risk. There is no reason to believe groundnuts will not continue to be the key source of income for rural households. Among the Mandinka and the Wolof they are cultivated by men, as is true but to a lesser degree for Fula and the Serahuli. Millet no longer provides as much of subsistence and nutritional needs as it once did, due to decline in soil fertility, overuse, and the amount of land devoted to groundnuts; swamp rice produced by women has become the means for maintaining household production. Arable uplands are in much shorter supply than swampland, but when these are lost and greater pressure is placed on the uplands, present difficulties will only intensify.

Fish is a far more important source of protein than meat for most villagers. The effect of the dam on fishing is discussed in the Aquatic Ecology and Gambia River Basin Development report, and here it is only noted that the loss of ricelands heightens the importance of the potential decrease in fish availability. The problem may be of relatively short duration, while new or better adapted fish species increase in the downstream saline environment and in the lake above the dam. During this time, however, special attention needs to be paid to the nutrition of people currently dependent on fish as their major source of protein.

While difficult to quantify, as tidal action is suppressed, there will be a great shift in the use of the natural environment by people living close to the river. Our studies are agriculturally oriented, but it is clear that the use of forest products, hunting, medicinal plants, and pasture are quite important in village life. Not all aspects of the environment will be altered with dam construction, but the people of Chamen, who rely so heavily on their environment for building materials and food in times of scarcity, need to be kept in mind when thinking of the overall changes that will be produced.[20] A standing joke among SES field staff was that if one needed something, you could go shopping at the forest NTC (NTC stands for the National Trading Corporation of Gambia, which runs stores throughout the country). The natural environment continues to be of great import for the economic well-being of villagers. In particular, during years of scarcity such as 1983, it serves as an important source of supplemental fruits, nuts, and leaves for meals, as well as building materials.[21]

4.7.2.2. Kekreti. Agriculture in the Kekreti zone is concentrated along the Gambia River and its tributaries. The valleys contain alluvial deposits along with a more certain water supply. AHT estimates that 3,670 hectares of arable land will be lost, and this is the best soil in the zone. Although the number of hectares is relatively low, little comparable land will remain elsewhere after the impoundment fills.

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[20]The expected changes in vegetation and wildlife are the subject of a separate team report (see Terrestrial Ecology and Gambia River Basin Development).

[21]While labor analysis has not been completed for the two villages in the impact zone (Bati Ndar and Chamen), the data show much more time spent in gathering and fishing than in the other Gambian villages.

According to the Terrestrial Ecology and Gambia River Basin Develeopment report on soils in the Kekreti zone, much of the remaining area is marginal at best for cultivation, except in the highlands between the Diarha River and the Guinean border. This has been the homeland of the Bassari for at least the past century and will not be affected directly by the dam.

4.7.2.3. Kouya, Kankakoure, and Kogou Foulbe. The loss of agricultural land probably will be greatest at Kankakoure, depending on the actual boundaries of the reservoir. Much of the plain along the river is cultivated, especially the farther upstream one goes from the dam site. Around Kouya there is some relatively good agricultural land, particularly in the village of Simbaya and also on the other bank toward Madina Salambande. Little agricultural land would be lost at Kogou Foulbe. Because Kouya and Kankakoure have been fairly recently settled, the degree to which they could accommodate future agricultural expansion is unexplored. It may be that health or other unknown difficulties have discouraged people from settling there except in relatively small, dispersed communities.

As has been emphasized throughout in our discussions of the Guinean portion of the basin, particularly away from the central plateau there is a very high usage of the environment -- trees and tree products, fishing, hunting, gathering. This is also the case in areas to be inundated.

4.7.3. Differential Effects of Loss of the Balingho Rice Fields

Work in the tidally irrigated swamp rice fields is arduous and time-consuming. Children either must be left in the care of others or taken to the fields, which because of the high water is neither safe nor healthy. Still, the work has provided women a source of control over both production and consumption, and rice has contributed to the overall nutrition of households with access to its cultivation. The loss of rice fields will diminish women's access to what has become a household staple and will alter household structures because women will lose a major productive role. This issue will be discussed as well in connection with irrigation, a context in which one can see how (as in Jahaly Pacharr) project policy can effectively include women. In the case of the loss of swamp rice-land, large numbers of women are involved, households may be deprived of a highly nutritious food, and strains will be added to families already pressed to meet income and food needs. These consequences will vary among villages depending on the importance of or dependence on swamp rice. If the estimate is correct that 43 percent of the land to be put to irrigation is currently in production, then it consists overwhelmingly of women's rice fields. Rice is a more reliable crop than millet and sorghum, and because women have been more responsible than some men in providing food for the household, these losses may not be able to be mitigated. The disproportionate burden of the negative consequences of Balingho will fall on women and children, at least during the long transition to irrigated production.

The loss of tidal ricelands will affect not only women. If all women who lose rice lands have rights to plots elsewhere, pressure on the uplands will force people, when possible, to go even farther to find fields. The entire village agrarian system will have to adjust to new conditions. The scale of these adjustments is outlined in the section on mitigation measures.

Another social effect on families is related to the employment created by dam construction. If men work as wage laborers, an increasing burden of agricultural production will likely fall on the women. Men who obtain employment may not necessarily purchase food to compensate for their agricultural contribution; they may choose from a range of ways to spend their income, some of which may have deleterious consequences for household nutrition. Studies of dam projects in other parts of the world show that household income can go up while nutrition goes down.

4.7.4. Differential Effects on Minorities in the Kekreti Zone

The Department of Kédougou contains many small societies, minorities in the context of the Senegal population. The best known of these are the Bassari, but they also include the Bedik, the Malinke subgroups, the Diakhanke, and the Fulbe, originally from Guinea. The damsite at Kekreti is close to the heartland of the Bassari, who already are faced with internal and external pressures to change. In addition, there are explicit and latent interethnic tensions in the region. One characteristic of minority populations is their lack of access to resources and power, and because of this and their small numbers it will be relatively easy to resettle the affected populations. This should not disguise the obligation to recognize the uniqueness and fragility of these populations. The construction of the dam and the accompanying shift in population and resources will place the Bassari, Bedik, Malinke and Diallonke social fabrics at risk. The Diakhanke and Fulbe are less at risk and appear to be capable of a quicker adaptation to changing conditions.

The attraction of dam, road, and building construction will have significant effects on the region. According to the AHT plans, the regional patterns of transportation and marketing will be completely altered. Almost all adult men in the zone stated that they would like to work on the construction crews, which would drain manpower from the agricultural sector. Those who succeed in getting jobs will be out of agricultural production for the duration of the project and may never return. Even those who do not find construction work may leave agriculture or the area in search of income, and presumably this will increase the rate at which young men leave the land.

The hiring process itself will generate considerable ethnic tensions. The difficulties in ensuring equal access to job openings and balancing employment can be considerable. If the project hires a large number of nonlocal workers (which it is bound to do), this will add an extra dimension to the problem.

The Kogou Foulbe zone has similarities to Senegal in that it is the home of some of the same minority peoples, the Bassari, Cognagui, and Boin. Kouya will be constructed close to the heartland of the Diallonke (a few villages of whom are also found in Senegal). They are in the minority except in the subprefecture of Balaki, where those of high social rank hold political office. Historical conflicts with the Fulbe are diminishing but are still important.

The dam at Kekreti will also affect the same peoples in Guinea because of the close ties maintained across the national borders. Youkounkoun is very near Salemata, and patients often are referred from the latter to the hospital at Koundara. As in the Kekreti area, the smaller groups are removed from the political process in the prefecture of Koundara. Indeed, because the Bassari and Cognagui are viewed negatively by many, special attention should be paid to how they will be affected by the dams.

4.7.5. Marketing

4.7.5.1. Balingho. The area surrounding Farafenni and Jenoi, which includes the ferry and Trans-Gambian highway, is a major trade center in the basin. The proposed construction will intensify commercial and urban tendencies, attracting workers to build housing, the bridge, the dam and associated structures, as well as the connecting roads. It will also attract numerous people attempting to provide commercial services. In all, the affected towns will receive perhaps 5,000-10,000 new inhabitants. People are drawn to where money circulates, and this will intensify the rural exodus from adjacent villages. Current marketing patterns will be altered, intensifying the need for domestic products (particularly foodstuffs) and for much greater quantities of imports for the construction workers. The infrastructure built to transport materials for the bride and dam will probably outlast the construction period and will thus create a new urban center in the region.

4.7.5.2. Kekreti. Current patterns of marketing in the Department of Kédougou differ from those of the area around Balingho and most of Senegal. This is due to low population density, poor transportation links, and proximity to the Guinean border. The current village specialization and crafts dependent on the markets will be changed. Markets serve both Senegalese and Guinean villages. Most people come by foot since roads are relatively poor and truck transport is limited. The numbers of construction workers and their demands will overwhelm current structures. There may be a decline in agricultural production as rural populations seek to gain more income in construction employment or in providing a range of services to the new centers. There will be a dual disruption, at the time of construction and after the reservoir has been filled, when new roads and communication links are established. New weekly markets will need to be created after the inundation.

4.7.5.3. Kouya, Kankakoure, and Kogou Foulbe. Around these isolated sites, most marketing relies primarily on head loading (foot traffic) for moving goods in and out. Lacking vehicles and good roads, people walk long distances to the nearest large markets. Those living in Balaki, for example, must cross the Gambia River, which will be much more difficult when the lake is created. The same will be true along the Liti, where movement across the river is now easy. What truck transport there is in Balaki depends on the sole vehicle bridge across the Gambia, which will be flooded by the dam at Kouya. There is some international trade to Kédougou via Balaki, but this route appears less important than that via Mali.

Local marketing will not be much disturbed around Kogou Foulbe, but regional patterns will be altered by both Kekreti and Kogou Foulbe.

4.7.6. Migration

A very important and long-term effect of all the dams will be the movement of people. Historically, the Kekreti zone has been attractive due to the availability of water, which will only be intensified with the creation of a large lake. Presumably this will draw large number of livestock, especially during the dry season. The lake will be shared by the wild animals in Niokolo Koba National Park and the livestock elsewhere along the perimeter. People also will be drawn, although the agricultural possibilities of creation of a large lake are not yet clear; agriculture along the tributaries may suffer. Migration is far more likely to be motivated by employment opportunities, and the performance of the new population cannot be predicted. Without question, however, migrants will compete for employment and resources with the area's inhabitants. Again, minority status will be an issue.

4.7.7. Quality of Life

Dams alter lives. It is far easier for engineers to envision the dams than it is for people in the region to know how they will be affected by them. Planners cannot be certain about the long-term effects of major construction projects and consequent changes in the human and natural environment. The tendency is to reckon the short-term advantages and hope long-term goals and objectives will not be drastically altered. The people near Kekreti and Balingho will want the jobs and money generated, but they will probably not be prepared for boom towns, construction sites, increased prostitution, and the transformation of their environment. The people in the affected zones believe the waters stored will and can be used by them for year-round human and agricultural purposes. Much of their support thus far may be based on misconceptions and misunderstanding of how the dams actually will function. Kédougou and other towns such as Salemata will be transformed. Kédougou, already a center for exploration of Saraya iron and for hunting trips, will become an important recreation area for workers, a source of a range of functions required by the construction project. The telegraph, telephone, and postal services will need upgrading. New housing will be built, and new populations will enter the region first in search of jobs and then because of the permanent water source. Urban planning for Kédougou and Farafenni would be desirable.

If experience elsewhere in the world holds true, most of the jobs will not go to the local population. Data on the man-years required for construction of the Kekreti Dam and accompanying power systems indicate the work will be capital intensive and will require skilled labor. This is unlikely to be found in the affected zones. Services for the construction workers and engineers will be provided by those with greater skills and capital than are found locally. In short, without planning, resource allocation, and sensitivity, the benefits of dam construction do not accrue to local residents, yet failure to take into account the needs and skills of those in the region means the loss of human resources and potentially disruptive social consequences.

4.7.8. Employment

The following deals with employment effects on Senegalese, Gambians, and Guineans as well as improved communication and trade links. It does not take into account the irrigation programs discussed in Chapter 6.

For the populations just downstream and upstream of Balingho, upstream of Kekreti in the reservoir zone, and in the areas around the Guinean dams, the major benefits will be possible employment opportunities. There may be a range of jobs associated with the construction at levels of pay significantly higher than currently available; there assuredly will be income earning potential much greater than currently exists and access to a wide range of goods not presently available, particularly around Kekreti and in Guinea. New skills will be learned, and longer term sources of employment will be available after completion of the dams, roads, and power lines.

4.7.9. Electrification

Much of the population in and near the basin needs electrification. The only city with hydroelectric power is Labé. Mali, Koundara, Youkounkoun, Tougue, Koubia, Kédougou, and some of the small towns or large villages would benefit greatly and a process of small-scale rural industrialization might be created.

4.7.10. Roads

A major difficulty cited by informants in the Kekreti and Guinean affected zones concerned roads and transport, particularly poor during the rainy season. This problem will be tremendously alleviated by the new roads created for Kekreti, although bearing in mind they will alter current patterns. Kédougou, already rapidly changing, will be the center for communication and transport because large-scale construction must be avoided in the park. Guineans and Malians will be attracted to the town. Although the sites in Guinea are relatively isolated, people living along the major roads that will be improved will benefit greatly in terms of access to markets, ability to move goods, and communication with urban centers.

4.7.11. Lake Fishing

Seasonal activity is important, particularly in the villages on the Gambia River, less so along the tributaries during the recent dry years. The potential of such a development is discussed in the Aquatic Ecology and Gambia River Basin Development report. With a greatly increased population, many from the coast, there will certainly be considerably more demand for fresh fish.

4.8. Mitigative Measures

4.8.1. Resettlement

Both planned and spontaneous resettlement will occur. It has become accepted practice that those who lose all or a major part of their livelihood because of the consequences of dam building and reservoir filling will be relocated. In addition to the forced relocation due to the dam impacts there appears to be need for an organized system to acquire the necessary labor for at least some of the irrigation development, particularly in zones of low population density. It will be an important policy choice as to whether one gives highest priority for movement to irrigation zones to those who have been displaced by the dams.

The creation of reservoirs behind the different dams will flood some homes, fields, pastures, and other resources (e.g., trees, plants). AHT has carried out a preliminary study of which villages will be affected by the Kekreti reservoir and some general cost estimates of compensation and resettlement. A thorough, detailed study of land use and alternatives will need to be carried out for the impact zone of Kekreti building upon the AHT and GRBS studies.

The critical question for the antisalt barrage at Balingho concerns whether or not resettlement will be necessary, and if it is, how many people will be involved. The answer to the question will be based upon the criteria used for determining whether or not there are sufficient land and other resources for those people who lose their rice fields and grazing lands to makeup those losses. Or, are there alternatives involving a combination of drawdown agriculture, diking or bunding, or irrigation. If resettlement is not required, then there will need to be compensation for lands lost, new economic activities, and assistance in making the transition.

There are two major categories of Gambians who will lose rice land: i) those who currently cultivate on the floodplains between Balingho and Kuntaur whose lands will be permanently flooded by the reservoir, and ii) those who currently cultivate on the tidally irrigated land upstream of Kuntaur but who would not be able to do so if tidal action ceases. Many, but not all of these people, presumably would have access to irrigated land. However, there will be those along the boloas who would lose tidally irrigated land without irrigation development. The most urgent immediate mitigative measure is to initiate a study combining the results of the 1983 censuses (which were not available during the study) and the drawing of maps based upon the Mark Hurd aerial photos (the relevant ones were not available during the study) to determine the number of people at risk. It is recommended that a field study be conducted of how important swamp rice is in the diet and household economies of those who will lose lands. Judging by earlier studies (Philips, n.d.; Haswell, 1975) swamp rice constitutes a significant percent of domestic grain consumption. According to Coode and Partners (1979) thirteen percent of all cultivated land in The Gambia was in rice. If, approximately sixty percent of the land is in peanuts that leaves forty percent in grains of which roughly one-third is in rice (overwhelmingly swamp rice). These general estimates fit both with our studies in terms of land devoted to different crops and LRDC's survey of the relatively underpopulated Bansang Nibras area. These estimates then provide an indication of the importance of rice production in the overall domestic grain production. It is not an argument against irrigation but does signal that the loss of the rice production will have serious consequences for a large number of Gambian households and villages. In turn, such a study requires analyzing the possible responses of households to such losses and whether or not this will result in increased migration, and the degree to which these households would seek to migrate to areas of irrigation development.

Moreover, decisions with respect to resettlement or compensation for the loss of infrastructure for Freedom from Hunger Campaign (FFHC) projects will need to be made, since the current improved tidal and rainfed rice programs will have to be altered between Balingho and Kuntaur. Clearly, further hydrological work is needed to define the magnitude of disruption and possible resettlement required or at least diking. If the lake behind Balingho rises to more than 1.7 MGD (which it will according to Rhein-Ruhr and the Danish Hydrological Institute under fifty-year or hundred-year flood conditions) during the rainy season, inundation beyond the floodplain might occur.

Two of the three Guinean dams will require resettlement; Kogou Foulbe is the exception. In contrast to Balingho and Kekreti, it does not appear there will be a problem in finding appropriate agricultural land in the vicinity for displaced populations. There may, however, be unforeseen factors, such as disease (onchocerciasis, filariasis, and so forth), which would render some sites unsuitable. In general, the sacrifices required of the affected population around the Guinean dams are much less severe than at Kekreti and Balingho.

Kinds or types of resettlement need to be distinguished, along with their associated costs. In the case of Kekreti, AHT has made a preliminary study, but there are major gaps; one example is income from nonagricultural activities that might be lost through resettlement. A more detailed survey is needed at the time of dam construction for reasons detailed below. No such effort has been made for Balingho, since it has been assumed there will be no need for planned resettlement. This assumption is questionable as more becomes known about the loss of tidally irrigated land. Even if resettlement is not necessary, unless other economic opportunities are created, many people will no longer have sufficient land to ensure household survival.

Planned resettlement to new communities for work on irrigation perimeters will depend on the options selected by OMVG and national governments for the levels of technology and on the amount of labor required. If a mix is selected, as is discussed in AHT, LRDC, and this report, there will be places where labor is scarce, particularly in the Bansang Nibras area, the North Bank in MID, and in eastern Senegal. These will be likely locations for new settlements with access to expanded irrigated cultivation. One option would be to give first preference to people displaced by Kekreti and Balingho. There will also be spontaneous migration to these new communities as potential migrants assess opportunities along the new lakes and irrigation perimeters. These shifts will strain school and health facilities, land, and housing as well as bring a needed supply of labor.

Forced resettlement is difficult and painful at best. From the standpoint of settlers and planners, it is preferable to find reception zones in the same area. This would be the least disruptive solution, for it would allow existing populations and ethnic distributions to be maintained and would minimally disturb existing market and intervillage relations. In the Kekreti zone, finding comparable adjacent agricultural lands is unlikely. More detailed work is definitely required to assess the relative costs of developing land, wells, and other infrastructure in the relatively poor strip adjacent to current river bottoms, in comparison to the costs of moving people to better lands farther away. Two factors explaining present settlement shifts to the lowlands have been decreased rainfall and the difficulty in using animal traction on hillsides and rockier soils. Having left such areas for these reasons, people will not be eager to return.

In the case of Kekreti people have already demonstrated a willingness to search for new lands and water, but there and elsewhere, if resettlement provisions are not adequate, people will not stay. The choice of reception zone must be made very carefully in order not to waste resources. Some people envision returning to Niokolo Koba National Park, where they believe excellent lands are denied them by park authorities. Detailed resettlement studies are needed to avoid far greater costs in the future.

It appears that affected villages in Guinea could be consulted and with the assistance of technical staff decide on a new site. It is assumed that communities will want to continue living as independent entities.

In the very likely event that many people will be moved from the Kekreti zone, there will be consequences both there and in the reception area. These are enumerated below.

In Kekreti, there will be considerable loss of population and of productive labor, particularly to the arrondissement of Salemata, where there will also be increased physical separation of the peoples. Diakately will no longer be able to serve as a center of rural administrative organization and will be reduced to an unworkable size. Salemata, with its school, dispensary, mission, store, offices, and so forth, will partly need to be rebuilt. A realignment of regional ethnic distribution west of Kédougou will result from the removal of most of the Manding communities (although Mako is no longer included in the inundated zone), a development which would strengthen Fulbe dominance. Finally, when the Bassari lose their bottomlands to flooding, they will become wage laborers for the dam, increase their already high levels of migration, or retreat to upland cultivation.

In the reception zone expansion room for populations already in the region would be lost. There also would be social and political restructuring due to shifts in ethnic distribution and communication and trade patterns. Tensions most likely would develop as new communities are given resources that indigenous populations might also want.

There is no substitute for the thorough investigation and planning of all moves, with the full knowledge of both relocated and receiving populations. Resettlement sites have not yet been identified and will require careful study. Efforts must be made to ensure viability of new communities. If options can be presented to the affected populations and if they are actively involved in the choice process, their commitment to resettlement will be greater. Decisions should include which villages will be clustered and which separated in the new locations. Even though multiethnicity may be a fine ideal, past experience suggests that heterogenous resettlement goes against people's wishes. Ethnic homogeneity generates less conflict, greater cooperation, and an easier transition to new surroundings. Longer-term patterns and intergroup animosities will not disappear and should be taken into account if the new communities are to function well. While noneconomic concerns seem less important than others, experience with other resettlement projects demonstrates they can make or break the program. Choices may include: remaining in the current location but using land not currently under production or not intensively cultivated; or shifts to nearby areas out of the inundation zone. The creation of a reservoir can permit irrigated agriculture not currently possible but requiring supplemental funding for its establishment. This may be less expensive than removal from the zone, compensation for lost resources, and adequate resources to form new communities.

The appropriate public health measures for those displaced, including food and nutrition surveillance, provision of water and sanitation facilities and other measures appropriate to new health needs are discussed in the Water-Associated Diseases and Gambia River Basin Development report.

As potential areas are found for those needing resettlement a series of measures are necessary to avoid or reduce future conflicts over land, services and other resources between the resettled and those already living in the area. How new populations are introduced, whether resources are given to them which are not available to local populations, prior relationships, will be important considerations in determining appropriate responses. Given the current patterns of rainfall, and delining land base in the Senegambian portion of the basin, these will not be easy issues to resolve.

A dimension easily overlooked but emphasized by Scudder concerns towns. "A major social oversight of settlement planning throughout the tropics and subtropics is the lack of attention paid to rural towns as opposed to smaller rural service facilities with virtually no industrial capacity."[22] The point is well taken. Rural development involves hierarchies of communities, and linkages to rural service center. These linkages to towns will be more seriously disrupted in the Kekreti area whereas the dams will facilitate them at Balingho and in Guinea. For Kekreti, a major mitigative measure will be to reestablish the trading, marketing, and service links that will be disrupted. Kedougou will be the hub.

4.8.2. Mitigative Measures in Balingho

4.8.2.1. Downstream. Tidal swamp rice will no longer be cultivable between Tendaba and Balingho because of heightened salinity and tidal amplification. Therefore, efforts should be concentrated on improved rainfed cultivation by protecting areas through bunds and better water control. Coode and Partners have estimated that 3,000 hectares of potential rice area can be saved in this manner. In addition, the saline content of the soils needs to be analyzed, as well as the possibility of using more saline-resistant rice seeds until the lands are more adequately flushed. This saline condition results from long periods of tidal action and relatively elevated levels of salt due to low rainfall.

Upland crop inputs may need adjustment to compensate for shortfalls in swamp rice production. Alternatively, greater food aid will be required during the transition.

People may increase their out-migration as their agricultural options lessen and/or they lose their rice fields. The question will then become the degree to which they can or will serve as labor for the irrigation zones.

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[22]"A Social Science Framework for the Analysis of New Lands Settlements in the Tropics and Subtropics," in Michael Cernea, ed., Putting People First: Sociological Variables in Development Projects (Oxford: Oxford University Press, 1985).

4.8.2.2. Upstream. Given current engineering designs, it appears that tidal simulation (which would be a significant mitigative measure) is not feasible. As in the downstream zone, efforts can be focused on improving rainfed rice and alternative crops (such as maize). Within the reservoir area, swamp rice (both rainy and dry season) will be lost, but upstream of Kuntaur substitution will be possible with the new irrigated perimeters. The problem of phasing then becomes critical. As many cultivators as possible should continue with tidal/swamp rice until the inundation and irrigated or improved rainfed rice lands become available. However, the construction of Balingho (with or without Kekreti) will result in the loss of much or all swamp rice, and there is not sufficient land for irrigation to compensate given the current commitment to maintain the reservoir at 1.3 MGD. The construction of Kekreti without Balingho will also alter rainy season swamp rice cultivation. Controlled floods and incorporation into irrigation projects appear to be appropriate.

Another important mitigative measure will be the voluntary or spontaneous resettlement of people into the newly developed irrigated zones. Facilitated by the government, such a process could lead to greater use of irrigated perimeters and to slow the increased pressures on the upland fields by shifting settlement to the North Bank and other less populated areas. Once again, control needs to be maintained over relocation so that those who will be losing through the dam construction can, if they choose, obtain access to new resources.

A possible mitigative measure that requires on-farm experimentation is the use of lands in the drawdown areas of the reservoir. Various recession periods, the kinds of soils available at different times, the degree of moisture retention, and the most compatible crop varieties need to be studied.

In sum, to prevent an increase in the rate of out-migration alternatives must be developed for the affected populations. Options include drawdown agriculture, alternative crops, intensification of upland cultivation (through new inputs), options for resettlement in the irrigation zone, or training and education for jobs that can be used during and after the construction phases.

4.8.3. Mitigative Measures for Livestock

The major constraint in the Kekreti area in the past has been water. With the reservoir, increasing numbers of livestock will come, especially if current rainfall patterns persist. There will be added pressure on pasturage, which will be significantly reduced by the loss of flooded bottomlands. Current herding practices are to move cattle, sheep, and goats to pasture and water principally during the dry season. With the availability of water, one can envision animal raising becoming a specialization of the zone. There will be an increased demand for meat all during the construction phases, in addition to the growing market due to regional mine developments. The situation should be monitored for increased conflicts between herders and farmers, but no mitigative measures appear to be required initially.

The situation around Balingho will be somewhat different, since much of the dry season pasture will be lost and little is available elsewhere (again assuming current rainfall patterns). Water will become less of a constraint and may provide more opportunities for herders, lessening the competition between livestock and humans for water at the end of the dry season.

The need for mitigative measures will be greatest in the irrigation zones, where provision should be made very early for livestock access to water and pasture, especially during the dry season. Current irrigation plans will convert many lowlands now used for dry season grazing.

4.8.4. Education and Training

Programs can help local populations compete effectively for jobs, and unless such training is provided the possibilities will remain low. Programs also are needed to assist populations being resettled, to help facilitate the move, to demonstrate agricultural techniques appropriate to the new environments, and to see that the inputs provided will be used effectively.

4.8.5. Food Assistance

The determination on who receives food assistance and under what circumstances must be done during the construction period and the first few years of dam operation. Synchronization is critical as people lose their lands to the reservoirs or at the construction sites (particularly the villages of Balingho and Salemata). During the phasing in of irrigated perimeters, people also will be without productive land.

4.8.6. Planning

It is essential that effective governmental units be created in the three nations to cope with the different consequences of the dams: food needs, options for resettlement, protection of the cultural integrity of minorities, and other diverse tasks. These will create manifold challenges for the respective governments and OMVG at the same time that major technical demands will be made: regulation of water behind the dams, construction and maintenance of irrigation works, hydroelectric construction and maintenance, and so forth.

A key factor in success will be a resettlement organization with a division responsible for each country but with overall coordination and supervision functions. In particular, Kekreti will have a series of direct effects on the Guinean portion of the basin. An organization, nested within OMVG, should be formed as soon as plans are well specified and the technical dimensions of the dams and reservoirs are known.

4.9. Future Work and Phasing

The construction times and reservoir filling for the three highest priority dams (Balingho, Kekreti and Kouya) will determine the phasing of mitigative measures. In addition, since many of the details about Kouya have not yet been identified it is difficult to plan without greater information. For example, the filling of Kouya will have basinwide consequences since it appears that it will take the entire flow of the Gambia River for one year to do so. One does not know if this will be done in one, two, three, or more years. The consequences for food assistance, irrigation plans, effects upon agriculture, et al., will vary depending upon the plan chosen. In general, the operational scenarios for the different dams and reservoirs will be worked out by OMVG as they refine and finalize their plans. From the socioeconomic perspective, each operational scenario, and the phasing of construction (including the irrigation perimeters) will have a range of implications. While there are separate and identifiable dam impacts discussed in this chapter, there is also the sequencing and pacing of irrigation development. These are intimately interconnected since there will be the replacement of swamp rice by irrigated rice in many parts of The Gambia. And, given the current scenario for Balingho's operation and the potential loss of floods downstream of Kekreti, there will be a transition time between irrigation perimeter availability and the loss of swamp rice lands.

As OMVG continues its planning, several steps need to be accomplished. Most of these involve decisions as to what are the appropriate institutions that need to be involved or created to implement them, and how to obtain the necessary resources to carry them out. These steps are:

- Determine the resettlement needs arising from the construction of Balingho.

- Determine the resettlement needs arising from the irrigation development scenario as outlined in the OMVG <u>Draft Indicative Plan</u>.

- Identify for all the populations to be resettled, appropriate lands for resettlement. Determine whether or not there are specific development options that might become available to them because of dam construction and reservoir formation: Such a list might include:

  a. fisheries development, phased to take advantage of the initial increase in fish populations with lake creation;
  b. drawdown utilization both for agriculture and livestock utlization;
  c. agroforestry development immediately inland from the upper reservoir margin;
  d. incorporation of resettled populations in the irrigation perimeters -- the timing issue is particularly important here;
  e. nonagricultural employment of some people during the dam construction and irrigation development phases.

- Identify and develop the appropriate organizational structures for planning and implementing the relocation component. If the irrigation option is used widely, then there will be a strong linkage with whatever irrigation authority is formed by OMVG and Member States.

- The resettlement components will have to be well in place before finishing construction. Earlier dam projects have demonstrated the need not to wait for construction to begin to have plans in place.

• Special agencies may need to be created to cope with specific problems. One expected area would be assistance to women who lose swamp rice fields.

• Develop plans for food assistance during the period just prior to resettlement when populations may have reduced their food production due to uncertainty and for the period after resettlement and prior to successful adaptation to new circumstance. And for the time period when the reservoirs will be filling and both swamp and irrigated rice production will fall. In addition, if these years coincide with bad rainfall then plans must be made in advance for such a potential catastrophe.

• Once a decision is made as to how many of the Guinean dams will be built a full dam impact study needs to be done. This study in our view needs to both determine resettlement requirements and the sediment loads carried during the rainy season. Because of steep slopes, deforestation, and lack of adequate ground cover, run-off appears to be quite rapid. It is possible that there are a series of implications for interventions and programs in the upper basin to protect the watershed. This is the case even if the current sediment load would not unduly shorten the potential life of the highest priority Kouya Dam. Such a study might focus on how to decrease wood use in urban areas, decrease reliance on fire to clear fields, prohibit of animal traction on slopes to remove tree stumps and roots, prevent of cultivation along already eroded streams and gulleys and increase terracing.

• Forthright communication and a series of meetings with the impacted populations will be helpful in diminishing rumors and to help the populations define and actualize their options. In the absence of clear and reliable information people will either expect benefits that may not be forthcoming or disasters that probably won't befall them. In the end, irrigation development rests upon those who will work in the fields. A successful strategy probably rests upon generating enthusiasm and support from those whose work will make the programs work. For those who have to be relocated sensitivity, compassion and good planning can make a difficult situation less so.

• A system of monitoring is best established as early as possible. The system of monitoring and later evaluation can be thought of in three phases: a) predam construction; b) construction; and c) irrigation development/postdam construction. Monitoring considerations are outlined in Chapter 10.

5. THE GUINEAN PORTION OF THE BASIN

5.1. Introduction

The status and development of the Guinean portion of the basin are critical for the entire area because so much of the water of the Gambia River comes from the highlands of Guinea. The environmental integrity of the Gambia River's headwaters is essential to the most effective utilization of the basin's resources. In the Guinean portion there are greater opportunities for hydroelectric power and lesser ones for irrigated agriculture. Rural development questions focus on the degree to which dam strategies will alter positively the current major problems of the region. There also needs to be discussion of major issues that may not be addressed by dam construction. Currently, most of the population obtains its living through agriculture combined with herding, artisanry, and labor migration.

The three dam projects suggested by the Guinean government have various objectives which reflect both national development goals and efforts to coordinate a viable international strategy. The emphasis on hydroelectricity is balanced with irrigation possibilities and overall water control within the basin. In the case of Kouya, there are irrigation opportunities in Senegal upstream of Kekreti Lake, as well as general control over the river's flow and storage against possible droughts. Kogou Foulbe can potentially irrigate up to 12,000 hectares in the region of Koundara, including several plains. The proposed dam at Kankakoure appears to involve hydroelectric potential. The relative isolation of the areas adjacent to the dams is much greater in Guinea than in Senegal and The Gambia. The opening up of isolated and peripheral regions in northern Guinea will bring great changes. The expansion and improvement of infrastructure, roads, and programs for agricultural intensification will lead in new directions. These paths will be quite distinct, depending on how many and which of the Guinean dams are constructed. It should be clear, then, that this discussion can only be preliminary. Plans for development in the Guinean portion of the basin are in the formulation stage. The benefits, cost, and risks are incompletely known. Nonetheless, some clear patterns emerge. These are briefly discussed in sections on agriculture, marketing, migration, and environment.

5.2. Agriculture

In this section questions of available land, current commercialization, degree of self-sufficiency, and state policies are considered.

5.2.1. Available Agricultural Land

The first major question that needs attention is whether agricultural producers will have sufficient land for a growing population without interventions to improve productivity. To answer this question, field measurements were taken from a sample of ten compounds in each of eight villages, from each of the four prefectures in the basin. Only those fields under cultivation in 1984 were measured, resulting in a total of 507 with a combined area of 209 hectares.

Per capita land under cultivation ranged from 0.18 hectares in the high population density region of Labé to 0.37 hectares in the region of Koundara. Per capita land under cultivation for the basin was 0.24 hectares.[1] Using the latter figure and adjusting the Guinean basin population of 249,209 by a migration factor of 10.2 percent, it is estimated that 53,710 hectares were under cultivation in 1984.

Because fallow patterns vary widely throughout the basin, it is difficult to estimate precisely the total area of agricultural land. Based on observations of the field staff, it would not be uncommon to find fields in fallow ranging from one to three times the area under cultivation. Total agricultural land area calculated on the basis of ratios of different fallow to fields under cultivation in 1984 is shown in Table 5.1.

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[1]These figures are calculated on the basis of a sample population adjusted for long-term and seasonal migration. Long-term migrants were assigned a weight of 1 while dry season, rainy season, and unspecified season migrants were all assigned a weight of 0.5, resulting in a migration factor of 10.2 percent.

TABLE 5.1.

FUTURE LAND NEEDS IN THE GUINEAN BASIN

Year	Population	Land Under Cultivation	Total Field Area[a] Fallow/Cultivation Ration[b]				
			1	1.5	2	2.5	5
1984	249,209	53,710	97,752	119,773	141,794	163,815	185,836
2000[c]	385,740	83,135	151,306	185,392	219,477	253,563	287,648

NOTE:
a) Areas based on an adjustment of population figures by a migration factor of 10.2 percent.
b) Areas include estimates of sunture equal to 18 percent of total.
c) Figures for the year 2000 based on population growth rates specified in the Indicative Action Plan (2.65 percent through 1991; 2.86 percent from 1991-2000).

University of Michigan, Gambia River Basin Studies, 1985.

Table 5.1. also projects agricultural land requirements for the year 2000 in the absence of any change in soil fertility or technology. These projections indicate the severe land pressure that is likely to continue in the basin over the next fifteen years. The figure of 83,135 hectares represents a 55 percent increase in the amount of cultivated land that would be necessary to maintain the population at its current level of per capita food output. It is unlikely that this figure could be achieved without a drastic reduction in fallow time. Only a fallow to fields under cultivation ratio of 2.5 or higher would be sufficient to prevent the length of fallow from falling below the length of cultivation time by the year 2000, if no new land were transformed to agricultural use. For a village with a current rati. of 1.0, this implies a fallow period equal to the number of years of cultivation. This would mean fallow time would decrease to one year for every four years of cultivation.

It is not likely that the utilization of new agricultural land would be sufficient to prevent the projected reduction in either current food levels or fallow time. In many of the villages surveyed, there were reports of already reduced fallow times over the past fifteen years that were said to have resulted from demographic pressures. In the higher population density regions such as Labé, reduced fallow times have been accompanied by increasing rates of borrowed fields. All of this would point toward limits on the amount of new land that could be transformed to agricultural use in many regions of the basin.

5.2.2. Commercialization of Agriculture

As noted earlier, there are no dominant cash crop(s) in the Guinean basin. Various crops and fruits are sold at different times of the year depending on price and circumstance. As a means of earning income, agriculture appears to be less important than other activities. Despite the relative isolation of the area and the diversity of crop production (outlined in Chapter 3), most villages depend on the purchase of foodstuffs to survive the year. Many producers sell their crops prior to harvest in order to obtain money for food or other necessities. The single most important reason for seeking cash loans (26 percent of respondents) was food purchases. Paying taxes (18 percent) and ceremonial expenses (15 percent) were the second and third most cited reasons. Agriculture is important for obtaining income, but that income does not suffice in most households to meet food needs. The reasons are complex:

i) national agricultural policies have favored state farms and consequently have ignored smallholders;
ii) there are soil limitations;
iii) the infrastructure is poor;
iv) there has been an outflow of labor in search of income outside the rural sector.

Increasing population and consequent land pressure, combined with the already heavy reliance on purchased food (15-50 percent depending on the village) mean there will be growing agricultural problems. The greatest potential for trouble lies in the Koundara area, which also has the lowest rainfall.

The expansion of fruit production and marketing can easily be envisioned with the improvement of facilities and roads. Bananas, oranges, and mangoes grow well and abundantly. In some discussions with producers they cited the fact that more fruit rotted than could be eaten and/or marketed. Vegetable cash crop gardens have long been a feature along the Fouta's innumerable streams and rivers. These include not only tomatoes and onions (the most important) but also green beans, okra, pepper, cabbage, pineapple, carrots, and lettuce. Onions are grown in Telire to be sold in the markets of Tountouroun and Labé. Gardening possibilities are clearly linked to market accessability.

It is too early to tell the effects on agricultural production of lifting what was termed normes de commercialisation. Producers were subject to marketing quotas which required each active rural household member to sell a certain quantity of agricultural output at the government-established price. This was purchased by the administrative/party authorities through the Entreprises Régionales de Commercialisation Agricole (ERCOA). Certain crops were to be kept within the region (such as grains), while others could be sold outside. The fixed prices were far below market rates. Households which were food-short as a result of forced sales had to buy fonio, maize, or (domestic) rice at five to ten times more than the official price. The "commercialization" was designed to make cheaper food available to government employees in the cities, who could buy at official prices. The major incentive offered to producers was that they could buy certain key imports at official prices, particularly cement, iron, roofing material and sometimes, gasoline, kerosene, and diesel.

The widespread assumption that in the late 1970s and early 1980s Guinean rural producers reverted to subsistence production needs to be tempered, at least for the basin. The studies demonstrate a substantial dependence on purchased food combined with continued reliance on imported goods even if much of that trade was illegal under the previous regime. It was observed that efforts were continuously made to market what was possible and to engage in a wide range of income-earning activities. Maize, fonio, groundnuts, and rice are sold in almost all the local markets. Sales of these staples, however, do not in and of themselves, imply the production of a marketable agricultural surplus. Cash shortages, common throughout the basin, force a significant amount of food onto the market at harvest time (and, as noted already, before harvest). The subsequent lean periods are dealt with in a number of ways, including livestock sales, prolonged periods of rationing, and labor migration.

The larger question to which the answer is not apparent, is what amount of resources should be put into the difficult agricultural zones of the Guinean part of the basin. "Difficult" is used in the sense that there is less promise for producing a large marketable surplus of either grains (rice) or cash crops (bananas, coffee, pineapples) than in other regions of Guinea. It needs to be made clear that agricultural development in the area will benefit primarily local agricultural producers thereby making a contribution to the larger food deficit of Guinea. The most promising zone has been and will be Koundara, where the establishment of larger farms on the plains of Ounamou, Koundara, and others (both adjacent to and within the basin) has created an important zone for the production of rice and groundnuts.

The Koulountou zone provides the best possibilities for irrigated agriculture in the Guinean basin. Already, numerous farmers (who had been grouped into a modern peasants' association) have cultivated rice with the aid of tractors on the plains of Ounamou, and peanuts, millet, and fonio on the plains of Koundara. In addition, Koundara has long served as a zone of agricultural expansion, particularly for Labé, and has attracted particularly successful cultivators. Probably due to the use of both oxen and tractors, women have been excluded from farming large plots in these areas. Women's labor, however, is essential during the bottleneck harvest and threshing periods. (Weeding is not done for rice on the plains because the fields are inundated.) One problem with utilizing the waters of the Koulountou concerns the prevalence of onchocerciasis and possibly other maladies which have and will inhibit settlement. This is true not only in Guinea but from the frontier to the Koulountou's confluence with the Gambia River.

Within the Guinean portion of the basin that has both a highland ecology and a high population density (Labé, Mali and Koubia), emphasis needs to be placed upon more effectively utilizing the waters from tributaires of The Gambia (e.g., the Silame, the Salime, the Liti, et. al.) for the intensification of rainy season cultivation. Virtually all of the villages along the tributaries have some relatively flat, clayey plains, some of which are suitable for microbarrages. The three proposed dams are relativey far removed from the most densely populated areas and therefore cannot be of direct use for improving agriculture. Because of the close proximity of villages to each other along many tributaries, projects need to take account of downstream needs and impacts. Controlled agricultural intensification may lead to decreasing pressure on the more easily eroded slopes and to increasing food production to keep pace with population growth.

An important issue over the next few years and one which will affect development efforts is declining soil fertility, which influences both the <u>sunture</u> and the practice of shifting cultivation. For the <u>sunture</u>, livestock declines due to diminishing pasturage, taxation policy and income needs have resulted in decreased availability of manure, a key for the past success of these fields. The degree to which composting and other techniques can be substituted needs to be investigated systematically. The question of shifting cultivation is of long duration. There has been both a decrease in fallow times, combined with a shift from rice and sorghum to fonio. This has led to a greater reliance on the <u>sunture</u> for household consumption requirements. There needs to be much further research on fonio, on perhaps expanding the <u>sunture</u> using male labor (which would mean a substantial change in the current gender division of labor), and on alternatives to manure. These steps could decrease the pressure on the soil-poor and overused fields.

5.3. Marketing

The success of agricultural development hinges on an improved infrastructure and changes in marketing. It is intended that the liberalization of trade will, under more normal climatic conditions, foster an increase in cash crop grain production for domestic (Guinean) consumption. It is clear that rural producers should markedly benefit from being able to obtain real market prices for commodities (at least certain ones) that have had to be sold at official prices. The effects of these changes on the overall standard of living of people in the basin is not immediately obvious, due partly to the importance of international trade. Since merchant involvement in this network requires the use of convertible currencies not obtainable through official channels (although this is changing), the value of merchant exports must equal the value of merchant imports. The types of goods exported at present are a function of foreign demand. Market forces would most likely work against an increase of grains, in favor of the current cash crops of fruit and roots (manioc and taro), with the exception of rice in Koundara.

While nonagricultural activities remain an important source of income at the village level, especially in terms of regional trade (that is, pottery, bamboo, straw, tools, and so forth), competitive pressure may intensify a decline in their economic viability with the greater opening of the Guinean markets to imports. No statistics were collected, but clearly a great deal of income is directed toward large home building. Although there have been noticeable multiplier effects on the construction industry, there also have been adverse effects on the environment (deforestation) as well as on the balance of payments in terms of increased demand for cement, metal roofing, paint, and other construction materials imported by the government at official prices.

This type of consumption was partly due to a lack of confidence in the banking system and its unit of currency. It also reflects the continuing pull of the city of Labé and of regional inequalities. Improving the infrastructure to provide even distribution of diesel fuel, animal traction equipment, and other inputs might minimize the negative feelings of those in the less favored zones in the basin. Indeed, the morale of government officials outside Labé is an important component in development strategies for the Guinean basin.

It appears that the development of employment alternatives to both agriculture and migration would make sense for the highland basin. The greater agricultural potential around Koulountou and in adjacent river basins makes that zone more promising for agriculture.

5.4. Migration

Migration in the Guinean portion of the basin can be viewed as one among many different strategies employed by members of households to generate income, to escape from the rigors of village life, to attain the means to marry, and to reduce risk by diversifying the allocation of labor into different activities. Migration, rather than agriculture, particularly in the absence of cash crops or raising livestock, has become the more prevalent option among populations in this area -- particularly among young men. The causes are diverse and hard to alter. Some probable causes are: domestic policies which have discouraged investment into agricultural production; low official prices for agricultural commodities; no improved agricultural inputs; lack of marketing infrastructure or transportation; low purchasing power for goods sold at official prices; and tenfold price increases for goods in the unofficial or parallel market. Whether or not the new government's abolishment of commercialization and changes in the currency (not yet accomplished) will slow down rates of migration, is not clear. The loss of male labor is filled either by women or children, or not done at all. Improving rural education will be very difficult, given household labor needs.

The extent to which some portion of migrants' earning find their way back to the village either in the form of cash, imported goods or savings for the migrant himself to accumulate wives, build or purchase livestock, proved to be difficult to substantiate. The rural populations, having been heavily taxed in kind and through head taxes, were reluctant to openly discuss actual remittances and their multiple uses. The high rates of migration, and the amount of home construction do indicate that some savings are accumulated. Patterns of investment are likely to be different between poorer and richer households. The high frequency of unmarried men make it apparent that the resources to establish a household are obtained from their earnings.

Assuming that the goal is decreased rural labor migration, at least two questions are relevant. Will the proposed dams affect current labor migration patterns? To what degree are the goals of the dams affected by these patterns? The short answer is that the current strategy of OMVG and the Guinean government will not be adversely affected by labor migration. However, the longer-term livelihood of basin residents would be improved if more people stayed in agriculture or alternative activities rather than leaving. This answer needs to be qualified with respect to the area along the Koulountou, where there are few villages and for reasons not fully understood. To place the land in cultivation would take far more labor than is currently available in the vicinity. The more densely populated areas near Youkounkoun are not likely to be a source of supply since the studies have demonstrated that the most food self-sufficient populations in the Guinean basin are the Cognagui; they are much less likely than other groups to provide agricultural labor. In addition, labor drawn to regional towns and cities is reluctant to return to agriculture. However, given productivity declines in older rice growing areas (such as the plains of Ounamou), many producers would be willing to experiment with new lands once the details were clear.

In terms of the work associated with actual dam construction, much of the discussion in Chapter 4 applies. There will be a lack of skilled labor, but certainly an adequate supply will be drawn to the sites from the surrounding areas. The risk will be further declines in agricultural production, and there will most likely be competition for local labor between agriculture and other income-earning activities. The great resilience of the region's rural economy is illustrated by the several innovative local industries developed, including brick-making, house construction (with cement as well as other local materials), cash crop gardens, manioc plantations (prior to mosaic), tailors, and so forth.

5.5. The Environment

> The valley in which they lie [the sources of the Gambia and the Rio Grande Rivers], forms a kind of funnel, having no other outlets than the two defiles by which the rivers run off; man has never dared to use the axe in the woods which overshadow these two springs, because the natives believe them to be inhabited by spirits; their respect for these places is carried to such a pitch, that they are careful not to enter them, and if anyone had seen me penetrate within them, I should have infallibly have been put to death. From the situation of these two sources, in a basin, between high mountains, covered with ferruginous stones and cinders, and almost entirely destitute of verdure, I am led to conjecture that they occupy the crater of an extinct volcano.

This quotation from G. Mollien, the first French explorer to visit the source of the Gambia River (in 1813), points out both the lushness along the river and the barrenness surrounding the plains, which Mollien mistakenly assumed were volcanic. The contrasts between forested water courses and the sterile plateaus, between the luxuriant and productive sunture and declining soil fertility, have characterized the landscape for at least two centuries. From a developmental perspective there are two types of environmental issues. The first is basinwide, that is, the degree to which practices within the Guinea basin might affect dam construction and irrigation plans for downstream. The second is the consequences of environmental degradation on basin residents.

Broad concerns include: the rapidity of runoff due to the loss of forests and therefore possible changes in the flow from the Gambia River and its tributaries during the rainy season; the quantity of sediment loads due to erosion and deforestation, which might affect dam life and quality of water for other purposes; and changes in water quality if mining is instituted in the Gambia watershed. These environmental consequences of human actions need further study. Less directly linked to human activity is the widespread decrease in springs and permanent water sources; from the village studies there has been a clear decline in water availability and seasonal flooding along the Gambia River and its tributaries over the past several years.

Mining effects are discussed in the aquatic and terrestrial ecology reports (see Aquatic Ecology and Gambia River Basin Development, and Terrestrial Ecology and Gambia River Basin Development). There will definitely be a need for further impact studies as specific projects are developed.

The fragility and stability of the Guinean environment has long been discussed. Certain features, such as the barren grasslands (bowal) of the highland environment, have existed for centuries. Whether these bowals are expanding, and whether new ones will be created by opening up less populated areas has not been resolved. In addition, there has been lively discussion about the kind and rapidity of erosion in the basin. Certainly, cultivation on steep hillsides without terracing contributes to the problem, as does the ever-increasing demand for wood for fuel, furniture, and house construction in the urban areas, which also place increasing strains on the few remaining forests in the basin.

In discussions with many officials, a tendency emerged to blame cultivators and herders for environmental destruction. This view ignores the reasons for various practices and the difficulties facing much of the population. The most important cause of current deforestation is not farming but logging, spurred by Labé merchants and the boom in house construction. Control efforts by the Service of Water and Forests have been unsuccessful. While most peasants now respect national policy and do not cultivate adjacent to water courses on steep slopes, the labor to construct adequate terraces often is not available. In addition, committing such effort to shifting fields is not viewed as worthwhile by cultivators, who perceive (and in many instances, are correct) that terracing has less effect on erosion than adequate forestation.

5.6. Conclusion

The primary beneficiaires of agricultural investment since 1979 have been the FAPAs, now virtually gone. These were given relatively great resources, while the Ministry of Agriculture was correspondingly neglected. The FAPAs did not succeed in their missions as extension agencies and disseminators of modernization among surrounding peasants, nor did they do much adaptive research. Indeed, FAPA productivity appeared to be lower (when they grew the same crops) than that of the neighboring peasantry. The latter also wondered aloud why they had not been given the resources, and why long-term cultivators could not, even with the means, obtain needed inputs. The restoration of peasant and farmer confidence in the national government will need to be part of a development strategy. The establishment of the new government has led to the search for new directions in rural development. New institutions are clearly needed for better agricultural research, extension, producer prices, infrastructure, and rural organizations to replace what had become a highly repressive and exploitative party. The development of the Guinean portion of the basin provides an important challenge to both OMVG and Guinea in terms of more rainfed agriculture and other development initiatives apart from irrigation. If the latter will work, it will have to be in central Gambia, for the Guinean portion of the basin requires a different strategy to meet its development objectives.

6. IRRIGATION EXPERIENCE IN SENEGAL AND THE GAMBIA

A principal objective of the OMVG Member States is to promote cultivation of irrigated foodgrains to increase food self-sufficiency and improve rural incomes. Senegal and Guinea have various options for implementing a strategy to attain this objective. In the case of Senegal, expansion of irrigation is taking place in the Senegal River Basin, a zone made attractive for this purpose by the availability of ample sunlight and good alluvial soils, coupled with relative lack of insects, crop pests and weeds. Also, because of the increasing severity of drought conditions, irrigation is becoming one of the few remaining viable alternatives for producers in this region. With these advantages and with investments already made in two large dams and with scarce resources, Senegal will have to weigh the availability of resources that can be directed to the Senegalese portion of the Gambia River Basin. For The Gambia, on the other hand, the Gambia River is the only resource, other than groundwater, available to exploit for irrigation. The other alternative is the improvement of upland agriculture and swamp rice in the face of uncertain rainfall patterns. The country's choices are much more limited.

For the Members States to make crucial development decisions it is important to know more about irrigated agriculture in Senegal and The Gambia. What lessons have been learned from the relatively modest and relatively recent experiences with irrigation? How well have irrigation schemes done? How have the farmers fared who have incorporated irrigated fields into their farming operations? What are the returns to irrigated agriculture?

This chapter examines the role of irrigated agriculture, primarily the cultivation of rice, in the current farming systems of the Gambia River Basin. A broad comparison is made with previous experience in the Senegal River Basin, followed by a more specific delineation of experiences with irrigation along the Gambia River. Chapter 7 examines the role and profitability of irrigation in two ecological zones in the basin (Upper River and Middle River Zones).

6.1. Irrigation Experience in the Senegal River Basin

In analyzing the potential for irrigated agriculture in the Gambia River Basin nations, it is instructive to review other irrigation development experiences. In the aftermath of the severe drought of the early 1970s, many nations adopted programs for the expansion of irrigated agriculture using total water control methods. Though a variety of crops are irrigated (tomatoes, maize, sorghum and vegetables), the primary focus was and continues to be on rice.

Large investments in river basin and irrigation development were justified on the ground that irrigated agriculture would be more secure, stable and productive than rainfed agriculture. In addition, with double-cropping and the use of modern inputs, it was assumed that irrigated agriculture would generate large marketable surpluses which would diminish cereal imports and save foreign exchange. Finally, it was assumed that irrigated rice would significantly improve rural incomes.

Despite the tremendous financial and manpower resources that have been and are being invested in irrigated agriculture, expected production levels have not yet been reached. Chronic problems to date -- low average yields, underutilization of irrigated areas and abandoned/deteriorated perimeters -- have severely limited the contribution of irrigated agriculture to food self-sufficiency, foreign exchange savings and increased rural incomes.

There are a variety of reasons for irrigation's unstable performance to date:

i) inadequate design and construction of perimeters;

ii) inappropriate specification of agronomic variables;

iii) inappropriate equipment, poor maintenance and replacement of equipment;

iv) unreliable input supply;

v) low level of farmer managerial skills relative to sophisticated irrigation technology;

vi) inadequate extension services;

vii) administrative inertia on the part of development agencies charged with irrigation development;

viii) high costs of production relative to low value of gross output.

To compound serious system imperfections, many farmers have not embraced irrigated agriculture as foreseen in project appraisal reports. While some farmers have successfully incorporated irrigated agriculture into their subsistence farming system, cropping intensities of irrigated rice are in general significantly less than 200% (i.e., year-round double-cropping).[1] Much of the irrigated rice production is consumed locally and has not helped meet growing urban demand for rice. Despite substantial input subsidies, irrigated agriculture has not consistently proved to be a profitable activity for farmers (Caisse Centrale, 1982).

The economic performance of irrigated rice production at the farm level has been disappointing. While irrigated rice has contributed to household food self-sufficiency, especially for farm families on small perimeters, it has not significantly improved rural incomes. In fact, other irrigated crops such as tomatoes, vegetables and maize have proved to be important sources of household income.

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[1]There has been much discussion of the relationship between peasants and the organization of irrigation for the Senegal River Basin. Critical of the operations of SAED has been Adrian Adams (1977, 1979 and 1985). A more recent account of variations in peasant responses particularly in the upper river area is Richard Miller's 1984 dissertation. The discussions of the upper river focus upon diverse peasant responses to irrigation technology, the complex relationships to SAED, the creation of peasant alternative strategies to alter SAED's heavy emphasis upon rice, and the patterns of labor migration which affect the regional farming systems. Migration and remittances are discussed among the Soninke are analyzed by Weigel, 1982; for the middle valley by Delaunay, 1984; and for the Bakel area, but away from the river is Josserand, et al., 1985. Overall there is more evaluation of the upper river perimeters than the delta and middle river which is unfortunate since the delta has over 19,000 of the irrigated hectares in production.

The magnitude of these problems becomes clear when one looks at the efforts of SAED[2] to expand irrigated agriculture on the left bank of the Senegal River. Since 1965 SAED has been responsible for the development and maintenance of irrigated perimeters. In 1983/84 approximately 20,000 ha had been developed for total water control irrigation of rice and, to a lesser degree, tomatoes, maize, sorghum and vegetables. Production figures for 1983/84 are in the order of 75,000 T of rice, 20,000 T of tomatoes and 4,700 T of maize and sorghum.

The available irrigated area along the river's length is divided between large-scale, capital-intensive perimeters (from 240 to 1000 ha) and small-scale, labor-intensive perimeters (from 15 to 20 ha). Large-scale perimeters have proven to be significantly more expensive to develop and maintain than small-scale perimeters. Current estimates are that large-scale perimeters can cost between $10,000 and $20,000 to develop while small-scale perimeters are less than $5,000 and can be as low as $3,000 (USAID/OMVS, 1983). In the Gambia River Basin most perimeters are constructed and/or managed on the small-scale level, but a few large-scale perimeters are appearing in The Gambia.

While productivity and economic performance have, in general, been higher on small perimeters than on large perimeters, overall performance has been disappointing. The cropping intensity for all crops was estimated at 122% in 1983. Contributing to the low intensity is a declining rate of use of existing perimeters over time because of the rapid deterioration of infrastructure and equipment. Average rice yields on small perimeters are 4.7 T/ha. On large perimeters yields have ranged from 4.5 down to 2.9 T/ha in the middle valley and delta, respectively. The Caisse Centrale estimated in 1982 that 74% of irrigated rice production was consumed by the producing household. Production from the Fleuve Region now contributes only a small percentage to national rice consumption. In 1980/81 this contribution was estimated to be only 6%.

Until recently, rice produced in the Senegal River Basin has not been competitive with imports even in the Region itself. In 1980/81 it was

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[2] Société Nationale d'Exploitation des Terres du Delta du Fleuve Sénégal et des Vallées du Fleuve Sénégal et de la Falémé.

estimated that it cost an average of 153 FCFA/kg to produce rice domestically. At the same time the average delivered import price per kilo was 95 FCFA for 100% brokens, and the official consumer price was 105 FCFA kg. This implies that a 58 FCFA premium/kg was paid for locally produced over imported rice (Caisse Centrale, 1982), although it should be noted that rice produced on the Senegal is of higher quality than the 100% imported broken rice that is preferred by urban consumers. The government has in the past given substantial subsidies to rice producers in the form of services and chemical inputs provided at less than cost. SAED has to be subsidized by donor organizations as well as by the government. In 1980/81 the total subsidy was estimated at 1.6 billion FCFA or $3.5 million. The subsidies will continue to be needed for at least the next five years.

At the farmer level, irrigated rice is gradually taking on the characteristics of a more profitable crop in the Senegal River Basin. However, certain changes in government policy and SAED management has made this possible. These changes have included tighter financial management, better planning, and increased producer and consumer prices. Just as important has been the lack of many other agricultural alternatives in the region in the last two years. Even livestock raising is becoming more tenuous. However, the more favorable circumstances for farmer participation has not made irrigated agriculture any less expensive for the GOS to maintain.

SAED's experience with irrigated agriculture over the last 20 years indicates that the expansion of irrigated agriculture is constrained by a series of technical, managerial, and policy issues. There is strong evidence that sustained double-cropping and high yields will be difficult to obtain under the same economic and social conditions which have characterized agricultural production in this region in the past. A policy of rapid irrigation expansion, especially one based on large-scale perimeters, will require significant production subsidies which, in addition to the costs of dam construction and irrigation development, will add to the already heavy debt burden of participating nations. While increasing the debt burden is undesirable it is not clear that there are any other viable alternatives due to inadequate rainfall both for rainfed and recessional agriculture.

6.2. History and Performance of Pump Irrigation in the Gambia River Basin

Government-sponsored efforts to develop pump irrigation in The Gambia were initiated in 1966, roughly the same time as in the Senegal River Valley. A full ten years lapsed before pump irrigation was introduced to the Senegalese portion of the GRB. By 1983, approximately 3,200 hectares had been developed for pump irrigation along the Gambia River, downstream of the proposed Kekreti Dam site. The majority of these were designed as small-scale schemes requiring low capital-investment and high inputs of manual labor for construction by participants. The outstanding exception has been the large-scale (560 ha) capital intensive scheme at Jahaly Pacharr in The Gambia. This scheme combines capital-intensive construction, maintenance and management with smallholder usage. The scheme is also the major exception to a generally disappointing experience with pump irrigation when measured in terms of use and performance. The following sections review the experiences of The Gambia and Senegal with pump irrigation in the Gambia River Basin.

6.2.1. Historical Experience in The Gambia

Pump irrigation systems, though small in size, were first introduced on a significant scale in The Gambia in 1966 after the arrival of a Taiwanese Agricultural Mission. Over the next nine years at least 650 hectares were developed on over 90 separate perimeters, most of which were located in the McCarthy Island Division (MID). In the 1970s projects financed by the World Bank and the People's Republic of China (PRC) added more than 1,700 hectares of irrigated land. By 1980 a total of about 2,780 hectares had been developed on 311 different perimeters, although a portion had already been abandoned (see Table 6.1).

The separate missions from Taiwan, the World Bank and China have contributed in different ways to the establishment of small-scale irrigated perimeters. All had relatively low levels of capital investment with the World Bank project having the highest development cost/hectare of the three missions.

Records pertaining to the Taiwanese tenure in The Gambia are scanty at best. The Taiwanese operated completely independently of the Gambian

TABLE 6.1.

TOTAL IRRIGATED AREA DEVELOPED IN THE GAMBIA

Region	TAIWAN (1966-1974)		ADP (1973-1976)		PRC (1975-1980)		DEVELOPER UNKNOWN		TOTALS[a]	
	Hectares Developed	No. of Perimeters	Hectares Developed	No. of Perimeters	Hectares Developed	No. of Perimeters	Hectares Developed	No. of Perimeters	Hectares Developed	No. of Perimeters
MID/South	435.79	61	308.2	26	339.34	49	6.00	3	1089.33	139
MID/North	50.55	9	185.15	22	217.38	22	0	1	453.08	54
URD	160.06	18	0	0	602.53	66	76.65	15	839.24	99
	646.40	88	493.35	48	1159.25	137	82.65	19	2381.65[b]	292[c]

SOURCE: Department of Agriculture seasonal reports for the irrigated rice program, 1980 through 1984 reports.

NOTES: a)These totals represent those areas known to have operated in 1980 or later. They do not include areas abandoned before 1980.

b)Approximately 400 hectares of irrigated land are known to have been abandoned before 1980. Therefore, the total area developed between 1966 and 1980 is approximately 2780 hectares.

c)Nineteen perimeters are known to have been abandoned before 1980. Therefore, the total number of perimeters established between 1966 and 1980 is 311.

University of Michigan, Gambia River Basin Studies, 1985.

Department of Agriculture (DOA) and left no progress reports. They developed perimeters ranging in size from 5 to 15 ha with individual plots of about 0.05 ha. Taiwanese policy was to provide technical support and equipment for perimeter construction and to supply inputs only for the first cropping season. They then moved on to develop new schemes, leaving farmers to procure their own inputs in subsequent seasons. Although the Taiwanese double-cropping model initially appeared successful, in practice many perimeters operated far below capacity or were abandoned completely largely as a result of lack of inputs.

The World Bank Agricultural Development Project (ADP), which was in existence from 1973 to 1977, was by far the best documented. The ADP was designed "to be an extension to new areas of a technology...believed to have already been successfully introduced by the Taiwanese."[3] As envisaged by the Gambian Government, the two projects were to have been closely integrated.[4] The Taiwanese, however, offered all inputs to farmers free of charge the first year whereas the World Bank project provided loans and expected payment. The two projects therefore competed during the first year of ADP operation. The ADP project developed 600 to 800 rather than the projected 1,200 ha and fell far short of its objectives of achieving 200% cropping intensity, maintaining individual holdings at 0.40 ha., and channeling all incremental production to the public market.

The PRC team arrived in early 1975 and from the start was more closely integrated with both the ADP and the Department of Agriculture than the Taiwanese had been. For more than a year, the PRC worked on an *ad hoc* basis to complete the construction of perimeters begun by the Taiwanese and to develop their own methods of system maintenance. The team then developed new perimeters, following ADP policies with the exception that power tilling was promoted on PRC schemes, as it had been by the Taiwanese.

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[3]World Bank, *ADP Project Audit Report*, p. ix.

[4]The ADP project appraisal included 10 Taiwanese technicians to be attached to the project. In practice, only three technicians actually worked with ADP; after six months, one of the three had returned to Taiwan and another had been recalled to assist the Taiwanese Mission in URD.

Once ADP was completed in 1977, the Gambian government reorganized the irrigated rice program. The Department of Agriculture (DOA) took responsibility for maintaining existing perimeters, servicing and replacing equipment, providing seasonal inputs, and collaborating with the Department of Water Resources in a canal lining program. The DOA was assisted in the first two tasks by PRC mechanics and extension personnel. By 1980, when the PRC team left The Gambia, it had developed almost 1,100 ha on 112 new and 22 old perimeters.

In 1982, an effort was begun to introduce large-scale pump irrigation in The Gambia. Viewed as a pilot scheme for future irrigation development after construction of the proposed antisalinity barrage, the Jahaly Pacharr project includes three pump-irrigated and drained perimeters totalling 560 hectares: one 440-hectare perimeter in the Jahaly swamp and two perimeters of 75 and 45 ha at Pacharr. The project is cofinanced by IFAD (International Fund for Agricultural Development), the African Development Fund, the Federal Republic of Germany, the Kingdom of the Netherlands, and the World Food Program. Total project costs are expected to be US$ 16.5 million.

In 1980, when the last of the three missions departed, the DOA prepared an inventory of irrigated perimeters. The Ministry's calculations showed that about 400 ha on 19 perimeters had been abandoned prior to 1980 (see Table 6.1). Virtually all of the perimeters abandoned in MID/South are located west of Carrol's Wharf, which LRDC maintains is the western limit of suitable irrigation land. The abandoned perimeters in the Upper River Division (URD) are no longer cultivated, for lack of production inputs and credit. These abandoned areas are omitted from further discussion.

What characterizes the cultivation of the remaining 2,400 ha that have been developed since 1966 by the Taiwanese, World Bank, and PRC missions and how do they compare with the Jahaly Pacharr scheme? Based on information gathered from a sample of 32 irrigated perimeters, the paragraphs below describe cropping intensity, size of holdings, farmer participation, land tenure, input supply, credit, and the provision of various services.

A review of DOA data over nine cropping seasons (1980 dry season through 1984 dry season) reveals the cropping intensity which has recently been achieved on the national total of 293 perimeters (see Table 6.2). It is clear that the dry season is far more intensively cropped than the wet season. Nevertheless, during no season has 80% of the total available surface been cultivated. In fact, the figures show a sharp downward trend in the annual cropping intensity with a rate as low as 36% in 1983. No more than 16 of the 293 perimeters have been consistently double-cropped since 1980; 55% of all perimeters were cultivated four seasons or fewer during the same period. The Jahaly Pacharr project has achieved a much more promising cropping intensity -- 200% in its first full year of operation.

Data on the total number of farmers participating in irrigation has not been consistently collected in all regions. During the 1981 dry season, the most intensively cropped season since 1980, the participation of 8,484 farmers was recorded. Almost exactly one-half of the perimeters have 16-45 members. Individual holdings tend to be small. Fully 80% of the perimeters have an average household holding of about 0.45 hectare, while only 30 schemes -- about 10% -- have mean size holdings of one hectare or above. The Jahaly Pacharr project is uniformly divided into 0.5 hectare plots with each farm family generally receiving one plot. Larger families were often allocated more than one plot if it was determined they had the family labor to cultivate it.

The extent of farmer involvement in the creation and operation of irrigated perimeters differs considerably between the older, smaller perimeters and the new Jahaly Pacharr project. Under the Taiwanese, farmers selected a site and were responsible for the construction of earthen bunds and canals. The project limited itself to providing initial tractor plowing, leveling, and power tilling. After the first season, farmers took entire responsibility for the operation and maintenance of the pumps, canals, and bunds. For the most part, the PRC operated under the same system. They did, however, provide a bulldozer to assist in construction of bunds and the main canal.

The present system for small perimeters gives the Department of Agriculture responsibility for providing fuel and oil, maintaining pumps, and offering power tilling services. Farmers are responsible for all other aspects of perimeter operation and maintenance. They are organized into informal associations (societies) to administer the perimeter. In

TABLE 6.2.

IRRIGATED CROPPING INTENSITY, 1980-1984 (9 seasons)

Year	DRY SEASON			WET SEASON			Annual Cropping Intensity
	Area (ha) Cultivated	No. of Perimeters Cultivated (1)	% of Total Area Cultivated (2)	Area (ha) Cultivated	No. of Perimeters Cultivated (1)	% of Total Area Cultivated (2)	
1980	1833.11	243	74	964.08	175	39	1.14
1981	1875.67	240	76	353.93	87	14	.95
1982	1010.83	166	41	54.27	25	2	.42
1983	810.91	137	33	83.18	29	3	.36
1984	1021.48	152	41	N/A	N/A	N/A	N/A

SOURCE: Department of Agriculture seasonal reports for the irrigated rice program, 1980 through 1984 reports.

NOTES: a)Total 293 perimeters.

b)Assume total developed surface area is 2447.25 ha. If areas abandoned before 1980 were included, percent of total area cultivated would decline slightly.

general, each society is run by an elected president and committee. Some perimeters are managed by "master farmers"[5] who make all decisions and retain full tenure rights over individual plots.

In contrast, the organization of the Jahaly Pacharr perimeters is very centralized, with farmers playing a minimal role in the operation of the scheme. The project carried out virtually all construction operations, with farmers required only to build small bunds between their plots. Project staff controls all pump operations and maintenance and determines the watering schedule. Irrigation assistants manage water distribution to primary, secondary, and tertiary canals. It is only after water has been let into two-hectare fields that farmers become responsible for distributing water to their half-hectare plots.

Many perimeters have been established on virgin land, but some took over swamp land on which rice had been cultivated by women.[6] In these areas women lost all land use rights. Furthermore, they were virtually eliminated from participation as plot owners in the small-scale schemes partly because they could not contribute labor to initial land clearing and construction (a prerequisite for plot acquisition) but more importantly, because there were far more household heads demanding plots than could be accommodated.

The Taiwanese were able to avoid land tenure conflicts by invoking a 20-year community leasehold as allowed under the 1966 Land Act. They gave preference to virgin land; for land which was claimed, but not in use, they required the claimants to voluntarily waive their special rights to the land for the 20 years of the lease.[7] The ADP attempted

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[5]An individual farmer owning and cultivating a large tract of land on a commercial scale. Both rainfed and irrigated crops may be grown. A master farmer will typically own tractor plows and rarely a combine, which he will also rent out to local farmers. Investment capital usually originates in the non-agricultural sector, e.g. in real estate development in Banjul.

[6]This is corroborated by the World Bank Impact Evaluation Report, which states that six of the seven sample schemes not owned by master farmers were virgin lands cleared by the men of the villages.

[7]ADP Quarterly Reports, from Brautigam, p.4.

to establish written legal rights to land they were to develop for irrigation. However, the fact that customary laws recognize <u>usufruct</u> rather than <u>ownership</u> rights led to the abandonment of attempts to formalize land tenure.

Various criteria were adopted for distribution of land after completion of construction. Often plots were distributed by lottery, with each participant receiving an equal share. An extra allowance of land was sometimes given to the society president or other respected leaders in the village. In some cases larger families were issued more land.

Land tenure issues have proved to be of major importance to the Jahaly Pacharr project. The Jahaly swamp has been under a government lease since 1950, when the Commonwealth Development Corporation (CDC) requested land for its proposed rice development scheme. The project took advantage of this leasehold and proceeded with construction without seeking further permission from the original land "owners". In the Pacharr swamp, however, no such lease existed and the project succeeded in acquiring formal use rights from the villages concerned. A major oversight of the project was the failure to record pre-project land-use rights. This led to serious conflicts when the time came to redistribute the land upon completion of the irrigation infrastructure. The project established one land distribution committee for each swamp to ensure an equitable allocation, but problems arose nonetheless. One interesting outcome of the Jahaly Pacharr land distribution process was that instead of listing compound heads as plot owners, 99% of the land was allocated to the women of the participating farm families. Whether this represents a real change or is a strategy to please outside donors, remains unclear.

One aspect of the traditional land tenure system has noticeably changed with the introduction of irrigation. Although land rental has never been widely practiced, 23 of the 32 sampled perimeters stated that it is possible to rent irrigated plots and of those, more than half said that plots are more frequently rented now than in previous years. Apparently more women are gaining access to irrigated plots on rental terms, but not as plot owners. It also points to an emerging market for productive land.

Prior to 1977 varied and conflicting policies were followed in supplying production inputs to the small-scale schemes. When the Gambian government reorganized the irrigated rice program in that year, it adopted a uniform policy for input supply and credit. A "water charge" to farmers was instituted for pump operation and maintenance. Both the water charge and power tilling were provided on credit. Seed (for the first crop only) and fertilizer were also issued on credit, while pedal threshers were provided free of charge. In 1982, the Government of The Gambia (GOTG) rescinded the credit option for all inputs except water charges. The fees instituted in 1977 have remained unchanged.

Repayment of seasonal credit is theoretically due upon harvest of the crop. However, enforcement for small-scale schemes has varied greatly over time. In 1977, the rule seems to have been applied fairly strictly, but in subsequent years many farmers received new irrigation loans despite outstanding debts. When the loan repayment rate for the 1982 dry season fell to a mere 13%, strict adherence to the full repayment rule was imposed. In the same year the credit option for fertilizer and power-tilling was revoked. As is clearly evident in Table 6.2, the amount of irrigated land cultivated in the following wet season (1982) dropped sharply. In 1984, farmers were required to repay their loan for their last cultivated season only,[8] further illustrating the inconsistency of the loan policy. The present system of loan repayment clearly affects the cropping intensity achieved on the small-scale perimeters. Since the outstanding debt of an entire perimeter must be repaid before inputs for the subsequent season will be provided, the whole perimeter remains inoperative if some members are in default.

Most farmers save seed from the previous season's harvest or purchase seed from a local "master farmer". Much of the seed produced in the last two years at the Seed Multiplication Unit at Sapu went to the Jahaly Pacharr project and was not available to other farmers.

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[8]For example, a society which cultivated in 1982 and 1983 with both loans outstanding was only required to settle the 1983 loan to operate in 1984. But a society in default for 1981 which had not cultivated since then was required to settle that loan in order to plant in 1984.

The Gambia Produce Marketing Board (CPMB) retains monopoly control over the importation and sale of fertilizer. In past years, fertilizer was imported from outside West Africa, but in 1983 GPMB began importing from Senegal. GPMB markets its fertilizer through its licensed buying agents, primarily the Gambia Cooperative Union (GCU). As most irrigation farmers are cooperative members (primarily to market their groundnuts), they can obtain fertilizer through this channel.

The Rice Mechanization Scheme at Sapu, mandated to provide pumping and power tilling services to all operating irrigation perimeters (with the exception of the Jahaly Pacharr perimeters), is burdened with a series of problems. First, each of the three irrigation missions used different power tillers and pumps. This obliges government mechanics to maintain and repair a bewildering variety of equipment. None of the original Taiwanese power tillers are still in operation; and while the PRC mission imported more than 100 power tillers between 1975 and 1980, at most eleven of these were in use during the 1984 dry season. A similar situation exists regarding pumps and pump engines. Pedal threshers proved to be the most durable pieces of equipment left by the irrigation development missions, but they are now old and have not been replaced over time.

In 1982, the UNDP (with funds from the UN Capital Development Fund) agreed to provide 50 pumps, 40 power tillers, 5 small tractors, and 500 pedal threshers to replace old equipment. However, the new pump sets are far too powerful for the schemes they are servicing and cannot be utilized to their full capacity.

A final problem facing the Rice Mechanization Scheme at Sapu is that of providing fuel and oil to perimeters in a timely fashion. In practice, the centralized system rarely operates as intended. Delays in the arrival of fuel consignments have led to reduced yields and, in some cases, total failure of a crop. Government policy encourages farmers to tap commercial supplies of fuel and oil when the Sapu system fails. The cost of a commercial purchase is deducted from the seasonal water charge, but credit for the purchase of these inputs is not available.

In contrast to the situation facing farmers on small-scale irrigation perimeters, those participating in the Jahaly Pacharr project have thus far enjoyed the benefits of an efficient input distribution system. The pumps are new and were imported with an adequate supply of spare parts. The available pumps also include adequate standby capacity should one of the pumps break down. There have been no delays in obtaining the required fuel and oil, nor were any undue delays experienced in land preparation. A complete credit package covering water charges, land preparation and fertilizer has been made available to farmers through the GCU. For the 1984 dry season, 99% of outstanding loans were recovered.

The unreliability of the irrigation support network outside of Jahaly Pacharr appears to have induced farmers to substitute hand tilling or animal traction for power tillers. Of the 32 sample perimeters, only four reported cultivating their entire area with a power tiller. About 20% of the total area for the 32 perimeters was estimated to be plowed by hand while four of the sample schemes used animal traction to some extent.

As a general rule, inputs for irrigated rice production in The Gambia have been highly subsidized. Farmers participating in the Jahaly Pacharr project also pay an annual fee (including pumping, tilling, and fertilizer) of D1400/ha while the estimated total annual operating and maintenance cost is D2300/ha. Charges on a per hectare basis for the 1984 dry season for the small-scale perimeters are shown in Table 6.3.

Recently the Government took steps to reduce or eliminate the remaining input subsidies. It intends to eliminate fertilizer subsidies gradually over the next 5 years. The situation regarding the subsidization of pumping and power tilling services is less clear, however, since the real costs of these services to the government after the 1984 devaluation of the dalasi have not been calculated.

The irrigation extension service is made up of three agricultural superintendents, agricultural assistants and demonstrators. One superintendent is posted to each irrigation region (Sapu, Basse, and Kuntaur) along with an agricultural assistant. The agents coordinate the distribution of inputs and keep credit records but collect little or no information on pumping hours, cropping schedules or fertilizer application rates. Farmers from the sample perimeters see extension agents in the field but view them as administrative recordkeepers rather than advisors on irrigation practices.

In retrospect, it is generally conceded that the existing small-scale perimeters were too simply conceived and constructed without adequate

TABLE 6.3.

ACTUAL COSTS, SERVICE CHARGES, AND SUBSIDIES OF THE RICE MECH. SCHEME
(1980/81 Financial Year)

Costs/Charges/Subsidies (Dalasis)	Pumping		Power Tilling	Total
	Wet Season	Dry Season		
Total Cost				
Actual costs[a] - total	330,485	1,003,002	468,523	1,802,010
Revenue[b] - total	86,377	167,915	27,051	281,343
Subsidy - total	244,108	835,087	441,472	1,520,667
- as of % of actual costs	74%	83%	94%	84%
Per Hectare Cost				
Actual cost - per ha (after devaluation)	341 (426)	525 (656)	232 (290)	-
Present service charge - per ha	247	247	37	-
- as % of actual costs (after devaluation)	(58%)	(38%)	(13%)	

SOURCE: PPMU, "Actual Costs in 1980/81, Current and Future Service Changes of the Rice Mechanization Scheme and Effects of the Recommended Increased Service Charges and Income and Management Decisions of the Farmers." Paper Number 1, Banjul, January 1983.

NOTES: a) Based on commercial cost of fuel.

b) Loan recovery at rate of 35.8% of total loans issued (Total loan = D785,874).

University of Michigan, Gambia River Basin Studies, 1985.

consideration given to efficient land and water utilization. The ADP Project Completion Report cited soil porosity as a major constraint on their perimeters. Some groups of farmers interviewed during the sample survey indicated that the presence of both clay and sandy, more rmeable soils within the boundaries of a single perimeter made scheduling of water distribution difficult while increasing water demand and pumping requirements.

Land leveling within a perimeter is crucial to proper water control and distribution. The irrigation missions generally did primary leveling but left the leveling of individual plots to farmers. As this work is arduous and requires some precision, the final leveling was often below standard.

Although some of the design maps prepared by ADP and PRC include drainage canals, none were actually constructed. While the schemes are generally located in areas which are not susceptible to flooding from the river, rainwater runoff from the uplands often floods the perimeters during the wet season. This renders many areas unsuitable for irrigated cultivation. They could be partially used for rainfed swamp rice with a considerable loss in yield.

Overall operating efficiency may be calculated by determining application, conveyance and pumping efficiencies. Application efficiency is the ratio between the volume of water used by the plants in a given area to the volume of water delivered to that area. Conveyance efficiency is the ratio of the volume of water actually delivered by the canal system to the volume of water obtained at the supply source. The product of application and conveyance efficiencies gives total system efficiency. Overall operating efficiency is then determined by multiplying total system times pumping efficiency. Under the most ideal of conditions it is possible to have an overall operating efficiency of about 48%. For comparison, the Jahaly Pacharr feasibility study anticipated an overall efficiency of 34% (Euroconsult, Annex c, p.83.) In most of the Gambian small-scale perimeters, however, overall operating efficiencies in general are less than 20% because of poor canals, heterogeneous soil conditions, lack of proper water distribution control, and mismatched pumps and engines.

6.2.2. Historical Experience in Senegal Oriental

Irrigated rice production in Senegal Oriental is more recent in origin and smaller in scale than in The Gambia. It has developed under the auspices of SODEFITEX (Société de Développement des Fibres Textiles), a parastatal rural development agency whose primary mandate is cotton production. The agency also has programs for the intensification of cereal, primarily maize, production in rotation with cotton. Rice cultivation in Senegal Oriental was largely rainfed in nature until the late 1970s, when a persistant decline in rainfall made production physically impossible.

In 1978 SODEFITEX established the Périmètres Irrigués du Sénégal Oriental (PISO), with a grant from the European Development Fund. PISO has its own technical advisor and staff of regional supervisors and field agents. It works in the departments of Tambacounda and Kedougou on 17 perimeters covering 426 ha. One new site of 200 hectares remains to be developed. With development of the Gambia River Basin, further expansion is anticipated. At the time of this writing development is only planned within the Tambacounda department, downstream of the proposed dam/reservoir at Kekreti. The OMVG Indicative Plan, unlike earlier reports, does refer to irrigation development upstream of the Kekreti Dam.

The PISO mandate covers development, operation and maintenance of perimeters, technical support, provision of inputs through a seasonal credit scheme, and training for self-management.

In Senegal Oriental irrigated crops are viewed as a supplement to, not a replacement for, rainfed crops. Sites have been selected to permit double-cropping of rice and maize. Prime locations were natural catchment areas along riverbanks, subject to intermittent flooding by rainfall, runoff and occasionally the river. Rice was to be concentrated on the heavier clay soils, and maize grown on the sandier, better drained soils of the periphery.

Perimeters were designed to be small, labor-intensive and requiring a low level of technology. Capital investment and development costs per perimeter averaged 600,000 FCFA in 1984 prices.[9] While there were

[9]SONED, Vol. II, 1980, and personal communication with PISO staff, Tambacounda, 1984.

physical constraints to the size of a perimeter, the actual amount of area developed was based on demographic considerations and labor constraints caused by competition from rainfed crops. PISO planners estimated that average holdings would not exceed one-quarter hectare per household. The total area developed was based on the number of interested households within a 10 km radius of the perimeter.

Table 6.4 provides details on perimeter establishment, listing primary villages and perimeter characteristics. Several villages may exploit one perimeter, depending on the population density of the immediate area and the level of interest. Table 6.5 shows actual use of perimeters since 1978/79.[10] From these tables it can be seen that full utilization of irrigation potential, even in one season, has not been attained and that exploitation of the potential maize area has decreased steadily. Dry season rice is the obvious choice of farmers, even though PISO originally viewed supplemental irrigation in the rainy season as more important.[11] Farmers have progressively abandoned attempts at irrigated maize, complaining of low yields.

Farmers were not organized into users' associations until 1981. Prior to this, the PISO extension agent interacted with farmers on an individual basis, mobilized manpower for perimeter upkeep and directed irrigation operations. In addition, he was charged with securing credit repayment from members. Perimeter operation and maintenance suffered. Debt repayment was low.

Since 1981, the farmers of each perimeter must belong to an association called a Unité Paysannale d'Irrigation (UPI) with an elected administrative board. In addition, delegates are usually selected to represent farmers from the larger participating villages. Members of the board and delegates are all elected from among perimeter participants and compensated in kind by the UPI. Board members are gradually assuming operation and management tasks and are also being trained to keep records on inputs provided through PISO credit.

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[10]Number of households using the perimeter and average holdings are gross estimates arrived at by multiplying the total area cropped by four, and assuming each hectare to be exploited by four individual households.

[11]Supplemental irrigation only to cover deficits in rainfall and to permit early land preparation.

TABLE 6.4.

DEVELOPMENT OF PISO IRRIGATED PERIMETERS (in hectares)
1978/79 - 1983/84

Village	Diende	Leba	Madina Diakha	Netteboulou	Courientiene	Adiaf	Gouloumbou	Kirily
Year established	1978	1978	1978	1978	1978	1978	1979	1980
Area Developed	13	35	27.5	50	68	52	55	75
Suitable for Rice	5	26	16	14	55	48	35	55
Other[a]	6	5.5	8.5	31	6	1	14	12
Infrastructure	2	3.5	3	5	7	3	6	8

Total area developed (ha): 426.5
Area suitable for rice (ha): 289
Area suitable for other (ha): 95
Infrastructure (ha): 42.5
Total irrigable area (ha): 384

Average size plot: 1/4 hectare or 2500 m^2
Average holding, per household:
PISO estimates: 1/4 hectare
IVS estimates[b]: 2698

SOURCE: Projet Perimetres Irrigues du Senegal Oriental (mimeo), J.L. Bolly SODEFITEX, Tamabcounda, April 1984.

NOTES: a) Sandy soils suitable for crops requiring good drainage. PIDO anticipated maize and bananas.

b) Of subsample.

University of Michigan, Gambia River Basin Studies, 1985.

TABLE 6.5.

USE OF PISO PERIMETERS, 1978/79 - 1983/84

A. Hectares cultivated in rice and as % of total area suitable for rice

	Diende	Leba	Medina Diakha	Nette-boulou	Couri-entine	Adiaff	Gou-loumbou	Kirily	Diali-ko
1983/84									
W.S.		67%	44%	-	-	18%	-	11%	-
D.S.	-	94%	92%	66%	51%	92%	66%	45%	36%
1983/84									
W.S.	-	-	-	-	-	-	-	-	-
D.S.	-	-	70%	-	71%	-	-	-	40%
1982/83									
W.S.	-	-	-	-	-	-	-	-	24%
D.S.	85%	90%	-	64%	83%	97%	84%	58%	-
1981/82									
W.S.	5%	-	-	4%	18%	-	39%	-	-
D.S.	150%	108%	141%	46%	57%	84%	83%	30%	-
1980/81									
W.S.	140%	17%	123%	86%	55%	-	39%	-	-
D.S.	125%	35%	128%	4%	-	25%	26%	-	-
1979/80									
W.S.	65%	13%	14%	-	53%	7%	-	-	-
D.S.	-	75%	-	-	-	-	-	-	-
1978/79									
W.S.	-	-	31%	-	36%	23%	-	-	-

NOTE: Percentages of suitable area cropped in rice exceeding 100% indicate that area considered unsuitable for rice was put in rice.

TABLE 6.5. (con't.)

B. Total hectares cultivated in other crops, all PISO perimeters,
Tambacounda department

	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84
Maize	7.5	22.5	2.5	1.75	-	-
Bananas	-	-	5.5	-	11.25	0.25

C. Percent irrigable area used of all perimeters, by year
(Annual Cropping Intensity)

	1978/79	1979/80	1980/81	1981/82	1982/83	1983/94	1984/85
Dry Season	12.7	27.6	47.4	49.7	16.7	47.1	-
Wet Season	17.5	18.4	23.[illegible]	6.4	2.2	-	10
Total Years	30.2	46	70.8	56.1	18.9	47.1	10

SOURCE: PISO annual records, Tambacounda office.

University of Michigan, Gambia River Basin Studies, 1985.

Membership in the UPI is automatically granted to those who participate in the initial clearing and development of the perimeter site and who have subsequently maintained claim to a plot. Membership is terminated indefinitely upon default of loan repayments. Women are denied membership, not on the basis of gender but because the traditional sexual division of labor excludes them from initial perimeter development. Since they are granted use of a perimeter plot by their husbands, their exclusion from membership has not been an issue to date.

The UPI are generally recognized by members as a positive development, but they are far from achieving the self-management capacity aspired to by PISO and farmers alike. The UPI boards rely heavily on PISO field agents for direction, even for relatively straightforward tasks such as scheduling communal work days.

The majority of perimeters in the Tambacounda department are located in lowland marsh areas not recently used for crop agriculture. Past use included fishing, livestock pasture or watering, and some hunting and wood gathering. In most cases one or two villages were identified as having established claims on the land, although residents of other nearby villages may have exploited marsh resources. PISO obtained permission to develop land through consultation with regional authorities and village representatives. Village agreement to participate meant that all former claims to the land were abrogated.

Herders have suffered the greatest loss with the development of pump irrigation, as livestock needs were not taken into consideration in perimeter design. Nonetheless, open conflicts between herders and irrigators are relatively rare, since access lanes to river watering sites are still available at other nearby locations.

Perimeters were divided into plots along contour lines and natural relief features, with the average plot measuring 1/4 hectare (2500 m^2). The number of plots allocated per household was determined on the basis of family work units available. The project design had estimated that a typical household of 4.2 work units (9 members) could manage a one-quarter hectare without imposing an onerous burden on existing rainfed crop systems. Larger households received two, or at most three, plots.

Plots were allocated among participants by lottery, with priority given to local notables. The majority of plots went to male household heads. The one-quarter hectare plots officially recognized by PISO were further divided into 6 "pilotes", measuring approximately 420 m^2. While the technical reason for subdividing plots was improved internal water control, divisions have served as the basis for reallocation of land. The registered owner commonly will allocate one or more pilotes to family members, or occasionally give one in loan to a friend or a friend's wife. Table 6.6 illustrates plot redistribution within six sample compounds from the Adiaff perimeter. It will be noted that only 6 of the 21 fields were cultivated by the registered owner.

Households without established claim to a perimeter plot can gain access by several means. The most common is a seasonal loan from a friend who is not using all his irrigated land. The UPI also has the right to reappropriate for a season registered parcels left idle due to debt delinquency. This land, plus any unclaimed plots, are allocated among nonowners, usually upon payment of a small fee (1500-3000 FCFA). Before the 1983 drought, demand for plots was relatively low and access not a problem. Interest has risen, however, with the prolongation of drought conditions, and access has become limited.

Quality of land in perimeters is variable, depending largely on location relative to the natural basin or presence of isolated dunes. The high permeability of sandier soils found along the periphery causes excessive percolation for rice cultivation, a complaint of many farmers and the reported reason for abandonment of many of the outer plots. Women commented that they typically were allocated plots having sandy soils, while the household head used the better plots. Borrowers also tend to receive the less desirable plots.

PISO policy is to provide essential inputs for irrigated rice, fuel for pumps and pump repair on a credit basis for the duration of the crop season. Chemical fertilizer is purchased by SODEFITEX from a private supplier in Dakar, SIES,[12] and shipped to Tambacounda for distribution to the UPI. Fertilizer was heavily subsidized by the Senegalese government until 1983. In that year the retail price of fertilizer was

[12]Société Industrielle d'Engrais Senegalais.

TABLE 6.6.

IRRIGATED AREA CULTIVATED BY HOUSEHOLD, SODEFITEX SAMPLE 1984 DRY SEASON

Household	HH Size	PISO Area (m^2)	Owner[b]	Area IVS Plot (m^2)	Total Area (m^2)	Relation User/Owner	Terms of Loan	Avg. Area Per Capita (m^2)
2	10	2500	CC	679		Wife-CC	148.5 kg paddy to owner[d]	181.9
2				600	1819	Wife-CC	"	
2				540		Wife-CC	"	
6	6	2500	CC	1,724		Same	Owner cultivated	373
6				220	2232	NR	77 kg paddy to owner	
6				288		Same	Owner cultivated	
10	11	2500	CC	1,565		Same	Owner cultivated	220.4
10				860	2425	Wife-CC	No obligation	
20	4	2500	CC	2,104	2104	Same	Owner cultivated	526
29	7	7500	CC	2,350		Same	Owner cultivated	8920
29			CC	1,639	5741	Nephew-CC		
29			NR	1,752		NR		
40	7	500	CC	2,477		Same	Owner cultivated	522
40				258	3656	Wife-CC	No obligation	
40				921		Niece-CC	No obligation	
19	5	see 06	CC of 06	909	909	Kin 06	165.4 kg paddy to CC 06	181
							Overall average	377
							Average per household	2,698

SOURCE: IVS data.

NOTES: a) Area registered by PISO for that household.
b) cc = Household head.
NR = No relation to household head.
c) Total area cultivated in rice that season, measured by IVS staff.
d) One-quarter hectare plot subdivided among three users, each repaying the owner the equivalent of one-third of the user fee (irrigation and inputs) in paddy.

University of Michigan, Gambia River Basin Studies, 1985.

doubled from 25 to an average of 52 FCFA per kilo. In 1984 the subsidy was removed entirely, a move which raised Dakar prices to 125 FCFA and 75 FCFA per kilo of NPK and urea, respectively. Although transport to Tambacounda adds a 10% markup and SODEFITEX incurs a further transport charge of 1-2% in delivering fertilizer to the perimeters, the agency chose to cede fertilizer to the UPI in 1984 at the subsidized price of 52 CFA and 48 CFA per kilo of NPK and urea, respectively. SODEFITEX was able to do so in part because it retained a large stock from the previous year when the subsidy had been in effect. The price was subsequently raised to 70 CFA for both fertilizers, starting with the 1985 dry season, but it still remains well below cost.

Selected and treated paddy seed is sold to farmers at a subsidized price set by the GOS. PISO absorbs the loss by absorbing the costs of transportation, seed selection, storage, treatment and delivery.[13] Pesticides are also sold, but very little is purchased by farmers. Herbicide, whose use is still in the experimental stage, is provided free to a small group of selected farmers.

PISO collects an irrigation fee from its farmers at harvest. The fee is based on a perimeter's consumption of diesel fuel. It covers part but not all of the cost of diesel fuel, oil, pump amortization and pump repair during the season. The only component for which farmers are charged the actual market price is diesel. In 1982/83, the irrigation fee was 250 FCFA per litre of diesel consumed by the perimeter. This rose to 300 FCFA/litre in 1983/84, reflecting an increase in the official market price of fuel.

Repayment of credit for inputs and irrigation charges is in kind or in cash, the former being by far the more common tender. Credit default prompted PISO in 1981 to adopt a policy of collective loan liability whereby the UPI serves as intermediary between farmer and PISO, assuming ultimate responsibility for collective loans. In fact, the idea of collective debt liability is still alien and unacceptable to UPI members. This policy also stipulates that only perimeters having no outstanding loans can operate.

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[13] Personal communication; SODEFITEX, Tambacounda, 1984.

Table 6.7 illustrates the high level of loan default and subsequent inactivity of 6 of the 9 Tambacounda perimeters in 1982/83. Farmers attributed the high rate of default to high costs of irrigation and to the relatively low purchase price offered for paddy in 1982/83 (51.5 FCFA/kg). The ratio of production costs to value of yield is roughly 50/50 and considerably less when fields are smaller than one-quarter hectare. These smaller plots tend to be managed by women and tend to be lower yielding, reflecting lower labor input and possibly delays in performing operations.

PISO policy was modified in 1983/84 in an effort to revitalize the program and to help farmers recover some of their losses after the poor harvest of the 1983 rainy season. On a one-time only basis, members with outstanding loans were permitted to rejoin the program providing they reimbursed 50% of the arrears and accepted to repay the remainder at harvest, in addition to the current season's loan.

PISO places considerable emphasis on assuring reliable input supply. Supplies arrive on time, in sufficient quantity and in good condition, and distribution to farmers is well managed. The major shortcoming of the system is lack of diversity in goods supplied. For example, the only compound fertilizer made available has been 8-18-27, which was designed for upland cotton and has not been tested for its suitability for irrigated rice or maize. The only variety of rice currently offered, I Kong Pao, is acceptable in terms of disease resistance, yield under existing conditions and taste, but it has poor tolerance to cold. As a consequence, nursery seeding is delayed and growth is retarded during cold weather, which in turn renders IKP's growing cycle too long to accommodate double cropping. Having seed available for only one variety leaves the entire irrigated rice program vulnerable to diseases such as blast, which is endemic and not presently curable. Although to date there have been no known outbreaks of blast, the risk of it occurring increases with each season.

Marketing of paddy in amounts over 100 kg is prohibited except by an authorized government buying agent, in this case PISO. In years of normal rainfall, PISO policy has been to purchase from farmers as much as they wished to sell. Farmers usually opted to sell only enough to repay

TABLE 6.7.

PISO CREDIT REIMBURSEMENT, 1979-1984

Villages / Years	M. Diakha/Pakeba		Diende		Leba		Neteboulou		Courientine	
	Owed FCFA[a]	Reimb'd (%)	Owed FCFA[a]	Reimb'd (%)	Owed FCFA[a]	Reimb'd (%)	Owed FCFA[a]	Reimb'd (%)	Owed FCFA[1]	Reimb'd (%)
1979/80	896.165	44	358.060	36	943.745	40	45.100	0		
1980/81	2623.629	36	1527.874	64	2741.378	37	1078.545	5	3267.543	43
1981/82	1584.151	4	1117.134	35	3200.946	43	2342.579	5	4799.017	64
1982/83	1170.099	48	390.750	100	1778.375	82	1285.545	18	6036.950	60
1983/84	1088.794	54	-	-	1596.1	80	4728.984	66	2901.735	66

Villages / Years	Adiaff		Gouloumbou		Kirily		Dialiko	
	Owed FCFA[a]	Reimb'd (%)	Owed FCFA[a]	Reimb'd (%)	Owed FCFA[a]	Reimb'd (%)	Owed FCFA[a]	Reimb'd (%)
1979/80	666.825	37	353.450	77	na	na	na	na
1980/81	2745.176	77	2484.111	84	1025.975	94	na	na
1981/82	3649.258	44	3918.850	74	2553.013	48	na	na
1982/83	3228.280	81	2673.250	84	2457.245	53	1842.570	72
1983/84	4728.984	80	2799.6	74	2501.454	80	1598.346	84

SOURCE: PISO records, Tambacounda, 1984.

NOTE: [a]Total value of credit extended to the perimeter, culmulated annually.

University of Michigan, Gambia River Basin Studies, 1985.

PISO credit (or a part of it). After the poor harvest of rainfed crops in 1983, PISO was restricted to buying from each farmer an amount equivalent to the value of the seasonal loan and any outstanding arrears.

Small amounts of paddy are sold within the area or to retail merchants. Producer price in the private market is generally inferior to the set price but it still is not low enough, or the resale margins high enough, to incite greater activity by private merchants in paddy marketing.

Under the PISO program, each perimeter is assigned an extension agent to oversee operation of the perimeter. The one-to-one ratio of extension agents to perimeters does not change regardless of perimeter size or number of participants. In Medina Diakha, for example, there is one agent for only 76 farmers cultivating an area of 14.75 hectares.

Agents are usually recruited through SODEFITEX headquarters in Dakar. Past experience and education level of new recruits are extremely variable. In fact, the main weakness of the extension service stems from the limited technical expertise of agents. While able to apply set guidelines and recommendations, agents are ill-equipped to deal with a broader range of problems.

The principal tasks of the agent are to assure farmer compliance with recommended crop husbandry techniques, to oversee crop development, to verify performance of irrigation activities, and to assist the UPI in maintaining records of input distribution and loan repayment. Agents spend a considerable portion of their time assisting the UPI in loan collection.

Under close supervision, as well as through experience, farmers have learned to follow the prescribed timing of seeding, transplanting and fertilizer application, to adhere to density and spacing guidelines and to apply recommended dosages of fertilizer.[14] Irrigation schedules are generally followed.

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[14]Small amounts are resold at a relatively minimal price, to given, to neighbors, but the redistribution rate is slight on the whole.

The other agency promoting irrigated agriculture in Senegal Oriental is OFADEC (Office Africain pour le Développement et la Coopération), a nonprofit, nongovernmental organization. OFADEC operations have been financed in large part by Catholic Relief Services (CRS), by USAID, and by donations from Protestant church groups.[15]

Created in 1978, OFADEC was granted authority by the GOS to operate in the sparsely populated zone along the Gambia River between Niokolo Koba National Park and the Gambian border. It has sponsored development activities in 15 existing and newly created villages. New villages have been established on officially virgin land, although in reality any unclaimed land has traditionally been used for pasture, wood gathering and hunting by nearby villages.

In contrast to PISO's exclusive focus on pump irrigation and rice production, OFADEC espouses a more holistic approach to development. The agency provides social, technical and economic assistance to members organized into farmer cooperatives. OFADEC also supplies members with food aid, distributed through Catholic Relief Services, and a small monthly stipend (1750 FCFA). Although agriculture is an important component of the OFADEC scheme, emphasis is also placed on improvement of health, education and social conditions for the cooperative constituency. In agriculture, the major thrust is now on rainfed crops and irrigated banana plantations. Irrigated rice has played a very minor role in the OFADEC program. Only one perimeter has been developed for full water control irrigation in the dry season (Adiaff). It has been used twice, once in 1981 on a collective basis and again in 1984 on an individual basis. The current OFADEC thinking is that irrigated rice is not cost-effective.[16]

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[15]The initial USAID grant, provided under the Title III program, was for 181 million FCFA, over the period 1980-83. An one-year extension channelled through CRS provided another 129 million FCFA.

[16]LeBloas, 1984.

The original OFADEC model envisioned collective cultivation of all crops, principally rainfed cereals for home consumption.[17] Irrigated bananas and vegetables were to be grown by the cooperative to provide cash income. The "model perimeter" was designed with 25 hectares of irrigated bananas, 50 hectares of rainfed cereals and 5 hectares of irrigated vegetables (for 100 cooperative members).

Lack of interest in collective cereal and banana production, evidenced by poor management of collective fields, prompted an almost total shift to individual or family level production in 1983. In 1984 the only remaining collectively produced crops were the older banana plantations and a few vegetable gardens. Collective cereal fields were distributed among individual members.

Irrigated bananas have emerged as unexpectedly lucrative, and have absorbed a significant proportion of farm labor.[18] The consequence has been little production of rainfed crops for domestic consumption. The provision of food aid and cash assistance appears to have contributed to this trend by assuring a measure of food security.

Future OFADEC developments will be concentrated south of Niokolo Koba National Park in the Kedougou department and along the Senegal River. OFADEC claims that new land suited for banana plantations along the Gambia River in the Tambacounda department is already exhausted, largely by OFADEC itself.

Membership in the cooperative association is required of all OFADEC participants. To foster solidarity, the association is supposed to be limited to 100 members. As a result more than one cooperative may exist in a village. OFADEC policy is to accept both men and women over 18 years of age as members of equal stature. In fact, men have been favored when demand is high and space is limited. In a typical household, only one or two individuals are participants, but they are assisted in cooperative tasks by the household at large.

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[17]Rainfed and irrigated crops were grown on large tracts of collectively cleared land, cultivated by the cooperative as a body and harvested grain distributed among members according to work input.

[18]Farmgate producer price of unripened bananas (1984) is 105 FCFA/kg, contrasted to initial OFADEC projections of 45 FCFA/kg.

The cooperative is an officially recognized, legal body with an administrative board elected by all cooperative members. Board members receive more assistance from OFADEC in the form of cash than do other participants. The membership is divided into work groups, each with a group leader.

OFADEC policy is to provide food aid and cash assistance for five years to newly established cooperatives to compensate temporarily for loss of food crops and income as a result of resettlement in OFADEC villages. When first instituted, cash assistance was 5000 FCFA/member. Later, monthly stipends for most members were reduced to 1750 FCFA/member, although members with special responsibilities received temporary extra stipends. In practice there has been some delay in cutting off these payments (Table 6.8) and in halting food aid assistance.

OFADEC envisioned that both rainfed and pump-irrigated crops would be grown on collectively cleared perimeters. Even on individually managed parcels, the practice of collective preparation of new fields is still followed. Cooperative members are expected to clear sites, uproot trees, dig irrigation ditches and prepare land for planting banana shoots. The use of heavy equipment for land clearing and construction has been largely eliminated on the ground that it encouraged a lack of responsibility among members. The willingness to clear new perimeters manually varies markedly by cooperative. Some have achieved impressive results (Sankagne III, for example), whereas others have been plagued by delays and poor quality work.

Like PISO, OFADEC assumes all infrastructure costs, including pumps, on collectively managed perimeters. For individualized plantations infrastructure costs are paid initially by OFADEC and recovered through annual payments by individual producers.

Land tenure under OFADEC differs fundamentally from that under PISO in that all newly cleared land is legally held by OFADEC and not the association of farmers. This is true even in existing villages. User, but not ownership, rights are extended to cooperatives for use by members. With the trend towards individualization, collective rainfed perimeters have been partitioned among members, and new banana plantations have been designed for individual management. Older banana

TABLE 6.8.

OFADEC; SUBSISTENCE FOOD AID AND CASH ASSISTANCE DISTRIBUTED, 1983

Cooperative	Year est'd	Number of Members	Semolina[a] (23 kg sack)	Milk[a] (23 kg sack)	Can Meat (340 gr.)	Cash Assistance[b]
Bantantinti	1977	171	1217	208	3130	77.500
Wassadou	1977	96	686	168	680	45.000
Adiaff	1978	106	1854	169	529	0.000
M. Kouta	1980	59	1734	124	1200	367.450
Koulari	1981	116	2073	156	611	2504.500
Koar	1981	84	3493	215	1458	1575.600
Sankagne II	1981	71	2478	92	640	1729.750
Sankagne I	1981	115	3531	492	576	2877.750
Faraba	1981	76	2427	158	889	1637.550
N'Guene	1983	59	456	73	155	895.705
Saal	1983	40	575	52	180	860.000

SOURCE: OFADEC Annual Report, Tambacounda, December 1983 and Linehan, 1982.

NOTES: a) Value of Food Aid (Linehan estimates, 1982)
Semolina 70 CFA/kg
Milk 120 CFA/kg
Can Meat 70 CFA/kg

b) 1750 CFA/regular member/month
2500-5000 CFA/specialized member/month.

plantations have remained collective, but there is little effort to sustain their fertility. Several have already been abandoned after at most 6 years of production out of a potential 15 years.

Layout of the OFADEC rice perimeter at Adiaff is similar to that of the PISO schemes, with 1/4 hectare plots subdivided into 6 pilotes. There appears to be no limit to the amount cultivated by a single family because plots are distributed to individual members rather than to households. There is a greater percentage of owner cultivated fields (8/16 owner cultivated as compared to 6/21 in the PISO sample). The OFADEC rice perimeter suffers from the same pattern of soil quality variation, however, and many plots are left unused because of excessive permeability, poor levelling and/or inadequate drainage.

A major feature of OFADEC's individualized banana scheme has been to eliminate variation in plot quality due to poor levelling. To avoid uneven flooding, irrigation is accomplished manually with a garden hose attached to a faucet. Soil quality throughout a single plantation is fairly regular and provides good drainage. Plot size is an issue. Males are allowed one-quarter hectare, but females have yet to receive any shares.

OFADEC's policy is to provide chemical fertilizers, seed and pump oil/fuel on credit at the official purchase price, although transport, storage and delivery costs are not passed on to cooperatives. OFADEC provides tractor services at no cost to the cooperative other than for fuel. The customary water use fee is calculated at harvest for rice or after a cutting for bananas. The total amount of diesel and oil used on a perimeter/plantation is divided among farmers proportionate to use. Unlike PISO, OFADEC recovers pump amortization and spare parts costs as separate items but collects fully only in the case of individually managed banana plots.

Individual fees for diesel on the OFADEC rice perimeter in 1984 were approximately 20,000 FCFA/quarter hectare or roughly double that charged for diesel, oil, pump amortization and repair on the PISO perimeters. Water use fees on individualized banana plantations are estimated to average 6,750 FCFA/month.[19]

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[19]Based on projected cost estimates for banana parcels, in a study prepared by OFADEC "Parcelization Proposal, Cost Analysis," (Dakar: OFADEC, 1983).

OFADEC's management of the marketing process has assured a 100% credit repayment rate for banana production. Loan payments are deducted from revenues before distribution to individual members. There is no formalized marketing of rice, however. Members who have not voluntarily repaid rice production credits by the time of the next banana cut risk having the amount withheld from banana earnings.

OFADEC does not have a well-established input supply source, as does PISO, and must spend considerable effort each year in search of supplies. It has on occasion been reduced to buying old fertilizer from surplus stock of other development agencies. Rice seedlings have been purchased by participants from neighboring PISO farmers who had planted more seedlings than they could transplant. The consequence of inadequate input supply has been lower than acceptable yields, especially in the rice perimeter. The effect on bananas has been forced abandonment of plantations and creation of new ones at great cost in labor time.

OFADEC does not market paddy. Most paddy is kept by members for household consumption. Farmers sell less than 20% of the harvest privately at prices similar to those obtained by PISO farmers. Banana marketing, on the contrary, is highly organized and regulated by OFADEC. In fact, the cooperative contract explicitly bars members from marketing on their own.

After marketing bananas through the official channels of the Ministry of Interior, OFADEC discovered merchants were willing to pay double the official price and bear transportation costs from the perimeter themselves. The price had climbed to 105 FCFA/kg by 1984, but bananas retail in Dakar for 300 FCFA/kg. National demand for bananas, estimated at 15,000 mt, is almost double local production, according to a 1979 report on fruit production and marketing in Senegal.[20] The Ziguinchor region is the other large producing area of Senegal.

Banana harvests occur every 2-6 months in a mature plantation. Most cooperatives have experienced difficulty in regulating the timing of harvest because of member reluctance to limit shoot emergence to one

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[20]LeBloas, 1984, citing J.P. Gaillard (1979).

shoot every three months. Irregular application of fertilizer, due largely to erratic supplies, has also contributed to difficulties in timing harvests.

OFADEC policy on extension services has changed over the years. Initially, OFADEC assigned an agent and several assistants to each cooperative. Numbers have been cut since 1983, partly in an attempt to delegate more responsibility to cooperative members. Older cooperatives now tend to share an agent with one or two newer settlements. After a salary dispute, OFADEC agents are now paid at least as well as, if not better than, their PISO colleagues. Field agents are recruited among private individuals or civil servants skilled in crop agriculture or engineering.

6.2.2.1. Factors relating to the technical efficiency of the system. In general, PISO and OFADEC rice perimeters were developed from the same model, stressing minimal capital investment in land leveling, canal lining, and emplacement of drainage facilities. The PISO schemes operate more efficiently, largely because of greater attention to design details and better access to technically competent construction managers. OFADEC's new banana plantations are designed with far greater care than was their rice perimeter. Table 6.9 summarizes the technical factors of perimeter design as they apply to PISO and OFADEC perimeters.

PISO perimeters are designed to receive water pumped from one or two motor pumps (Deloule pump with Lister HR2 or HR3 diesel engine) set on floats anchored near the riverbank. Water is lifted up through PVC[21] piping to a cement stilling basin located on the embankment. Penstock piping in most cases is buried for protection.[22] Irrigation water is carried from the stilling basin along principal canals following the outer contours of the perimeter. These feed into secondary canals joined at right angles. Some perimeters are equipped with a central drainage

[21]Polyvinyl coated.

[22]Pipeline conveying water from the floating pump to the canal stilling basin.

TABLE 6.9.

SUMMARY ASSESSMENT OF TECHNICAL FEATURES OF PISO AND OFADEC PERIMETERS

	PISO/Rice	OFADEC/Rice	OFADEC/Bananas (Buried Pipe Irrigation Scheme)
1. Feasibility Studies:			
General topo. map, plan	yes	yes	yes
Topo. map w/contour lines scale of 1:2000	yes	no	no
Topo. data for drainage	yes	no	no
Soil map, scale 1:2000	yes, but insufficient detail[a]	no	no
Socioeconomic studies	yes, rudiemtnary	yes, rudimentary	yes, rudimentary
2. Basic Strucutre and Equipment			
Pumping station	location: good bank erosion activity: low overequipped for area cultivated[b]	location: good bank erosion activity: high	location: good bank erosion activity: high overequipped for area cultivated[c]
Pump type	Pump: Deloule Engine: Lister (diesel), HR 2 or 3 Floats: fiberglass foam plastic, iron caissons Penstock: lightweight galvanized steel pipe with plastic pipe 0200 ha Buried for protection	Pump: Caprari Engine: VW (diesel) 2 or 3 cyulinder Floats: 4x2 barrels linked by wooden floor and 2 iron beams Penstock: intake of lightweight galvanized steel pipe, discharge with rubber pipe and plastic pipe, 0200 ha Buried for protection	same same
3. Irrigation System			
Canal network	Canals unlined, compacted mannually Slope controlled through cement drops Canal depth adequate Little evidence of wall erosion Some canal leakage	Canals unlined, compacted manually Slope poorly controlled, no drop structures Canal depth too great Significant wall erosion Some canal leakage	Buried pipe irrigation labor at adequate depth
4. Drainage System	No natural evacuation Minimal drainage construction[d]	same	NA

TABLE 6.9. (con't.)

5. Flood control[e]	Absent	Absent	Absent
6. Adaptation of land parcels	Manual leveling Moderately uneven relief[f] Excessive slope for rice at periphery	Manual leveling Moderately uneven relief[f] Excessive slope for rice at periphery	Manual leveling Minimal leveling required
7. Water Cotrol: Velocity of Flow and Pump Reliability	Flow velocity controlled with drops and slope gradation PISO est. optimal = 2501/ha Actual avg. est. = 2701/ha[g]	Poor control of flow velocity No estimate, but cost of diesel fuel/unit double PISO's costs	Flow measure at faucet of 1.2 l/sec adequate Need water meters (general and prepared) combined with values to control volume delivered
Pump Reliability:	Regular maintenance by PISO mechanic but inadequate use made of para-professional operators for minor repairs and basic maintenance Maximum delay for repairs = 24 hours Avg. # break downs/season = 4-5	Maintenance by OFADEC mechanic but use of paraprofessionals for basic maintenance and minor repairs Usual delay for repairs = 24 hours, but 2 weeks in special cases/lack of spare parts is problem Avg. # break downs/season = 4-5	
8. Road System	Feeder/access road constructed linking perimeter to village Poor acess from village to main road	same	same

SOURCES: Personal communication with PISO staff, Tambacounda, 1984.
Personal construction with OFADEC staff, Tambacounda, 1984.
LeBloas, 1984.
Berard, 1982.

NOTES:
a) Soils data not indicated on maps scale 1:2000.
b) Designed for cultivation of a larger area, based on initial estimates of demand.
c) Expansion of plantations anticipated.
d) Study (Berard, 1982) revelaed prohibitive costs of drainage and flood control construction
e) Protection against 100 year flood not considered essential by AHT (1984).
f) Could be corrected with improved drainage and with use over time.
g) PISO esimates based on calculations of pump diesel consumption, not measured efficiencies.

University of Michigan, Gambia River Basin Studies, 1985.

canal and a guard ditch. All canals are of earthen construction, compacted manually. Aside from the stilling basin the only cement structures are partitions between primary and secondary canals, and drops along secondary canals. Access to the perimeter is assured by construction of a feeder road leading from the village and encircling the perimeter.

The OFADEC rice perimeter is built along the same principle. However, since no detailed topographical studies or maps were prepared, there is poor fit between layout of the irrigation network and natural relief features. Excessive slope causes rapid flow along primary and secondary canals, and erosion of canal walls. PVC penstock piping carrying water from the floating pump to the stilling basin is not buried for protection, and erosion along the river embankment is a serious problem.

Rice perimeters under both systems suffer from drainage problems, lacking natural or man-made evacuation channels. Inadequate drainage limits the area which can be irrigated in the rainy season, but it is not a serious problem in the dry season. A 1982 study revealed that the construction cost of adequate drainage networks would be prohibitive.[23]

The improved OFADEC banana plantation, adopted in 1983, constitutes a radical shift in the approach to banana cultivation. Plantations are divided into one-quarter hectare plots and managed individually rather than collectively. Irrigation is manual, each tree watered one after the other. The system consists of a buried PVC pipe network and a faucet at the center of each parcel with water distribution in the parcel assured by garden hose. A major advantage of this system is elimination of the need for land leveling, since trees are watered individually and water is stored in a small basin circling each tree.[24]

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[23]Berard, P.M. Etude de la Protection contre les Crues des PISO (Bureau pour le Développement de la Production Agricole, pour la SODEFITEX/M.D.R., 1982).

[24]Leveling of river embankment areas was not only excessively expensive but unwise as it removed the nutrient-rich surface horizon of soil.

6.2.2.2. Summary comparison of OFADEC and PISO pump irrigated schemes. PISO and OFADEC both commenced operation of pump-irrigated schemes in 1978. Conceived with widely different objectives (improved food self-sufficiency versus holistic development via food and income security, respectively) and managed under two distinctive development approaches, they have gradually come to accept coexistence after an initial period of conflict. Tensions between the two were originally aggravated by competition over farmers, the latter exploiting the situation by arguing for services provided by one but not the other. OFADEC's cash and food distributions and village improvements stand in sharp contrast to PISO's policy of noninvolvement in community welfare programs.[25] The different management styles and program objectives have resulted in two distinct pump irrigation programs, each with a particular area of strength.

PISO's mandate has been irrigated cereal crops, namely rice and maize. Its strong point is rice; it has shown that with attention to perimeter design, a well-developed input supply system and close technical supervision, irrigated rice can produce relatively high yields of 5T/ha. Achieving these results, however, has been costly. Thus far, the expense has been borne by donors and by SODEFITEX, the latter with earnings from the cotton program. SODEFITEX maintains that administrative costs per farmer and per unit of output are excessive, and it is seeking means to streamline administrative and management operations. Further, despite extensive effort, cropping intensities remain low, averaging 50% over two seasons. Reaching higher cropping intensities is technically constrained by the fact that roughly 33% of the irrigable area consists of sandy soils ill-suited for rice. Because of the current emphasis on mastering rice cultivation, this portion remains unused and thus represents wasted investment and an impediment to benefiting from economies of scale.

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[25]PISO is charged with operation of an integrated development program in the department of Kedougou, combining agricultural development with livestock management, and health and water supply services.

Comparatively, OFADEC has a poorly managed irrigated rice program. Farmer attempts to grow rice have been hampered by an inadequate input supply system and irrigation inefficiencies. OFADEC rice production has suffered not only from poor input supply but also from lack of competent technical supervision. The frustrations of OFADEC cooperative members at Adiaff have been heightened by seeing better crop development in the adjacent PISO perimeter.

Banana production is, without question, OFADEC's strong point. The new individualized scheme is especially popular and promises to yield good returns with increased management and irrigation efficiencies. The long-term profitability of the scheme hinges on system and equipment upkeep, on provision of inputs, and on technical supervision. These have not been strong points of the OFADEC program to date. And while there is a growing technical knowledge of the crop, it remains inadequate to sustain high levels of productivity.

6.2.2.3. Farmer response to management strategies. Neither OFADEC's nor PISO's management strategy is considered exemplary by participants. PISO is criticized for its top-down approach, which is only slightly improved since the creation of the UPI. Farmers resent the high irrigation fees assessed through a formula they can not comprehend. At the same time, they fail to recognize that the fee does not cover all production costs. Nonetheless, they rate the performance of the PISO program higher than OFADEC's, and claim repugnance over the latter's regimented and collectively organized work program.

OFADEC members do complain of the regimentation, collective work and sanctions levied for absences, although they are somewhat mollified by adoption of the individualized production scheme. Members also resent their lack of freedom of movement, stipulated in the cooperative contract.[26] Opinion varies among cooperative members. Older members are grateful to have been provided with alternatives while younger members are more demanding of immediate benefits.

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[26]Participants are only allowed a specified number of leave days, in a policy adopted by OFADEC to eliminate the problem of free riders.

7. COMPARATIVE RETURNS TO IRRIGATED AND RAINFED SYSTEMS

This section examines primary data collected in three of the intensive survey (IVS) villages located in two different irrigation expansion (ecological) zones. These data have been analyzed: (i) to test the validity of assumptions made by existing pump irrigation projects about labor availability and farmer behavior, and (ii) to investigate the profitability of irrigated agriculture.

The basic conclusions of the analysis are that:

- family labor is underutilized most of the year but is nonetheless insufficient at certain peak periods during the cropping season;

- the uncertainties of the agricultural input supply system and high production costs combine to create strong disincentives to irrigated agriculture;

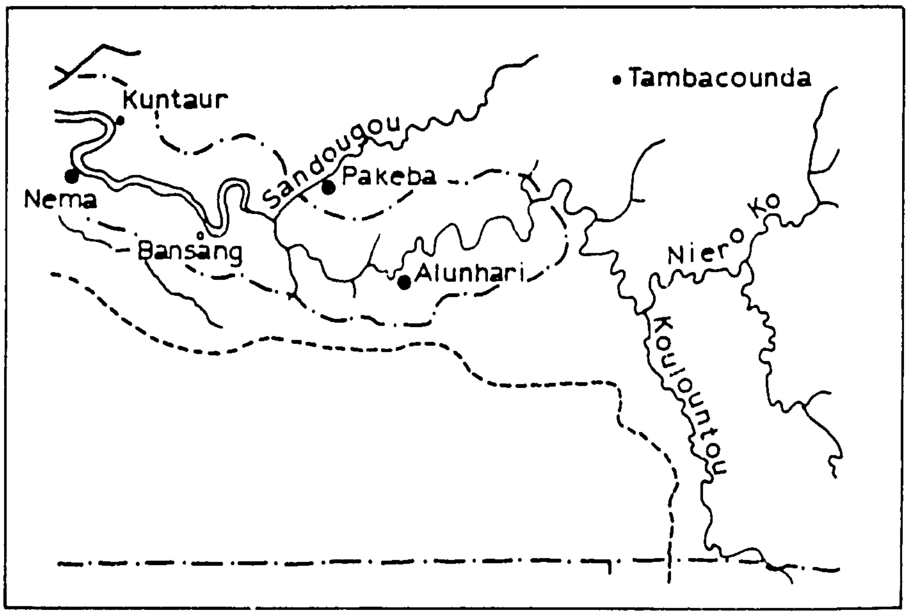
- those farmers that have successfully integrated irrigation into their rainfed system compensate by reducing the area planted to rainfed crops, in this case groundnuts rather than cereals.

The three villages are Alunhari, located in The Gambia in the Upper River Zone (URZ), and Pakeba and Nema, located in the Middle River Zone (MRZ) in Senegal and The Gambia, respectively (see Figure 7.1). Data were collected on both rainfed and irrigated agriculture during the 1983 rainy season and the 1984 dry season (Table 7.1). This was a poor year for rainfed agriculture with inadequate and erratic rainfall, although the impact was less noticeable in the Upper River Zone than elsewhere in the Basin. Crop failure in cereal crops was evident after a midseason dry spell in July, and labor input was curtailed accordingly. Consequently, two sets of farm budgets were prepared for Pakeba, the village hit hardest by the drought, one using IVS data to portray returns in a poor rainfall year, and the other using secondary data (AHT, 1984) to illustrate returns in a normal year.

The farm budgets are based on IVS data for input use, labor allocation per crop, and level of animal traction or tractor plowing employed. The IVS data also provided crop yield estimates and field measurements. For the second set of Pakeba budgets, estimations of

FIGURE 7.1.

LOCATION OF INTENSIVE SURVEY VILLAGES: NEMA, PAKEBA AND ALUNHARI



University of Michigan, Gambia River Basin Studies, 1985.

TABLE 7.1.

BASIC INFORMATION ON IVS HOUSEHOLDS FOR ESTIMATING COMPARATIVE RETURNS TO VARIOUS AGRICULTURAL SYSTEMS

Zone	Village	Population	Number of Households Sampled	% of Total Population	A. Number of Households With Double-Cropped Irrigation[a]	B. Number of Households With Single-Cropped Irrigation[b]
MRS	Nema	168	10	100	6	4
	Pakeba	239	13	100	None	13
URS	Alunhari	2420	35[c] (783 persons)	32[c]	4	5
Total		2827	33		11	22

NOTE: a) Refers to households using irrigation in both rainy and dry seasons.
b) Refers to households irrigating only in the dry season.
c) Of thirty-five households sampled 25 were for bimonthly questionnaires and 10 were both labor and bimonthly. Ten households with all production dated equalled 263 persons or 11% of total population.

University of Michigan, Gambia River Basin Studies, 1985.

normal year yields were taken from other published reports, in particular AHT (1984) and SONED (1980).

Official market prices were employed to determine variable costs of seed and fertilizer and value of crop harvested. No attempt has been made to calculate shadow prices since these are not the basis on which farmers decide whether to expand, diminish or compare cropping enterprises. Gross returns are expressed per hectare and per 8-hour agricultural man-day (MD).

For crop associations, it has been assumed that the primary crop occupied 67% of the land area in that crop association. With regard to equipment, even though many farmers own some, use of animal traction has been evaluated using the daily rental fee as a proxy for the opportunity cost of using equipment on one's own fields. Wage labor, when employed, has been valued at current local levels, rather than at the inflated government minimum wage level for unskilled labor.

The actual allocation of household labor to various agricultural and non-agricultural activities has been compared to estimated labor availability for Alunhari and Pakeba only. In calculating labor availability, a 10-hour day has been assumed for all activities, as contrasted with an 8-hour day for agriculture only. Activities have been divided into six major groups: agriculture, livestock, domestic activities, travel and absence, other income earning activities, and hunting, fishing and gathering. Average hours per activity have been calculated by dividing total hours for each age-sex category and activity by the total number of persons in the category. Labor hours are weighted by age-sex category; adult male and female hours are valued at 100% while children's hours are valued at 50%.

Each village is presented in detail before more general implications are presented.

7.1. Alunhari, Upper River Zone (URZ)

Alunhari was selected for analysis because of its irrigated agriculture and because the sample households can be divided into two categories: those engaged in irrigated agriculture (Group A) and those not engaged in rainy season irrigation (Group B).

Alunhari is experiencing an acute shortage of land for upland, rainfed agriculture. The shortage has been exacerbated by proximity to the regional market town of Basse, with its densely populated periphery, as well as by the large size of Alunhari itself. Much of the land used by Alunhari residents is borrowed from neighboring villages with a land surplus.[1] Like other Serahuli settlements, Alunhari has a high rate of labor migration.

The major effect of the shortage of land is a low land-use ratio, 6.35 ha of cultivated area per average household and 0.55 ha per working individual. Women predominate in the labor force because of frequent male absences which further accentuates the relatively low land per person ratio. The amount of land women can cultivate is restricted by the distances they must travel to borrowed fields and the competing demands of domestic chores.

The presence of a master farmer enhances Alunhari's value as a survey village. Certain farm households in Alunhari appear to have ready access to improved technology (e.g., fertilizer, tractor plowing) owned by, or made available through the auspices of, the master farmer. Access is facilitated through family ties to the master farmer. The impact of this improved technology on yields and on returns per hectare and man-day of labor is very evident in the analysis of farm and crop budgets. It should be emphasized from the start, however, that access to these technologies is restricted to a minority of farm households in Alunhari, and is even more restricted in other villages along the River.

The master farmer himself was not included in the analyses of farming systems in Alunhari on the ground that he is an extreme case. However, the division of households into two categories -- those involved and those not involved in rainy season irrigation of rice -- reflects their relationships with the master farmer.

7.1.1. Labor Availability and Use

The large size of Serahuli households is illustrated in Table 7.2. An average household is comprised of 5 adult males, 5 adult females and

[1]Much arable land in The Gambia is owned, in the traditional sense, by a village. Borrowing among villages is a common method of redressing land shortage problems.

5 children of working age, or 12.5 labor units. Elders and minors, not considered members of the working population, add an additional 8 members to the household. Not accounted for in Table 7.2 are members absent on long-term migration. For purposes of evaluating overall labor availability, it should be assumed that at least one adult male is absent all the time, representing the cumulative effect of frequent short term absences of males.

TABLE 7.2.

HOUSEHOLD COMPOSITION: UPPER RIVER ZONE (ALUNHARI) 1983-1984

	Individuals	Labor Units (LU)
Adult Male	5.2	5.2
Adult Female	5.4	5.4
Children over 8 yrs	4.7	2.4
Children under 8 yrs	7.3	0.0
Over 65	1.0	0.0
TOTAL	23.6	12.5

SOURCE: IVS data.

NOTES: Sample size: 9 Households.
Range in household size: 10-60 persons.

University of Michigan, Gambia River Basin Studies, 1985.

Labor availability for the average household is compared with actual use for the period June 1983 to May 1984 in Figure 7.2. The amounts of time indicated for travel and absence are unrealistically high due to long absences of individuals averaged over the total population. There is a tendency for males in Alunhari to be absent for long periods of time.

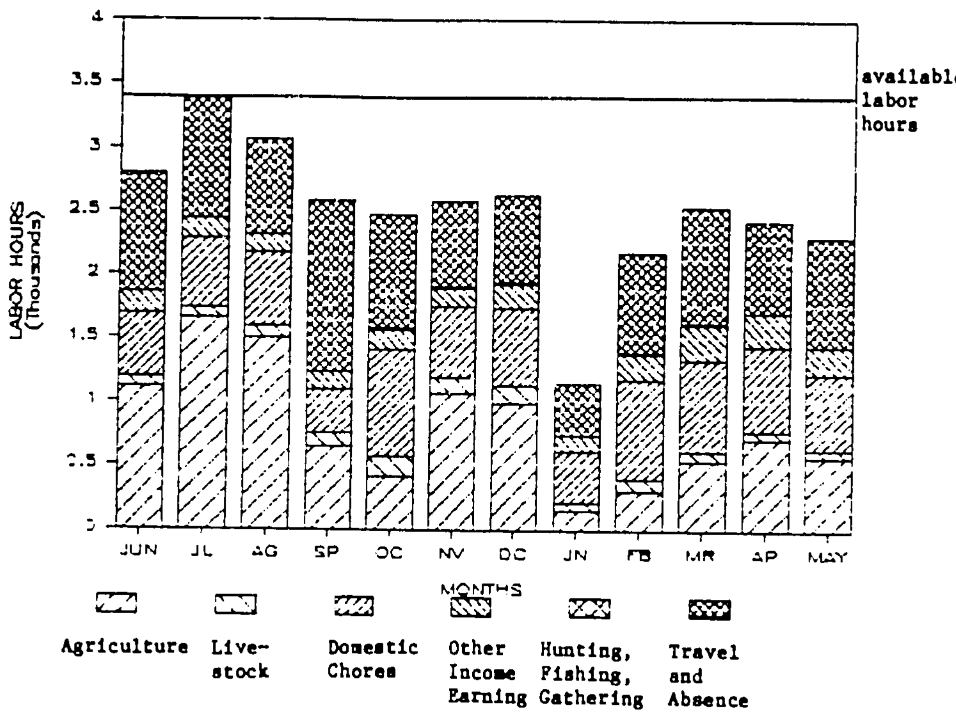
Household labor is predominantly allocated to agriculture, domestic work and travel/absence. Hunting, fishing, and gathering occupy only a small portion of household labor and this category is too small to be visible in the reduced version of Figure 7.2. In agriculture, the busiest months are June through August and November-December,

FIGURE 7.2.

FAMILY LABOR AVAILABILITY AND THE USE
OF AN AVERAGE HOUSEHOLD

In the Upper River Zone of the Gambia River Basin

June 1983–May 1984



SOURCE: IVS data.

University of Michigan, Gambia River Basin Studies, 1985.

corresponding to planting and weeding and then harvesting of rainfed crops. The one time when labor use equals labor availability is in July, when planting and first weeding are most exacting. Agriculture labor picks up again in April of the following year when weeding of irrigated rice peaks and in May when land preparation begins for the next rainy season. For the 1983 rainy season, the amount of labor hours spent on agriculture are deflated because of the midseason drought which led to abandoned fields and curtailed activity on remaining fields. However, the drought was less pronounced in the Upper River Zone than elsewhere in the Basin. Its major damage in Alunhari was to crops planted late in the season, such as the secondary crop in a crop association.

Domestic activities consistently demand about 20% of all household labor (adult male and adult female) expended with the exception of July and September when women's labor on rainfed crops is especially time consuming. From May to August travel/absence decreases and agricultural time is double the amount spent on other activities. This trend reverses itself in the period January through March. The high amount of travel time in September can be attributed to religious celebrations.

There is relatively little time spent in livestock raising, which peaks in the period October through December, when animals are allowed to graze harvested fields and must be watched. Less time is devoted to livestock after January. Cattle are left to scavenge while labor is increasingly allocated to income-generating activities.

It is worth noting the strong differentiation in labor use based on gender (Table 7.3). Women account for more time than men over the entire year across all activities. A large component of this labor expenditure is for domestic work, which consistently accounts for 30-40% of the total labor supplied by women. Males account for fewer labor hours in part because of their frequent absences. Children contribute an average of 28% of total labor.

Family allocation of labor to various cropping enterprises is shown in Table 7.4. The slightly lower average of man-days/labor unit found in Group A households can be attributed to their use of tractors for land preparation (plowing). This not only reduces time spent in land preparation but diminishes labor demand for weeding because of superior initial weed control with deep tractor plowing.

TABLE 7.3.

GENDER DIFFERENTIATION IN LABOR ALLOCATION: ALUNHARI 1983-1984
(% of total hours spent on specified activities)

	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1. All Activities												
Child	30	26	24	26	26	29	29	31	26	28	29	30
Male	29	32	32	31	33	29	27	26	27	26	26	26
Female	41	43	44	44	41	42	44	43	46	46	45	45
	100	100	100	100	100	100	100	100	100	100	100	100
2. Agricultural Activities												
Child	39	32	25	33	34	31	31	22	25	36	43	43
Male	30	32	34	37	42	27	26	17	18	25	22	21
Female	31	36	41	30	24	42	42	61	57	39	34	36
	100	100	100	100	100	100	100	100	100	100	100	100

SOURCE: IVS data.

University of Michigan, Gambia River Basin Studies, 1985.

Groundnuts and groundnut associations consistently occupy most family labor time, taking 50-70% of labor invested in crop agriculture. This high proportion of labor time is a consequence of the large area devoted to groundnuts and to the labor intensiveness of the crop itself. Group B households devote a relatively greater amount of labor time to groundnuts and require more man-days per hectare than Group A households (182-224 MD/ha versus 147 MD/ha, respectively). This disparity can at least partially be attributed to the latter's use of mechanized plowing.

Maize, late millet and millet associations are more demanding of labor input in Group B households for several reasons. Late millet is grown in association with early millet, necessitating a high allocation of time to protect it from bird damage.[2] Maize likewise is susceptible to pest damage. Both crops demand more labor for weeding and harvesting/threshing than does sorghum. As labor input into sorghum associations is only one-half that for millet, sorghum is allocated proportionally less of the total labor time despite occupying roughly the same land area as millet.

In Group A households, only 8% of agricultural labor time is allocated to irrigated rice, largely because of the limited area in rice. In labor demand per hectare, irrigated rice is comparable to groundnuts grown in pure stands (174 MD/ha).

While labor shortages for agriculture are not well illustrated in Figure 7.2, farmer interviews revealed that labor is perceived as a major constraint to increasing upland area in cultivation. One reason for labor shortages is that the periodic peak demands are of short duration but are critical. For instance, peaks occur in the 2-3 day planting period after a rain throughout June and July, and they recur later over 2-3 week weeding periods. Furthermore, although labor may be available in an absolute sense, in that all working members of the household are not fully occupied over an 8-hour work day, it is difficult to get younger males more involved in agriculture. The younger males of Alunhari increasingly regard their opportunity cost for agricultural labor as higher than its returns. With farm households able to rely on migrants' remittances rather than uniquely on agriculture for their livelihood, youth are liberated to seek wage labor even if the likelihood of success is relatively low. Wage labor has the double attraction of being more prestigious and potentially more remunerative than agriculture with immediate pecuniary rewards.

7.1.2. Cropping Patterns

Crop mix and land area under cultivation are shown in Table 7.5. Several differences in cropping patterns emerge. Group B households

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[2]Early millet does not have the protective awning of late millet and is also one of the earliest of the cereals to mature. Both factors contribute to making it highly vulnerable to bird devastation.

TABLE 7.4.

MAN-DAYS PER CROP AND HOUSEHOLD LABOR ALLOCATION: ALUNHARI 1983

Crop	Households without Irrigation (Group B Farms)			
	MD/Ha	Ha/Crop	MD/Crop	% of Total MD
Rainy Season:				
L. Millet & Assoc.	117	1.54	180	16
Sorghum & Assoc.	55	1.36	75	7
G'nut & Cereals	224	0.45	101	9
G'nut & Cowpea	223	1.25	280	9
G'nut & Squash	186	1.83	341	30
Maize & Assoc.	144	0.46	66	6
Groundnuts	183	0.53	97	9
Dry Season:				
Irrigated Rice	280			

Crop	Households with Irrigation (Group A Farms)			
	MD/Ha	Ha/Crop	MD/Crop	% of Total MD
Rainy Season:				
L. Millet	53	2.58	136	26
G'nuts & Cereals	148	1.18	174	33
G'nuts, Cowpea/Squash	147	0.73	107	21
Maize & Assoc.	105	0.61	64	12
Irrigated Rice	174	0.23	40	8
Dry Season:				
Irrigated Rice	250			

SOURCE: IVS data.

University of Michigan, Gambia River Basin Studies, 1985.

cultivate a larger land area than Group A households (7.42 ha versus 5.33 ha) probably because of greater labor availability, but a smaller area per labor unit (0.48 ha/LU versus 0.63 ha/LU). Group B households have a greater proportion of the cultivated area in groundnuts and groundnut associations than Group A households (4.06 ha or 55% of cultivated area versus 1.91 ha or 36%). The amount of area in cereals is

TABLE 7.5.

CROPPING PATTERNS: ALUNHARI 1983
(Rainy Season)

Crop	Households without Irrigation (Group B)			Households with Irrigation (Group A)		
	Land Area (ha)	Ha/Lu	% of Farm Area	Land Area (ha)	Ha/Lu	% Total Area
Late Millet	1.00	0.06	14	2.58	0.31	48
L. Millet Associations	0.54	0.04	7	-	-	-
Sorghum & Associations	1.36	0.09	18	-	-	-
Groundnuts	0.53	0.03	7	-	-	-
Groundnut/Cereals	0.45	0.03	6	1.18	0.14	22
Groundnut/Cowpea	1.25	0.08	17	-	-	-
Groundnut/Squash	1.83	0.12	25	-	-	-
Groundnut/Cowpea or Sq.	-	-	-	0.73	0.09	14
Maize Associations	0.46	0.03	6	0.61	0.07	11
Irrigated Rice	-	-	-	0.23	0.27	4
Total Area	7.42			5.33		
Range in Farm Size						
Avg. Labor Unit/HHold	15.4			8.4		
Avg. Area/Labor Unit	0.48			0.63		
Cash Crop Intensity[a]	55%			33%		

SOURCE: IVS data.

NOTE: a) Percent of total cultivated land area in cash crops (groundnuts and rice) with primary crop in associated stands accounting for 67% cultivated area in that association.

roughly the same in both farm categories (45-52%), the main difference being that with Group B farms there tends to be greater diversification in cereals. For example, Group B households grow late millets and sorghums in both pure and mixed stands, rather than pure stands of late millets only, as do Group A households. In general, Group B households favor crop associations, with 79% of cultivated area (5.9 ha) in associations, whereas Group A households slightly favor pure stands (47% or 2.5 ha in associations).

Group B households tend to allocate a greater percentage of land area to cash crops; 55% of cultivated area versus 33% for Group A households.[3] This can be partially explained by the fact that the crop unique to Group A households, rice, is not only higher yielding than the traditional cash crop, groundnuts, but also has a higher market value. The official 1983/84 price of rice was D510/MT, higher in the parallel markets, whereas groundnuts sold commonly at the official price of D450/MT. Rice serves both a cash and a food crop. It is a preferred and highly valued food crop, and when scarce is often reserved for special occasions. In years of poor rainfed crop production, it may be conserved to supplement depleted stores of rainfed cereals. In the case of Alunhari in 1983, it is probable that rice was stored but also sold since late millet and sorghum fared reasonably well despite midseason dry spells.

Greater than 45% of cultivated area is devoted to crops grown in mixed stands. Crop diversification, between and within fields, is a commonly observed strategy of risk minimization. Crop yields, shown in Table 7.6, also help explain the preference given to crops grown in association. It is assumed that all crops are local, unimproved varieties, except for irrigated rice. In the case of late millet grown as the primary crop in an association, its yield (1032 kg/ha) is superior to that when grown in a pure stand (692 kg/ha). On the other hand, sorghum's yield has not been improved by association. Groundnut yields respond variably to associations. There was a favorable response when

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[3]Based on the assumptions that groundnuts serve primarily as a cash crop and that cereals are food crops for home consumption.

TABLE 7.6.

CROP YIELDS: ALUNHARI
1983-84

Crop[a]	Households Without Irrigation (Group B)	Households With Irrigation (Group A)
Late Millet	692	859
L. Millet w/E. Millet	-	1032
E. Millet w/L. Millet	-	0
Sorghum	3828	-
Sorghum w/L. Millet	729	-
L. Millet w/Sorghum	279	-
Maize w/Cereals	0	0
L. Millet w/Maize	574	601
Groundnuts (sole)	2043	-
G'nut w/Cereals	2519	2555
Cereals w/G'nut	78	27
G'nut w/Cowpea	1062	-
G'nut w/Cowpea & Sq	1309	-
Cowpea in Assoc.	525	525
Squash	0	0
G'nut w/Squash	1604	-
Irrigated Rice	2300[b]	4500[c]

SOURCE: IVS data, except for rice yields.

NOTE: a) Yield is for first crop only.
b) Dry season irrigated crop only; source: World Bank, 1984. Reported yields from IVS survey gave unrealistic results, i.e., 10 mt/ha.
c) Both seasons; source: AHT, 1984.

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coupled with cereals but not when grown with cowpea or squash. Maize yield failures were experienced across the board in 1983, caused by the midseason drought.

Early sorghum had the best yield of all the cereal crops, considerably higher than reported averages of 859 kg/ha for The Gambia (AHT, 1984). As fertilizer application rates, shown in Table 7.7, were roughly equal for early sorghums and late millets, the higher yield of the sorghums reflects the greater viability of early maturing varieties in a drought year. There is, in fact, an increasing shift by farmers out of late into early maturing cereal varieties in response to several years of erratic rainfall.

7.1.3. Use of Improved Technology

Use of improved technologies is limited largely to chemical fertilizers, animal traction and tractor plowing. Fertilizer use (Table 7.7) was greater for rainfed cereals than is commonly reported among Gambian farmers (AHT, 1984) and is attributable for the most part to government sponsored fertilizer distribution programs, which were active in the survey year. No groundnut fertilizers were available in 1983. Farmers recognize the need for fertilizer amendments, especially under conditions of land scarcity.

TABLE 7.7.

FERTILIZER USE: ALUNHARI 1983
(in kg/ha[a])

	Group B HHolds without Irrigation	Group A HHolds with Irrigation
Sorghum	389	-
Millet	279	190
Maize	331	311
G'nuts	0	-
G'nut/Cereals	116	285
G'nut/Cowpea	256	-
G'nut/Squash	202	-
G'nut/Cowpea or Squash	-	290
Irri. rice	-	630[b]

SOURCE: IVS data.

NOTES: a) Fertilizer use was averaged across all fertilizer types: NPK, urea, SSP, TSP and other unspecified chemical fertilizers used by farmers in the sample.
b) Rainy and dry season.

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Animal traction is also widely employed for at least one of its most common uses -- plowing, seeding or weeding -- as shown in Table 7.8. Tractor plowing is used by some households practicing rainy season irrigation.

TABLE 7.8.

ANIMAL AND FUEL POWERED TRACTION USED BY CROP, ALUNHARI 1983-84

	Group B Households Without Irrigation	Group A Households With Irrigation	
	Animal Traction[a] (days/ha)	Animal Traction[a] (days/ha)	Mech Plow[b] (ha)
Rainy Season			
Millet	15.0	4.1	0.8
Sorghum	13.3	-	-
Maize	23.4	0	0.35
G'nuts	7.7	-	-
G'nut/Cereal	4.6	1.9	0.42
G'nut/Cowpea	3.9	-	-
G'nut/Squash	10.7	-	-
G'nut/Cowpea or Squash	-	5.8	0.26
Irri. Rice	-	0	0.11
Dry Season			
Irrigated Rice	0	0	0.19

SOURCE: IVS data.

NOTES: a) Use of animal traction is the total across all traction activities.

b) Tractor plowing is recorded on a per hectare basis rather than in days.

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TABLE 7.9.

FARM ENTERPRISE BUDGET: ALUNHARI HOUSEHOLDS WITHOUT RAINY SEASON IRRIGATION, 1983-84
(GROUP B FARMS - DALASIS)

Variable Costs	L. Millet & Assoc.	Sorghum & Assoc.	G'Nut Cereals	G'Nut Cowpea	G'Nut Squash	Ground-Nuts	Maize Assoc.	Farm Total	Irrigated Rice
	1. Rainy Season								2. Dry Season
Area (ha)	1.54	1.36	0.45	1.25	1.83	0.53	0.46	7.42	0.27
Seed	6.47	6.73	22.12	74.67	89.10	39.35	13.23		6.89
Fertilizer	68.47	84.65	8.35	51.20	59.15	0.00	24.36		25.52
Animal Traction	161.70	126.62	14.49	34.13	137.07	20.57	75.35		0.00
Wage Labor	0.00	0.00	0.00	26.25	36.23	0.00	0.C0		0.00
Material, Misc.	25.56	0.00	23.27	24.00	44.29	8.64	0.00		0.00
Transort	0.00	0.00	5.94	26.13	23.61	16.06	0.00		10.00
Mech. Plow	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00
Irrigation Fee	0.00	0.00	0.00	0.00	0.00	0.00	0.00		66.70
Total Cost to farm	262.48	218.00	74.17	236.38	389.45	84.62	112.94	1378.04	109.11
Returns to Production of Farming Enterprise									
Value of Production	401.13	480.82	332.55	616.44	721.98	487.26	42.07		621.00
Less Totel Cost	262.48	218.00	74.17	236.38	389.45	84.62	112.94		109.11
Gross Margins	138.65	262.82	258.38	380.06	332.53	402.64	-70.87		511.89
Returns/ha	90.03	193.25	574.18	304.05	181.71	759.70	-154.07		1895.89
Manday, Fmly. Lab.	179.9	74.4	100.8	279.6	340.6	96.8	66.3		75.6
Returns/Manday	0.77	3.53	2.56	1.36	0.98	4.16	-1.07		6.77
MD/ha, Fmly Lab.	116.8	54.7	224.1	223.7	186.1	182.7	144.1		280.0

SOURCE: IVS for all crops except irrigated rice, IVS. Data for irrigated rice adapted from IFAD, 1984 and LRDC, 1984.

NOTES: Assumptions aboaut input use:

Crop	Amount of Seed	Seed Cost (Farm Gate Price)	Crop	Amount of Seed	Seed Cost (Farm Gate Price)
Sorghum	15 kg/ha	0.35 D/kg	G'Nut	165 kg/ha	0.45 D/kg
Millet	12 kg/ha	0.35 D/kg	Cowpea	20 kg/ha	1.00 D/kg
Maize	42 kg/ha	0.39 D/kg	Squash		Assume No Cost
			Rice	50 kg/ha	0.51 D/kg

Crop	Amount of Fertilizer	Animal Traction	Wage Labor	Mechanical Plow
Sorghum	389 kg/ha	13.3 days/ha	0 MD	0 ha
Millet	279 kg/ha	15 days/ha	0 MD	0 ha
Maize	331 kg/ha	23.4 days/ha	0 MD	0 ha
G'nut/CE	116 kg/ha	4.6 days/ha	0 MD	0 ha
G'nut/CP	256 kg/ha	3.9 days/ha	7.0 MD	0 ha
G'nut/SQ	202 kg/ha	10.7 days/ha	6.6 MD	0 ha
G'nut	0 kg/ha	7.7 days/ha	0 MD	.14 ha
Ir. Rice	630 kg/ha	0 days/ha	0 MD	0 ha

Unit Costs:

Fertilizer	Animal Traction	Wage Labor	Mechanical Plow
155 D/MT	7 D/Day	3 D//MD	35 D/ha

Irrigation Fee: 247 D/ha.

TABLE 7.10.

FARM ENTERPRISE BUDGET: ALUNHARI HOUSEHOLDS WITH RAINY SEASON IRRIGATION, 1983-84
(GROUP A FARMS - DALASIS)

	1. Rainy Season						2. Dry Season
Variable Costs	Late Millet	G'nut Cereals	G'nut/Cowpea Squash	Maize Assoc.	Irrigated Rice	Total Farm	Irrigated Rice
Area (ha)	2.58	1.18	0.73	0.61	0.23	5.33	0.38
Seed	10.84	61.00	37.28	7.56	5.87		9.70
Fertilizer	78.43	53.81	33.87	30.35	23.18		35.90
Animal Traction	74.05	15.69	29.64	0.00	0.00		0.00
Wage Labor	0.00	0.00	0.00	0.00	0.00		0.00
Materials & Misc.	40.25	29.32	19.20	0.00	10.00		14.10
Transport	72.24	31.03	14.71	0.00	0.00		0.00
Mechanical Plow	28.00	14.87	9.20	12.81	3.78		6.65
Irrigation Fee	0.00	0.00	0.00	0.00	56.81		93.86
Total Cost to Farm	303.81	205.72	143.9	50.72	99.64	803.79	160.21
Returns to Production of Farming Enterprise							
Value of Production	775.67	923.39	304.38	42.07	527.85	2573.36	1710.00
Less Total Cost	303.81	205.72	143.90	50.72	99.64	803.79	160.61
Gross Margins	471.86	717.67	160.48	- 8.65	428.21	1769.57	1549.79
Returns/ha	182.89	608.19	219.84	-14.18	1861.78		4078.39
Manday, Fmly. Lab.	1340.4	174.20	107.30	64.00	40.00		95.00
Returns/Manday	3.51	4.12	1.50	- 0.14	10.70		16.31
MD/ha, Fam. Lab.	52.10	147.60	147.00	104.90	174.00		250.00

SOURCE: For all crops except irrigated rice, IVS. Data for irrigated rice adapted from IFAD, 1984 and LRDC, 1984.

NOTES: Assumptions:

Crop	Amount of Seed	Seed Cost (Farm Gate Price)	Crop	Amount of Seed	Seed Cost (Farm Gate Price)
Sorghum	15 kg/ha	0.35 D/kg	G'Nut	165 kg/ha	0.45 D/kg
Millet	12 kg/ha	0.35 D/kg	Cowpea	20 kg/ha	1.00 D/kg
Maize	42 kg/ha	0.39 D/kg	Squash		Assume No Cost
			Rice	50 kg/ha	0.51 D/kg

Crop	Amount of Fertilizer	Animal Traction	Mechanical Plow
Millet	190 kg/ha	4.1 days/ha	0.8 ha
Maize	311 kg/ha	0 days/ha	0.36 ha
G'nut/CE	285 kg/ha	1.9 days/ha	0.42 ha
G'nut/CP	290 kg/ha	5.8 days/ha	0.26 ha
Ir. Rice	630 kg/ha	0 days/ha	50% of Area

Unit Costs:

Fertilizer	Animal Traction	Mechanical Plow
155 D/MT	7 D/Day	35 D/ha

Irrigation Fee: 247 D/ha.

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7.1.4. Comparative Returns to Crop Enterprises

Tables 7.9 and 7.10 represent farm enterprise budgets for the cropping patterns illustrated in Table 7.5. Returns to production, or gross margins, are analyzed on a per hectare and on a per man-day basis. Table 7.11. compares costs and returns, per hectare, for crop enterprises for Group A and Group B households. The farm enterprise budgets indicate that relatively little wage labor was employed in 1983, the exception being used by nonirrigation households for groundnut associations. Given the large area allocated to groundnut associations, it is understandable that extra labor was required for weeding, harvesting and threshing.

TABLE 7.11.

ALUNHARI: COMPARATIVE RETURNS TO PRODUCTION

	HHolds without Irrigation Group B			HHolds with Irrigation Group A		
1. Rainy Season Crop Association	Costs per ha	Returns per ha	Returns per MD	Costs per ha	Returns per ha	Returns per MD
L. Millet & Assoc.	170.44	90.00	0.77	117.76	183.00	3.51
Sorghum & Assoc.	160.29	193.00	3.53			
G'nut & Cereals	164.82	574.00	2.56	174.34	608.00	4.12
G'nut & Cowpea/Sqsh.				197.12	220.00	1.50
G'nut & Cowpea	189.10	304.05	1.36			
G'nut & Squash	212.81	181.00	0.98			
Maize & Assoc.	245.52	-154.00	-1.07[a]	83.15	-14.00	-0.14[a]
Groundnuts	159.66	759.70	4.16			
Irrigated Rice				433.22	1861.78	10.70
2. Dry Season	Costs per ha	Returns per ha	Returns per MD	Costs per ha	Returns per ha	Returns per MD
Irrigated Rice	354.60	1945.40	6.95	421.61	1873.40	7.49

SOURCE: IVS data and tables.

NOTE: a) Negative returns to maize are explained by high costs of D246/ha and very low production.

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7.1.5. Rainy Season Crops

The superior returns for rainy season irrigated rice, assessed at D1860 per hectare and at D10.70 per man-day, are clearly shown in Table 7.11. It should again be stressed that these levels of return were made possible by the ability of the farm households to assure favorable conditions for irrigated rice cultivation. They were able to use their own resources, or those of the master farmer, to procure fertilizer, and equally importantly, fuel to operate the irrigation system.

The next most profitable crop is groundnuts, in pure stands and then in association with cereals. In pure stands it generates returns of D760 ha and D4.20/MD. When associated with cereals, groundnuts obtain returns per hectare approaching D600/ha. Maize yielded negative returns in both categories of farming systems, largely as a result of poor rainfall distribution.

From Table 7.11, it can be concluded that under existing economic conditions in The Gambia farmers are committed to a strategy of food security. Although food crops generate considerably lower returns than cash crops both per man-day and per hectare, farmers allocated at least 45% of their cultivated area to the former. Cereal food crops are also grown in association with groundnuts, further augmenting the proportion of land area devoted to meeting home consumption needs. The level of resources, human and material, invested in maize associations indicates it is a crop in which farmers are willing to risk investment, although only on a limited land area. In a normal rainfall year, maize can produce yields of 1400 kg/ha (LRDC 1984), making it a profitable undertaking. It has the added advantage of being the earliest maturing of the food crops.

7.1.6. Dry Season Irrigation

Dry season irrigation of rice was practiced by seven of the nine sample farm units. Average area cultivated by households not involved in rainy season irrigation was 0.27 ha; in households involved in rainy season irrigation, the average area was 0.38 ha. Land area per labor unit was 0.012 ha and 0.05 ha, respectively, showing a marked increase in land area per labor unit in "irrigation" households. In both categories, the area in dry season irrigation is on average divided into two plots, one of which is commonly managed by the household head as a collective family field. The other tends to be managed by a subordinate adult male or by a wife (wives).

Households not practicing rainy season irrigation do not have the access to inputs and tractor plowing of households doing rainy season irrigation. Consequently, they obtain lower yields and have to expend more manual labor in rice cultivation, lowering their returns per man-day and per hectare.

Production costs of irrigated rice increase in the dry season as a result of the need for increased amounts of fertlizer. Water changes in The Gambia are fixed and are the same for both rainy and dry seasons, although it has been estimated that irrigation needs in the dry season are 167% of those of the rainy season (SONED, 1980), which should result in a proportionate increase in fuel and oil costs. Concurrently, there is an increase in labor input for water management in the dry season, while weeding, planting and other activities are relatively unaffected. Nonetheless, as illustrated in Table 7.11., these increases do not significantly alter the relative profitability of irrigated rice when compared to rainfed crops.

7.2. Pakeba, Middle River Zone (MRZ)

The village of Pakeba is located along the Sandougou Bolon in Senegal Oriental (Figure 7.1). It is one of ten villages participating in two SODEFITEX irrigation schemes adjacent to the Bolon. The area is not densely populated. Irrigation is practiced by Pakeba farmers mainly in the dry season (Table 6.5) on the Medina Diakha perimeter although in 1984 a small portion of the perimeter was double-cropped.

The villages participating in the irrigation projects are primarily Mandinka but also include Peul, Diakanke, and Sarakole. With the exception of the Peul, all groups have similar social structures, which dictate the same patterns of labor and land organization. The Sarakole tend to have larger extended households, much like those in The Gambia.

The villages along the Bolon share many characteristics which have a direct influence on the basic type of farming system practiced in the area. In response to an extended period of low and poorly distributed rainfall, farm families have gradually become less capable of meeting their own food requirements from on-farm production. Changing climatic patterns have dictated changes in resource allocation. For example, the farming system can only partly be classified as subsistence because there has been greater emphasis on production of the more drought-resistant cash crops such as groundnuts and cotton. Income from groundnut and cotton sales has been primarily used to meet basic food requirements.

The sequence of poor production years has had implications for the availability of family labor. Long-term labor migration has been increasing within the past 7 or 8 years with more males leaving to work in other parts of West Africa, the Middle East or Europe. Off-farm employment opportunities in the region are limited as there are no large towns other than Tambacounda. Seasonal migration is also on the rise. Males depart following the groundnut and cotton harvests in December for extended periods in search of employment in the larger towns and cities of Senegal or The Gambia (Kaolack, Thies, Ziguinchor, Dakar or Banjul).

The presence of the Bolon not only has made irrigation technically feasible, it has also served as a productive resource for dry season cultivation of tidal swamp rice. Rice cultivation has therefore been known for a long period of time, although it was and still is primarily a crop cultivated by women.

7.2.1. Labor Availability and Use

Average household composition for the village of Pakeba is given in Table 7.12. It is estimated that there are about seven working members per household and that the total amount of available labor is approximately 210 man-days per month.[4]

Labor availability and use are shown in Figure 7.3. Agricultural activities peak in the months of July-September and again in January-February. The former period corresponds to the weeding and harvest

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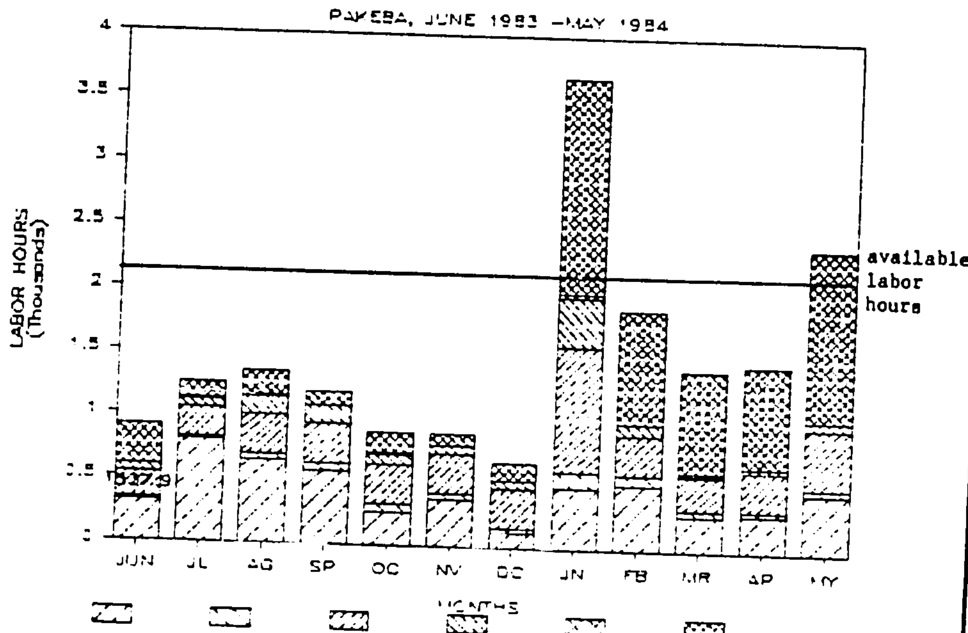
[4]With a 10-hour day for all activities, six adults X 30 days/month plus two children for 5 hrs/day X 30 days/month = 2100 man-hours or 210 man-days/month. Labor availability has not been adjusted for adults absent on extended seasonal migration.

FIGURE 7.3.

LABOR AVAILABILITY AND THE USE OF AN AVERAGE HOUSEHOLD

In the Middle River Zone of the Gambia River Basin
June 1983-May 1984



Agriculture — Live-stock — Domestic Chores — Other Income Earning — Hunting, Fishing, Gathering — Travel and Absence

NOTE: January figures shown are inflated and should not be considered representative for that month.

SOURCE: IVS data.

University of Michigan, Gambia River Basin Studies, 1985.

TABLE 7.12.

HOUSEHOLD COMPOSITION: MIDDLE RIVER ZONE (SANDOUGOU BOLON) 1983-1984

	Individuals	Labor Units (LU)
Adult Males	3	3
Adult Females	3	3
Children over 8 yrs	2	1
Minors under 8 yrs	4	0
Over 65	1	0
	13	7

SOURCE: IVS Data.

NOTES: Sample Size: 14 Households.
Range in Household Size: 2-53 persons.

activities of the rainy season crops. Labor hours would be higher if drought conditions had not existed in 1983 since more time would have been devoted to weeding and harvesting. The second peak is associated with land preparation and transplanting for the dry season irrigated crop. Agricultural labor uses reaches its minima in December and in March-April.

Time spent in agriculture for the entire rainy season (May-December) was unusually low in 1983 because the severe midseason drought in July caused complete failure of many crops for all farmers.

Peak times for the care of livestock occur from October to December because of the need to graze and water animals away from the village while crops are being harvested. Labor use on livestock reaches a minimum during the months of May to July when farmers are devoting more time to land preparation and seeding. Livestock either will be left to graze on their own or will be entrusted to a local herding family.

Labor allocated to domestic activities is consistently high but reaches a maximum from October through December. The 1983 figures are somewhat inflated because of the cutback in agricultural labor, especially harvesting activities. Time spent in other income-earning activities such as paid labor on neighbors' fields was negligible in 1983. Hardly any labor was expended for hunting, fishing or gathering.

The number of hours spent on miscellaneous activities (travel and absence) is relatively high during the early part of the dry season, reflecting a large investment of time by males to find off-season employment, to visit relatives in the region, to search for food supplies, or to sell livestock in local markets to meet food needs.

Of 1,680 man-days of labor available to the family between May and December of 1983, only slightly more than 56% was expended on cropping activities.[5] On a per hectare basis, pure groundnut stands demanded the highest labor input, followed by cotton and maize (Table 7.13). Allocation of family labor to different crop enterprises in 1983 was a function of climate with the more drought-resistant groundnut and cotton crops receiving the bulk of labor inputs. High labor demands for maize reflect the intense nature of maintenance required by this compound crop. Labor expenditures for cotton and groundnuts are about the same, indicating that returns to labor must be perceived by farmers as being comparable. Both crops demand intensive labor input for specific activities: spraying of cotton, weeding of groundnuts and harvesting and threshing of both. Millets and sorghums utilized the least labor input because of limited amounts of time spent on second weedings, harvesting, and threshing. Virtually all labor inputs to cereal crops were completed by the month of October. In a year of normal rainfall, the harvest of late maturing cereals would extend through November.

In terms of actual labor use, groundnuts and groundnut associations employed nearly 67% of the total amount of family labor expended in agriculture, reflecting the large amount of land allocated to this crop (Table 7.13). Cereal crops accounted about 24% of total labor while cotton only demanded 8%. Labor bottlenecks were limited to the months of May and January. May is when land preparation for rainfed crops overlaps with the harvest of the dry season irrigated rice crop. In

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[5]This figure does not include hours worked in the months of May-June 1983 on irrigated rice from the 1983 dry season.

TABLE 7.13.

MAN-DAYS PER CROP AND HOUSEHOLD LABOR ALLOCATION: PAKEBA[a]
1983-84

Crop[c]	MD/Ha	Ha/Crop	MD/Crop	% of Total MD
Rainy Season				
Millet	80	1.02	82	8.7
Late Sorghum	60	1.17	70	7.4
Maize and Assoc.	115	.67	78	8.2
Groundnut-Cereals	84	1.63	137	14.5
Groundnuts	120	3.10	360	38.0
Groundnuts-Squash	100	.95	95	10.0
Groundnut-Cowpea	107	.42	45	4.8
Cotton	117	.69	80	8.4
Dry Season				
Irrigated Rice	220[b]	.38	84	100

SOURCE: IVS data.

NOTE: a) Man-days calculated separately from data shown in Figure 7.3. Man-days for agricultural labor are valued at eight hours each.
b) Includes guarding activity which is not accounted for in ther studies.
c) Dry season tidal (bolon) rice is not included because of the very small number of households cultivating it (4 of 13 households in 1984).

University of Michigan, Gambia River Basin Studies, 1985.

January land preparation for irrigated parcels competes with the harvesting, threshing, and marketing of groundnuts and cotton.

In 1983 hardly any wage labor was engaged. It was not an important cost component of any farm enterprise. Even traditional land-labor exchanges with seasonal workers from Guinea lapsed as "navêtanes" left the area prior to the second weeding to find other employment in urban centers.

There are important differences in labor allocation to crops according to gender (Table 7.14). The most active months for males are March to June, which witness travel in search of off-farm employment, maintenance of irrigated rice, and preparation of rainfed crops. Minimal amounts of agricultural labor were expended in November-December because of lack of produce to harvest. The percentage of labor expended by children over all activities is fairly constant throughout the year, ranging between 20 and 25% of the total. Females supply an extremely high proportion of total labor, reflecting their double role as the major source of domestic labor and as active cultivators. Peak times for women are in August for weeding, in November-December for harvesting of small compound fields, and during February for land preparation and transplanting of rice seedlings.

TABLE 7.14.

GENDER DIFFERENTIATION IN LABOR ALLOCATION: PAKEBA 1983-1984
(% of total hours spent on specified activities)

	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1. All Activities												
Child	25	21	19	25	23	22	22	28	21	25	24	23
Male	47	41	39	37	37	28	26	34	37	47	50	44
Female	29	38	42	38	41	50	51	38	42	28	26	33
	100	100	100	100	100	100	100	100	100	100	100	100
2. Agricultural Activities												
Child	29	16	18	26	33	27	28	51	16	25	26	39
Male	45	47	51	44	39	31	29	48	17	37	29	31
Female	27	36	31	30	28	42	44	0	67	38	46	30
	100	100	100	100	100	100	100	100	100	100	100	100

SOURCE: IVS data.

University of Michigan, Gambia River Basin Studies, 1985.

7.2.2. Land Availability and Use

While land in general near the Sandougou Bolon is not scarce at this time, land with highly fertile soils and good location is becoming scarce. Two distinct trends in land use in the Sandougou Bolon area are evident. First, with decreasing rainfall, the marginal sandy soils have gradually been abandoned to long-term fallow. The remaining fields are cultivated yearly without fallow, thereby degrading the best resource available.

Secondly, in order to increase food production in the face of adverse climatic conditions, farmers have attempted to extend cereals production to good soils located at some distance from the village. This strategy has been made possible through use of animal traction equipment but is limited as a solution to the problem. Even with traction equipment, labor is a constraint. With the increasing risk of unfavorable climate, men are seeking off-farm employment. Pest damage (monkeys, wild boar) in fields located far from the village is a serious problem and difficult to control. As an alternative strategy to produce food, some farmers have given increasing emphasis to dry season irrigation on the SODEFITEX perimeters.

Land in cultivation by crop is given in Table 7.15. Including small plots in vegetables and taro (cocoyams), average farm size is 9.88 ha. Without these minor crops, it is about 9.65 ha. Cassava is no longer produced in the area.

Groundnuts dominated all other crop combinations and accounted for almost 52% of the cultivated land, followed by cereals (35%), cotton (7%), and minor crops such as squash, cowpea, taro, and other vegetables (6%). Very little land was allocated to maize. Late variety millets and sorghums dominated the cereals crops. Purestand groundnuts was the major crop cultivated, accounting for almost one-third of the land in production. Most of the land was under purestand cultivation (70%). Associated crops of groundnuts and cereals account for 25%.

There is a correlation between the amount of land cultivated in a particular crop and the number of households producing it. However, maize and cotton are examples of crops grown on small surface areas but produced by a large number of households. Maize is a compound crop

TABLE 7.15.

CROPPING PATTERNS: PAKEBA, 1983
(Rainy Season)

Crop	Land Area (ha)	Ha/LU	% of Farm Area
Sorghum	1.17	.17	11.8
Millets	1.02	.10	10.3
Maize and Assoc.	.67	.09	6.8
Groundnuts	3.10	.44	31.4
Groundnut-Cereals	1.63	.23	16.5
Groundnut-Squash	.95	.14	9.6
Groundnut-Cowpea	.42	.06	4.3
Cotton	.69	.09	7.0
Total Area	9.65		
Avg. Labor Unit/HHold	7.3		
Avg. Area/Labor Unit	1.32		
Cash Crop Intensity[a]	60%		

Range in Farm Size: .45 - 36 ha.

SOURCE: IVS data.

NOTES: a) Percent of total cultivated land area in cash crops (groundnuts, cotton, rice) with primary crop in associated stands accounting for 67% of cultivated area in that crop.

University of Michigan, Gambia River Basin Studies, 1985.

cultivated by nearly every household. Fewer households grow millet and sorghum, but the area in cultivation is nearly triple in size.

Across all crops the average land area per worker is about 1.3 ha, a very high amount considering that much labor is still done by hand. The area per worker would be somewhat larger if abandoned fields were included.

Table 7.16 illustrates the severe impact of the midseason drought and overall poor distribution of rainfall in 1983 on yields of all crops. Virtually no late sorghums and very little maize were harvested. Some early millet varieties survived, but output was only about one-tenth the normal level. Groundnuts, cotton, and the secondary crops all yielded poorly, not even approaching their potential levels of output. The effect of these negligible yields, occurring after a series of poor production years, was to convince farmers to persist with irrigated rice into the 1984 rainy season.

TABLE 7.16.

CROP YIELDS: PAKEBA, 1983
(kg/ha)

Crop	
Sorghum	0
Millets	186
Maize and Assoc.	176[a]
Groundnuts	325
Groundnuts/Cereals	155[a]
Groundnut/Squash	175[a]
Groundnut/Cowpea	128[a]
Cotton	250

NOTE: a) First crop only. All second crops in associated stands, failed in 1983.

University of Michigan, Gambia River Basin Studies, 1985.

7.2.3. Use of Improved technologies

Animal traction equipment is used by all households and on nearly all crop mixes. The amount of time and the number of fields for which seeders and weeders were employed are greater than the corresponding figures for plowing (Table 7.17). This indicates a strategy to avoid labor bottlenecks in June-July. Plowing is more frequently used for groundnuts, while weeders and seeders are primarily employed for grain crops and cotton. Nearly 36% of the traction time is allocated to foodgrain crops, a very high percentage considering that equipment was originally intended for use on cotton and groundnuts. This further illustrates farmer strategies to increase the area cultivated in food as well as cash crops.

TABLE 7.17.

ANIMAL TRACTION USE BY CROP AND ACTIVITY, PAKEBA, 1983
(days/ha)

Crop	Plowing	Seeding	Weeding	Lifting	Total MD
Rainy Season					
Sorghum		6.0	5.0		11
Millet	7.6	5.4	5.2		18.2
Corn/Assoc	7.8	10.4	11.6		29.8
Groundnuts/ Cereals	2.4	2.7	3.9	2.0	11
Groundnuts	4.2	4.5	5.5	3.8	18
Groundnut/Sq.	2.9	3.3			6.2
Groundnut/Cp	2.7	2.3	2.2	2.3	9.5
Cotton	3.1	3.5		6.4	13

SOURCE: IVS data.

University of Michigan, Gambia River Basin Studies, 1985.

A major reason for the expected high use of traction equipment on cotton and groundnuts is that it is part of a technical package. Each year farmers are provided seed, fertilizer and, for cotton, insecticides. The use of these inputs for groundnut and cotton production is widespread around the Sandougou Bolon. Farmers generally have a good knowledge of how to use them. However, with the exception of animal traction, very few improved technologies are available for grain crops.

Table 7.18 shows expected fertilizer use for various crop combinations. Actual use by farmers in Pakeba was somewhat different in that hardly any fertilizer (NPK or urea) was applied to groundnuts. In 1983 fertilizer deliveries were late and underestimated. This may be one reason for the generally poor groundnut harvest.

Farmers seek to increase output by increasing land in cultivation. They generally do not try to increase production through more intense use of fertilizer, insecticide and other inputs for three basic reasons. First, there is as yet no serious land shortage, although fertility is decreasing. Second, inputs are not always available. Third, inputs are costly and in years of rainfall shortage do not assure improvement in

TABLE 7.18.

EXPECTED FERTILIZER USE: PAKEBA, 1983
(kg/ha)[a]

Sorghum	100
Millets	100
Maize	200
Groundnut/Cereals	100
Groundnut/Cowpea	100
Groundnut/Squash	100
Groundnuts	100
Irrigated Rice	600
Cotton	275

SOURCE: SONED Afrique-Courtoy, 1982.

University of Michigan, Gambia River Basin Studies, 1985.

crop performance and can even be harmful. In years of poor rainfall, a farmer who increases land area risks wasting his own labor for which there are few alternatives uses. Were he instead to increase his use of inputs, however, he would risk going into debt.

7.2.4. Returns to Rainfed and Irrigated Crop Enterprises

The following tables show returns to various rainy season cropping enterprises. Financial crop budgets in Table 7.19. are based on the actual experience of farmers in the 1983 rainy season. Accordingly, yield levels and overall production are extremely low for all crops. The gross value of all cropping enterprises was estimated at about 113,000 FCFA.

Costs of seed, fertilizers, and pesticides for groundnuts and cotton are not given because they are not paid directly by farmers. These inputs are usually advanced to farmers by a government agency (SODEFITEX for cotton and formerly SONAR for groundnuts). Their cost is deducted automatically from the total value of output at the time of marketing to the agency. No fertilizers were actually employed for grain crops. Seed for grain crops, although saved from one year to the next by farmers, has been valued at official government prices.

TABLE 7.19.

FARM ENTERPRISE BUDGET, USING ACTUAL YIELDS IN 1983
PAKEBA (FCFA)

	1. Rainy Season								2. Dry Season
Variable Costs	L. Millet E. Millet	Late Sorghum	G'Nut Cereals	G'Nut Cowpea	G'Nut Squash	Ground-Nuts	Maize Assoc.	Cotton	Irrigated Rice
Area (ha)	1.02	1.17	1.63	0.42	0.95	3.10	0.67	0.69	0.38
Seed	0.510	0.585	0.275	0.280	0.000	0.000	0.660	0.000	0.882
Fertilizer	0.000	0.000	1.700	0.000	0.000	0.000	0.000	0.000	10.465
Draft Plow	7.700	0.000	3.900	1.100	2.800	13.000	5.200	2.100	0.000
Draft Seed	4.125	5.250	3.330	0.750	2.325	10.500	5.175	1.800	0.000
Draft Weed	3.975	5.100	4.800	0.675	0.000	12.750	5.775	3.300	0.000
Draft Harvest	0.000	0.000	2.475	0.750	0.000	8.850	0.000	0.000	0.000
Wage Labor	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Material/Misc.	1.080	1.990	1.370	1.130	1.000	8.850	1.065	0.190	30.780
Total Cost to farm	17.390	12.925	17.850	4.685	6.125	53.950	17.875	7.390	42.127
Returns to Production of Farming Enterprise									
Value of Production	1.860	0.000	11.718	2.509	7.718	70.525	6.758	12.075	99.300
Less Total Cost	17.390	12.925	17.850	4.685	6.125	53.950	17.875	7.390	42.127
Gross Margins	-15.530	-12.925	- 6.132	- 2.176	1.593	16.575	-11.117	4.685	57.173
Returns/ha	-15.225	-11.047	- 3.762	- 5.181	1.677	5.347	-16.593	6.790	150.455
Manday, Fmly. Lab.	82.000	70.000	137.000	45.000	95.000	372.000	77.000	81.000	106.000
Returns/Manday	- 0.190	- 0.184	- 0.045	- 0.048	0.017	0.045	- 0.144	0.058	0.540
MD/ha, Fmly Lab.	80.000	60.000	84.000	107.000	100.000	120.000	115.000	117.000	280.000
Costs/ha	17.049	11.047	10.951	11.155	6.447	17.403	26.679	10.710	110.861

SOURCE: For all crops except irrigated rice, IVS. Data for irrigated rice adapted from SONED, 1980.

NOTES: Assumptions about input use:

Crop	Amount of Seed	Seed Cost (Farm Gate Price)
Sorghum	9 kg/ha	50 FCFA/ha
Millet	10 kg/ha	50 FCFA/ha
Maize	20 kg/ha	50 FCFA/ha
Cotton	45 kg/ha	No Direct Cost to Farmer

Crop	Amount of Seed	Seed Cost (Farm Gate Price)
G'Nut		No Direct Cost to Farmer
Cowpea	20 kg/ha	100 CFA/kg
Squash	-	-
Rice	80 kg/ha	58 CFA/kg

Crop	Amount of Fertilizer	Animal Traction	Wage Labor
Sorghum	100 kg/ha	11.8 days/ha	0 MD
Millet	100 kg/ha	18.2 days/ha	0 MD
Maize	200 kg/ha	29.8 days/ha	0 MD
G'nut/CE	100 kg/ha	11 days/ha	0 MD
G'nut/CP	100 kg/ha	9.5 days/ha	0 MD
G'nut/SQ	100 kg/ha	6.2 days/ha	0 MD
G'nut	100 kg/ha	18 days/ha	0 MD
Ir. Rice	600 kg/ha	— days/ha	0 MD
Cotton	275 kg/ha	13	0 MD

Fert. Cost:

NPK 52 FCFA/kg

Traction Cost:

Seed and Weed: 750 FCFA/day
Plow: 1,000 FCFA/day

University of Michigan, Gambia River Basin Studies, 1985.

Animal traction cost items make up the bulk of the variable costs. Costs per hectare, not including family labor, are generally a reflection of the amount of animal traction time used on a particular crop mix. The highest cost crops to produce are maize, followed by groundnuts in pure stands, sorghum and groundnuts-cowpeas in association. Cotton is the least expensive crop to cultivate, given current levels of subsidization by SODEFITEX.

Gross returns to each enterprise are expressed on a per hectare and per man-day basis in Table 7.20. Cotton, in a dry year and at official product prices, provides the highest return per unit of land and per unit of labor. Next come groundnuts, groundnuts associated with squash or cereals, and lastly the purestand cereal crops. The least profitable crop is maize in terms of returns per hectare. This is a function of poor yields, high hand and traction labor inputs, and a lower producer price than for cash crops.

TABLE 7.20.

GROSS RETURNS PER HA AND PER MAN-DAY: SENEGAL SANDOUGOU BOLON AREA, 1983 RAINY SEASON

Crop	Gross Margin/Ha (FCFA)	Mandays/Ha	Gross Margin/ Manday (FCFA)
Cotton	6,790	117	58
Groundnuts	5,350	120	46
Groundnut/Squash	1,680	100	16
Groundnut/Cereal	-3,760	84	-45
Groundnut/Cowpeas	-5,180	107	-48
Maize and Assoc.	-16,590	115	-141
Sorghum	-11,050	60	-184
Millet	-15,225	80	-190

SOURCE: IVS data.

University of Michigan, Gambia River Basin Studies, 1985.

The above estimates of returns per man-day in a poor rainfall year illustrate well why farmers are increasingly discouraged by agriculture. The result of their labor in 1983 was not only low value of production but also decreased food security. Yet they have few alternatives. The decision to put labor to other uses, in this case to migrate outside the region, has been practical given the conditions of rainfed agriculture and low levels of physical output. Food crops are the least profitable in terms of return to labor. Cash crops show some positive returns but far less than the local daily wage rate for agricultural labor: 500 FCFA/man-day.

After the very poor 1983 rainy season, under the threat of impending food shortages, some farmers elected to intensify irrigated crop production in the 1984 dry season. Most households did so by increasing the amount of land irrigated over that of the previous dry season while continuing to produce traditional tidal (wamifaro) rice in the bolon.

In the 1984 dry season irrigated rice production showed successful returns both on a per hectare and a per man-day basis (Table 7.19). The value of gross output was substantial given fairly good yields and an increased official buying price for paddy (60 FCFA/kg). Returns per man-day far exceed any cropping enterprise in the rainy season but are roughly comparable to the current daily wage rate. This experience encouraged farmers to continue cultivating irrigated rice into the following rainy season. Anticipating continuation of poor climatic conditions, and low labor inputs for upland crops as a consequence, farmers did not expect that labor requirements for irrigated rice would adversely affect cultivation of rainfed crops.

How do returns to irrigated rice and to rainfed crops compare under the assumption of normal climatic conditions? Households are assumed to have the same basic resources. Labor availability remains stable at 1680 man-days between May and December. The land under cultivation and the cropping pattern remain unchanged except for the inclusion of irrigated rice. The amount of irrigated rice land cultivated in the dry season is the same as that exploited in the rainy season, 0.38 ha.

The actual use of labor changes dramatically in the rainy season. More labor is required on traditional rainfed crops due to higher demands at second weeding and harvesting. There are fewer labor hours for water management for irrigated rice because it only supplements rainfall in periods of shortfall. Labor allocation and the areas cultivated per crop are shown in Table 7.21.

In percentage terms, labor allocation to cereal crops increases slightly compared to groundnuts and cotton. Irrigated rice demands the most labor per hectare, followed by groundnuts and cotton and then by cereal crops. However, each crop's labor demands relative to the others does not change from the estimates given in the first budget (Table 7.19). The important difference is the total amount of man-days used in crop production versus total amount of available labor. Nearly 1360 man-days or 81% of total available labor is used on cropping activities leaving very little time for domestic work, livestock raising, or other income-generating activities. In addition, there is no provision for labor expenditure on minor garden crops or dry season irrigated rice.

TABLE 7.21.

MAN-DAYS PER CROP: SENEGAL SANDOUGOU BOLON AREA
1983 RAINY SEASON WITH IRRIGATION

Crop	MD/Ha	Ha	MD/Crop	% of Total
Millet	130	1.02	133	9.7
Late Sorghum	130	1.17	152	11.2
Maize and Assoc.	130	.67	87	6.4
Groundnut/Cereal	110	1.63	179	13.2
Groundnuts	150	3.10	465	34.3
Groundnut/Squash	110	.95	105	7.7
Groundnut/Cowpeas	115	.42	48	3.6
Cotton	150	.69	104	7.6
Irrigated Rice	220	.38	84	6.2
		10.30	1357	100.0

SOURCE: IVS Data and AHT (1984)

University of Michigan, Gambia River Basin Studies, 1985.

The use of improved technologies has not been altered with the exception of more days spent on lifting increased amounts of groundnuts. Input unit amounts and costs remain unchanged as do requirements for wage labor and other materials. Yield levels rise on all upland crops, but decrease on irrigated rice because of fewer sunshine days and lower maturation rates.[6] The same official GOS prices are used to value crop

[6]Yields correspond to those used in AHT reports.

TABLE 7.22.

PAKEBA
FARM ENTERPRISE BUDGET, USING NORMAL YIELDS IN 1983
(in 000 CFA)

Variable Costs	1. Rainy Season								2. Dry Season
	L. Millet E. Millet	Late Sorghum	G'Nut Cereals	G'Nut Cowpea	G'Nut Squash	Ground-Nuts	Maize Assoc.	Cotton	Irrigated Rice
Area (ha)	1.02	1.17	1.63	0.42	0.95	3.10	0.67	0.69	0.38
Seed	0.510	0.585	0.275	0.280	0.000	0.000	0.660	0.000	0.882
Fertilizer	0.000	0.000	1.700	0.000	0.000	0.000	6.499	0.000	10.465
Draft Plow	7.700	0.000	3.900	1.100	2.800	13.000	5.200	2.100	0.000
Draft Seed	4.125	5.250	3.330	0.750	2.325	10.500	5.175	1.800	0.000
Draft Weed	3.975	5.100	4.800	0.675	0.000	12.750	5.775	3.300	0.000
Draft Harvest	0.000	0.000	4.890	1.260	2.850	11.625	0.000	0.000	0.000
Wage Labor	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Material/Misc.	1.080	1.990	1.370	1.130	1.000	8.850	1.065	0.190	18.468
Total Cost to farm	17.390	12.925	20.265	5.195	8.975	56.725	24.374	7.390	29.815
Returns to Production of Farming Enterprise									
Value of Production	43.350	49.725	112.350	31.850	55.125	271.250	87.195	53.130	79.800
Less Total Cost	17.390	12.925	20.265	5.195	8.975	56.725	24.374	7.390	29.815
Gross Margins	25.960	36.800	92.085	26.655	46.150	214.525	62.821	45.740	49.985
Returns/ha	25.451	31.453	56.494	63.464	48.579	69.202	93.763	66.290	131.539
Manday, Fmly. Lab.	133.000	152.000	179.000	48.000	105.000	465.000	87.000	104.000	84.000
Returns/Manday	0.196	0.242	0.514	0.552	0.442	0.461	0.721	0.442	0.598
MD/ha, Fmly Lab.	130.000	130.000	110.000	115.000	110.000	150.000	130	150	220
Costs/ha	17.049	11.047	12.433	12.369	9.447	18.298	36.379	10.710	78.461

SOURCE: IVS data. SONED, 1980 and AHT, 1984 for labor mandays and yields for irrigated rice.

NOTES: Assumptions: Amount and cost of input use the same as in Table 7.19. with following exceptions:

Groundnuts: Increase in days of traction harvest.

Groundnut associations: 4 days/ha.
Groundnut pure stand: 5 days/ha.

Maize fertilizer input: 200 kg/ha.

**Irrigation fee: 80.000 CFA/ha.

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TABLE 7.23.

RETURNS TO HECTARE AND TO MAN-DAY: SANDOUGOU BOLON AREA, 1983 RAINY SEASON WITH IRRIGATED RICE

Crop	Returns/Ha (FCFA)	Man-days/Ha	Returns/Man-day (FCFA)
Millet	25.451	130	196
Sorghum	31.453	130	242
Maize/Assoc.	93.763	130	721
Groundnut/ Cereals	56.494	110	495
Groundnuts	69.202	150	461
Groundnut/ Squash	48.579	110	441
Groundnut/ Cowpea	63.464	115	552
Cotton	66.290	150	422
Irr. Rice	131.539	220	598

SOURCE: IVS data and AHT (1984).

University of Michigan, Gambia River Basin Studies, 1985.

production. The producer price of paddy is valued at 60 FCFA/kg, which was the official price until October 1984, when it was raised to 66 FCFA/kg. The revised budget is given in Table 7.22.

Table 7.23 provides a comparison of gross returns per hectare and per man-day for a farming system which has incorporated rainy season irrigation. At 1984 price levels, returns to paddy production have improved substantially in relation to other crops. Although rice is less remunerative than maize (returns/man-day), it is more competitive than groundnuts or cotton and is far superior to the traditional cereal crops.

7.3. Nema, Middle River Zone (MRZ)

Nema is located along the south bank of the Gambia River some 5 km west of Georgetown. Coverage of a Gambian village in the MRZ was considered important as approximately 56 percent of the proposed irrigable area in The Gambia lies wthin this zone (AHT, 1984).

Nema is a Mandinka village as are the majority of settlements in the area. The structure and organization of the village and households are the same as those previously described for the MRZ (section 7.2). In recent years, farmers from Nema have had difficulty in meeting household food needs from on-farm production, primarily because of adverse climatic conditions. Land availability is a constraining factor to increased production since the area is densely populated and uncleared land for upland fields is in short supply. As the river bank topography favors both swamp and flood recession (bafaro and wamifaro) rice, lowland rice cultivation has long played an important role in existing farming systems. However, the future role of unimproved lowland rice is problematic, as low river levels in recent drought years have permitted advances of the saltwater front unusually for upstream, jeopardizing the existence of rice cultivation systems.

The analysis of the IVS data and presentation of farm enterprise budgets for Nema are divided between households which grew irrigated rice in the rainy season (6 households) and those which did not (4 households). All households cultivated irrigated rice in the 1984 dry season.

7.3.1. Labor Use and Availability

Discussion of labor resources is limited to the direct application of labor to specific crop enterprises and does not include broader comparisons of labor utilization over agricultural and nonagricultural activities as in previous sections. Table 7.24 gives the average household composition and labor availability for households with rainy season irrigation (Group A) and those households without (Group B). Group A households are almost twice the size of Group B households and have roughly one-third more working members.

Table 7.25 compares household labor allocation during the rainy season by crop and by farm category. Average labor allocation per hectare for all crops is about the same for both sets of households, 139 MD/ha and 169 MD/ha for Group B and Group A households, respectively. However, there is wide disparity between households for labor allocated to the same crop.

For individual crops, Group A households expend more labor per hectare for all crops except swamp rice. This difference in labor expenditure can be attributed to greater amounts of available labor. Group B households, on the other hand, invested a greater proportion of labor on swamp rice (51 percent vs. 42 percent). Overall, the importance of rice is evident from the high percentage of agricultural labor time devoted to rice.

Labor allocation to upland cereals across all households was limited in 1983 due to a midseason drought and subsequent cutbacks in weeding and harvesting activities.

TABLE 7.24.

HOUSEHOLD COMPOSITION: MIDDLE RIVER ZONE (NEMA)
1983-84

	Households Without Rainy Season Irrigation Group B		Households With Rainy Season Irrigation Group A	
Category	Individuals	Labor Units	Individuals	Labor Units
Males	4	4	6	6
Females	4.5	4.5	7.3	7.3
Children	3	1.5	5.2	2.6
Minors	4.5	-	9.8	-
Over 65	1.3	-	1.8	-
Total	17.3	10	30.2	15.9

SOURCE: IVS data.

NOTES: Sample Size: 10 Households
Range in Household Size: 71-10 persons

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Most labor was allocated to food crops (70-72 percent of total labor for both sets of households). Group B households spread their labor over a wider range of upland grain crops. Irrigated rice demanded the most labor per hectare, followed by swamp rice. Both types of rice competed with groundnuts for labor. Group B households directed a higher percentage of their labor to swamp rice and groundnuts than did Group A.

TABLE 7.25.

MAN-DAYS PER CROP AND HOUSEHOLD LABOR ALLOCATION: NEMA, 1983-84

Crop	Households Without Rainy Season Irrigation Group B				Households With Rainy Season Irrigation Group A			
	MD/Ha	Ha/Crop	MD/Crop	% of Total MD	MD/Ha	Ha/Crop	MD/Crop	% of Total MD
<u>Rainy Season:</u>								
Swamp Rice	231[a]	1.26	291	51%	162	2.28	370	42%
Irrigated Rice	-	-	-	-	280[a]	.25	70	8%
Early Millet	105	.34	35.7	5%	140	.42	58.8	6%
Late Sorghum	92	.62	57.4	10%	136.5	1.04	142	16%
Maize & Assoc.	77	.32	24.6	4%	-	-	-	-
Groundnuts	128	1.13	144.6	24%	172	.64	110	12%
Groundnut-Cereals	-	-	-	-	140	.59	82.6	9%
Groundnut-Cowpea	91	.4	36.4	6%	-	-	-	-
<u>Dry Season:</u>								
Irrigated Rice	340[a]	.36	122.4		257[a]	1.85	475.5	

SOURCE: IVS data.

NOTE: a) Includes guarding activity which is not accounted for in other studies.

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For example, 30 percent of Group B labor went to groundnuts and associated crops versus 20 percent for Group A households.

7.3.2. Land Use and Availability

Table 7.26 shows major cropping patterns for Nema households. Several minor crops (cassava, assorted vegetables, cocoyam) are cultivated by each group, but these account for less than 4 percent of land in cultivation. The scarcity of land for upland crops is reflected in the small area cultivated by each set of households and the low average land area per labor unit.

Several land use and cropping pattern characteristics distinguish Nema from Pakeba and Alunhari. Cereal foodgrains are more dominant in Nema across both categories of households than in Pakeba and Alunhari, accounting for 62 percent and 77 percent of the total area cultivated by households without and with rainy season irrigation, respectively. Rice dominated rainy season cereal production for both sets of households in 1983. For all households practicing rainy season irrigation, nearly 50 percent of cultivated land is in rice. This confirms the importance of rice in Nema as a primary crop in the farm system as opposed to its supplementary role in systems analyzed in the URZ and along the Sandougou Bolon in the MRZ.

Another major characteristic across all households is the relatively limited amount of land cultivated in mixed stands. The concentration on solestand crops is attributed to the large amounts of land cultivated in rice and groundnuts and the widespread use of animal traction equipment for seeding and weeding cereal and groundnut crops (Table 7.29). Use of traction equipment discourages multiple cropping.

In addition to the cultivation of irrigated rice, there are also important differences in rainy season cropping patterns between the two sets of households. First is the more extensive cultivation of groundnuts by Group B households. This pattern is the opposite of that found in Alunhari. It also tends to refute the LRDC assumptions about household land use in the Bansang Nibras irrigated development models. The emphasis on groundnut cultivation suggests that farmers in Nema respond to adverse climatic conditions, as do farmers in Pakeba, by cultivating the more drought resistant cash crops for purposes of

TABLE 7.26

NEMA: CROPPING PATTERNS: NEMA 1983-84
(Rainy Season)

	Households Without Rainy Season Irrigation Group B			Households With Rainy Season Irrigation Group A		
Crop	Area (ha)	ha/LU	% (of total)	Area (ha)	ha/LU	% (of total)
Rainy Season:						
Swamp Rice	1.26	0.13	31	2.28	0.14	43
Irrigated Rice	-	-	-	.25	0.02	6
Early Millet	.34	0.03	9	.42	0.03	8
Late Sorghum	.62	0.06	15	1.04	0.07	20
Maize and Maize Assoc.	.32	0.03	7	-	-	-
Groundnuts	1.13	0.11	28	.64	0.04	12
Ground-Cereals	-	-	-	.59	0.04	11
Groundnut-Cowpea	.4	0.04	10	-	-	-
Dry Season:						
Irrigated Rice	.36			1.85		
Total Area:						
Range in Farm Size:	7.8-1.7 ha			12.4-1.8 ha		
Average Labor Units/HHold:	10			16		
Average Area/Labor Unit:	.40 ha			.34 ha		
Cash Crop Intensity:[a]	28%			19%		

SOURCE: IVS data.

NOTE: a) Percent of total cultivated area in cash crops (groundnuts and irrigated rice) with primary crop in associated stands accounting for 67% of cultivated area in that association.

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purchasing food. It can be envisioned that with conditions of continuing drought and salt intrusion into swamp rice areas, farmers may put increasing effort into groundnut production.

While the percentage of land in coarse cereals is high for the two sets of households, there is a marked difference for specific crops. Whereas the relatively less demanding sorghum and millet crops dominate in Group A households, Group B households also cultivate maize. Maize has a relatively high demand for labor. The fact that no maize is cultivated in Group A households provides further evidence of competition not only between upland and lowland cereal crops, but between labor-intensive cereals. In this case, irrigated rice discourages production of the most labor-intensive cereal, maize.

TABLE 7.27.

CROP YIELDS: NEMA 1983-84
(kg/ha)

Crop	Households Without Irrigation Group B	Households With Irrigation Group A
Rainy Season:		
Swamp Rice	0	0
Irrigated Rice	-	1,757
Early Millet	255	715
Late Sorghum	93	320
Maize and Maize Assoc.	Pure Maize: 215 Maize (w/L. Millet) 571 Maize (w/Sorghum) 0 Sorghum (w/Maize) 487 Millet (w/Maize) 16	-
Groundnuts	625	1,100
Groundnuts-Cereals	-	GN (w/Millets) 970 Late Millet (w/GN) 52
Groundnuts-Cowpeas	Groundnuts: 1,387 Cowpea: 0	GN (w/Cowpea) 1800 Cowpea (w/GN) 187
Dry Season:		
Irrigated Rice	5,333	5,862

SOURCE: IVS data.

As was the case in other parts of the Basin, crop production in the 1983 cropping season was poor, with the exception of groundnuts (Table 7.27). The crop most adversely affected was swamp rice; the harvest was entirely destroyed by lack of water late in its growth cycle.[7]

Generally, all rainfed cereal crops fared very poorly. The higher cereal yields of Group A households can be attributed to higher rates of

TABLE 7.28.

FERTILIZER USE: NEMA, 1983 (kg/ha)[a]

Crop	Households Without Irrigation Group B	Households With Irrigation Group A
Rainy Season:		
Wet Season Swamp Rice	0	0
Irrigated Rice	-	595
Early Millet	0	210
Late Sorghum	0	40
Maize and Associations	170	-
Groundnuts	50	0
Groundnut-Millet	-	65
Groundnut-Cowpea	70	-
Dry Season:		
Irrigated Rice	500	600

SOURCE: IVS data.

NOTE: a) Fertilizer use was averaged across all fertilizer types: NPK, SSS and TSP and other unspecified chemical fertilizers used by farmers in the sample.

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[7]According to the villagers this was caused by the operations of Jahaly Pacharr which diverted their water. Nema villagers have not been compensated for their apparent losses.

application of fertilizer (Table 7.28). For households without rainy season irrigation, high yields of sorghum in association with maize are explained by two factors. First, sorghum resisted the midseason drought and, secondly, higher application rates of fertilizer were used on cereals associated with maize compared to pure stands. Groundnut yields were higher when associated with cowpeas than in pure stands.

TABLE 7.29.

ANIMAL AND FUEL POWERED TRACTION USE BY CROP: NEMA 1983-84

	Households Without Irrigation Group B		Household With Irrigation Group A	
Crop	Animal Traction[a] (days/ha)	Mech. Plow[b] (ha)	Animal Traction[a] (days/ha)	Mech. Plow[b] (ha)
Rainy Season:				
Swamp Rice	0	0	0	0
Irrigated Rice	-	-	0	.25
Early Millet	8	0	18	.21
Late Sorghum	8	0	11	.52
Maize and Assoc.	18	0	-	-
Groundnuts	6	0	13	0
Groundnut-Millet	-	-	2	.29
Groundnut-Cowpea	0	0	-	-
Dry Season:				
Irrigated Rice	0	0	0	.90

SOURCE: IVS data.

NOTES: a) Use of animal traction is totaled across all traction activities.
b) Tractor plowing is recorded on a per hectare basis rather than in days.

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7.3.3. Use of Improved Technologies

Tables 7.28 and 7.29 illustrate the use of purchased fertilizers and animal traction/mechanical equipment on different crops, respectively. No farm enterprise employed pesticides or herbicides, and seed was only occasionally purchased from outside sources. It is interesting to note that no improved inputs were alloted to swamp rice, contrary to the production assumptions employed by other economic analyses (AHT, 1984).

Purchased fertilizer (Table 7.28) was confined to NPK and Single Super-Phosphate. There were no purchases of urea. While Group B households limited use of fertilizer to maize, maize associations, and groundnuts (i.e., the higher yielding crops), Group A households concentrated fertilizer on millet and sorghum. Despite high rates of fertilizer use on irrigated rice (595 kg/ha), rainy season yields were low (1,757 kg/ha) compared to dry season yields when equal amounts of fertilizer were employed (Table 7.27). This suggests factors other than amounts of fertilizer use influenced crop performance. Likely other factors include fewer sunshine days during the rainy season and crop husbandry (i.e., labor allocated to weeding).

Fertilizer use on maize also had no apparent affect on yield, largely because of drought conditions midway through the growth cycle. In both groups of households, purchases of fertilizers are positively correlated to land area under cultivation.

While overall use of equipment is high (Table 7.29), use of animal and motorized traction is more common among Group A households. These households have more land on average and need equipment to relieve labor bottlenecks which occur because of the incorporation of irrigated rice into the farming system. Group B households in the rainy season employed no mechanized plowing and concentrated the use of traction equipment on cereal crops. Group A households focused traction efforts on weeding activities for cereal crops but allocated a higher amount of total traction time to the more labor-intensive groundnut crop, especially for planting. The use of tractor plowing and traction equipment appears essential for households wishing to expand areas in upland crops while cultivating irrigated rice.

7.3.4. Comparative Returns to Crop Enterprises

Tables 7.30 and 7.31 provide farm enterprise budgets for the two sets of cropping patterns shown in Table 7.26. Table 7.32 compares costs and returns per hectare and per man-day for the two different farming systems.

A comparison of the variable costs across all households shows that purestand groundnuts and maize are the most expensive rainfed crops to produce. The high cost of maize is attributed to the extensive use of traction equipment. Higher use of traction and the imputed cost of seed in purestand groundnut fields contribute to their relatively high cost of production. The cost of traction is offset by the high productivity of groundnuts.

For all upland cereals the major cost item is for the use of animal traction equipment. All crop production costs for Group A farming systems are higher than for Group B. The former use higher rates of fertilizer application, more animal traction, and mechanical plowing.

7.3.5. Rainy Season Crops

In returns per hectare and per man-day, the groundnut-cowpea association for Group B households is the most profitable (D 5.74/man-day). This is primarily due to low costs (small amount of fertilizer used and the absence of traction costs) and the relatively high yields of both crops given the climatic conditions.

Returns per man-day for all groundnut crops are either almost equal to or higher than those for rainy season irrigated rice, largely as a result of lower production costs for groundnuts and the low average yields for rainy season irrigated rice in Nema. Irrigated rice yields are substantially lower than those recorded for Alunhari and Pakeba.[8] On the other hand, returns per hectare for irrigated rice are greater than for any crop except the groundnut-cowpea association.

No crop with the exception of the groundnut-cowpea association provides returns remotely approaching the estimated daily rate for unskilled agricultural labor (D5/MD).

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[8]This may be due to any number of factors such as physical infrastructure of the rice perimeters, pumping efficiency, breakdowns in the irrigation system, soil quality and fertility, and planting dates.

TABLE 7.30.

NEMA: FARM ENTERPRISE BUDGET, 1983-84
(Households Without Rainy Season Irrigation: Group B)
(in Dalasis)

Variable Costs	Early Millet	Late Sorghum	Maize Assoc.	Groundnut	Groundnut Cowpea	Swamp Rice[a]	Dry Season Irrigated Rice
Area (ha)	0.34	0.62	0.32	1.13	0.4	1.26	0.36
Seed	1.43	3.26	4.29	83.90	23.51	19.28	9.18
Fertilizer	0.00	0.00	8.70	9.04	4.48	0.00	28.80
Animal Traction	19.04	34.72	40.32	49.04	0.00	0.00	0.00
Wage Labor	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Material, Misc.	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transport	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Irrigation Fee	0.00	0.00	0.00	0.00	0.00	0.00	88.92
Total Cost to Farm	20.47	37.98	53.31	141.98	27.99	19.28	126.90
Returns to Production of Farming Enterprise							
Value of Production	30.35	20.18	38.98	317.81	235.78	0.00	979.14
Less Total Cost	20.47	37.98	53.31	141.98	27.99	19.28	126.80
Gross Margins	9.88	-17.80	-14.33	175.83	207.79	-19.28	852.24
Returns/ha	29.06	-28.71	-44.78	155.60	519.47	-15.30	2367.33
Mandays, Family Labor	60	51	20	144	36	291	122
Returns/Manday	0.17	- 0.35	- 0.73	1.22	5.74	- 0.06	6.99
MD/ha, Family Labor	175.0	81.7	61.0	127.5	90.5	231.0	340

Assumptions about input use:

Crop	Amount of Seed[b]	Seed Cost (Farm Gate Price)
Sorghum	15 kg/ha	D 0.35 kg
Millet	12 kg/ha	D 0.35 kg
Maize	42 kg/ha	D 0.39 kg
Groundnut	165 kg/ha	D 0.45 kg
Cowpea	20 kg/ha	D 1.00 kg
Rice (Irrigated)	50 kg/ha	D 0.51 kg
Rice (Swamp)	30 kg/ha	D 0.51 kg

Amount of Fertilizer		Animal Traction
Sorghum	0 kg/ha	8 days/ha
Millet	0 kg/ha	8 days/ha
Maize	170 kg/ha	18 days/ha
Groundnut	50 kg/ha	6.2 days/ha
Groundnut/cowpea	70 kg/ha	0 days/ha
Rice (Irrigated):		
Dry Season	500 kg/ha	0 days/ha
Rice (Swamp):	0 kg/ha	0 days/ha

Average Cost of:	Fertilizer	Animal Traction
	0.16 D/kg	7 D/day

SOURCE: IVS Data.

NOTE: a) No yields were obtained in 1983. Assuming an average yield of 1,200 kg/ha (AHT, 1984, Annex E) returns per hectare would be D 596.70, and returns per manday D 2.58.

b) Adapted from AHT, 1984, Annex E.

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TABLE 7.31.

NEMA: FARM ENTERPRISE BUDGET, 1983-84
(Households With Rainy Season Irrigation: Group A)
(in Dalasis)

Variable Costs	Early Millet	Late Sorghum	Ground-nut Assoc.	Groundnut	Rainy Season Irrigated Rice	Swamp Rice[a]	Dry Season Irrigated Rice
Area (ha)	0.42	1.04	0.59	0.64	0.25	2.28	1.85
Seed	1.76	5.46	32.12	47.52	6.38	34.88	47.18
Fertilizer	14.11	6.66	6.14	0.00	23.80	0	177.60
Animal Traction	52.92	80.08	8.26	58.24	0.00	0	0
Wage Labor	0.00	0.00	0.00	0.00	0.00	0	0
Material, Misc.	0.00	0.00	0.00	0.00	0.00	0	0
Mech. Plow.	7.77	19.24	10.92	0.00	9.25	0	31.50
Irrigation Fee	0.00	0.00	0.00	0.00	61.75	0	456.95
Total Cost to Farm	76.56	111.44	57.44	105.76	101.18	34.88	713.23
Returns to Production of Farming Enterprise							
Value of Production	105.11	116.48	252.56	316.80	224.02	0.00	5530.80
Less Total Cost	76.56	111.44	57.44	105.76	101.18	34.88	713.23
Gross Margins	28.55	5.04	195.12	211.04	122.84	-34.88	4817.57
Returns/ha	67.98	4.85	330.71	329.75	491.36	-15.30	2604.10
Mandays, Family Labor	59	142	83	110	70	369	475
Returns/Manday	0.49	0.04	2.36	1.92	1.75	- 0.09	10.14
MD/ha, Family Labor	140.0	137	140.0	172.0	280.0	162.0	257

Assumptions about input use:

Crop	Amount of Seed[b]	Seed Cost (Farm Gate Price)
Sorghum	15 kg/ha	0.35 D/kg
Millet	12 kg/ha	0.35 D/kg
Maize	42 kg/ha	0.39 D/kg
Groundnut	165 kg/ha	0.45 D/kg
Cowpea	20 kg/ha	1.00 D/kg
Rice (Irrigated)	50 kg/ha	0.51 D/kg
Rice (Swamp)	30 kg/ha	0.51 D/kg

	Amount of Fertilizer	Animal Traction	Mechanical Plow
Sorghum	40 kg/ha	11 days/ha	0.52 ha
Millet	210 kg/ha	18 days/ha	0.21 ha
Groundnut	0 kg/ha	13 days/ha	0 ha
G'nut Assoc.	65 kg/ha	2 days/ha	0.29 ha
Rice (Irrigated):			
Rainy Season	595 kg/ha	0 days/ha	0.25 ha
Dry Season	600 kg/ha	0 days/ha	0.90 ha
Rice (Swamp):	0 kg/ha	0 days/ha	0 ha
Average Cost	0.16 D/kg	7 D/day	37 D/ha

SOURCE: IVS data.

NOTE: a) No yields were obtained in 1983. Assuming an average yield of 1,200 kg/ha (AHT, 1984, Annex E) returns per hectare would be D 596.70, and returns per manday D 3.69.

b) Adapted from AHT, 1984, Annex E.

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TABLE 7.32.

NEMA: COMPARATIVE RETURNS TO PRODUCTION, 1983-1984
(in Dalasis)

	HHolds without Irrigation Group B			HHolds with Irrigation Group A		
Crop Association	Costs per ha	Returns per ha	Returns per MD	Costs per ha	Returns per ha	Returns per MD
Rainy Season:						
Swamp Rice[a]	15.30	-15.30	-0.10	15.30	-15.30	-0.08
Irrigated Rice	-	-	-	405	491	1.75
E. Millet	60	29	.17	181	68	.49
L. Sorghum	61	-29	-.35	106	5	.04
Maize and Assoc.	166	-45	-.73	-	-	-
Groundnuts	126	156	1.22	165	330	1.92
Groundnut-Millet	-	-	-	97	331	2.36
Groundnut-Cowpea	70	520	5.74	-	-	-
Dry Season:						
Irrigated Rice	353	2367	6.99	386	2604	10.14

SOURCE: Tables 7.30. and 7.31. (IVS data).

NOTE: a) No yields were obtained in 1983. Assuming average yields of 1,200 kg/ha (AHT, 1984, Annex E.) returns/ha of 596.70 and returns/man-day of 3.69 for households with rainy season irrigation or 2.58 for households without rainy season irrigation could be expected.

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Groundnut association generated returns of D5.75/MD for groundnut-cowpea while groundnut-millet gave returns of D2.35/MD and purestand groundnuts averaged returns of D1.90/MD or lower. Returns per man-day are heavily influenced by the use of and costs associated with traction or motorized equipment.

Across both sets of households, early millet produced the highest returns per man-day for upland cereals, followed by sorghum and maize. Compared to other crops, low returns to cereals are explained by low (caused by poor rainfall distribution) and relatively lower yields prices. Maize and sorghum yielded negative returns in Group B households because of very low crop output and/or high costs associated with traction (sorghum).

The key indicator of profitability of various crops is returns/man-day as labor is the most binding constraint. While returns to land area is important, irrigated rice and groundnuts really do not compete for the same soil resources and do not involve comparison of marginal changes in this production factor.

Had yields of rainy season irrigated rice equalled dry season yields (5 mt/ha), returns of D7.65/MD could have been achieved. Certain conditions must exist to maintain the relative profitability of rainy seaon irrigated rice compared to other rainy season alternatives: yields must be no less than 5 mt/ha, production costs must remain unchanged relative to output prices and climatic conditions unfavorable to upland rainfed crops must persist.

7.3.6. Dry Season Irrigation

All households in Nema cultivated dry season irrigated rice. However, the amount of land cultivated by each category of household differs significantly. Households with no irrigated rice in the rainy season worked only 20 percent as much land as that put into production by Group A households, 0.35 ha vs. 1.8 ha (Table 7.26). The disparity between the two groups is also great in terms of land area per labor unit. In Group B households, the land area/labor unit ratio is 0.05 ha/LU while the ratio Group A category is 0.11 ha/LU. The variation can be attributed to the presence of two large master farmers among rainy season irrigators and the use of mechanical plowing on approximately 50 percent of the irrigated area by Group A households.

Yields of irrigated rice showed marked improvement in the dry season, attaining an average of 5.3 mt/ha in Group B households and 5.9 mt/ha in Group A households (Table 7.27). Because the amount of fertilizer used in both seasons and by both categories of households is roughly the same

(500-600 kg/ha), it can be assumed that the yield difference is due to other factors such as greater solar radiation, more attention to details of crop husbandry and less competition from other agricultural activities, planting dates or irrigation efficiency. Further research is recommended to better understand the great disparity between rainy and dry season yields of irrigated rice.

Mechanical plowing for irrigated rice in the dry season was used only by Group A households. This substantially lowered their labor investment, despite the greater availability of family labor, but also increased costs. With mechanical plowing, man-days/ha of labor were 257 versus 340 for Group B households which used no mechanical plowing on dry season irrigated rice (Table 7.25). The combined effect of high yields and use of mechanical plowing generated returns/man-day of D10.14, similar to those achieved in Alunhari. For households without mechanical plowing, returns/man-day were D7.00.

With or without mechanical plowing, returns per man-day for dry season irrigated rice are competitive with the daily wage rate for unskilled labor (D5/MD) across both sets of households. As in Alunhari, the presence of master farmers who are able to secure inputs (fertilizers) and services (tractor plowing) through their own resources creates a favorable (production) environment for the continued production of irrigated rice in the dry season at current cost and price levels. It is interesting to note that costs of dry season irrigation are approximately the same for both sets of households, indicating no particular advantage in terms of economics of scale.

7.4. Conclusions for Incorporation of Irrigation into Existing Farming Systems

This chapter has described some experiences of farmers who have incorporated irrigation into their production systems. Three village farming systems, representing two distinct ecological zones, have been analyzed to investigate the profitability of irrigated rice production compared to other cropping enterprises. Each of the three villages represents a unique combination of land resources, labor availability, cropping patterns, and costs associated with irrigated rice production.

In two villages (Alunhari and Nema) households with and without rainy season irrigated rice have been subjected to a comparative analysis. The perspective chosen is one of looking at the profitability of irrigated rice production from the farmer's viewpoint and at his experience thus far in adopting irrigation technology. For all three villages, returns to land and labor for various cropping enterprises were calculated and compared. The outcome of these analyses are relevant to the feasiblity of double-cropped irrigated rice.

7.4.1. The Upper River Zone (Alunhari)

Despite the high returns to rice and relatively lower returns to other cereal food crops in the URZ village of Alunhari (where no maize was cultivated), it is interesting to note that all farmers still allocated at least 45% of their land to non-rice cereals. This underlines the continued importance of a strategy amongst farmers to reduce the risks associated with variations in climate by cultivating a variety of crops. As illustrated in the case of Nema, maize may be a relatively more profitable crop because of the good yield response to improved inputs and recent increases in producer price. The risk avoidance strategy is also reflected in the expanded use of earlier maturing but relatively lower yielding cereal varieties.

In the dry season, differences in yields between Group A and Group B households are attributed to Group B's relatively poorer access to needed inputs. Despite increased irrigation costs on private schemes, returns to labor continue to be higher than for any of the rainfed crops. However, returns per man-day for rice cultivation in the dry season is only slightly higher than the official wage rate (D5/MD). For Alunhari irrigated rice was profitable in the rainy season because of fairly high assumed yields, a higher per unit price for output than other crops, and lower relative production costs i.e., no animal traction. In addition, all critical inputs were made available on time, mainly due to association with a master farmer.

A major immediate problem for the expansion of irrigation in the URZ will be limited labor and poor access to labor saving devices among the majority of households. To help relieve this constraint more on-farm demonstration and use of animal traction for irrigated rice should be investigated. This is especially true in the rainy season. Without access to equipment to relieve labor constraints for rice or upland crops, labor will continue to be a major bottleneck. Currently, overall labor availability will also continue to be heavily influenced by more attractive off-farm wages in The Gambia.

In the Upper River Zone (URZ) it is conceivable that increased pressure on land resources may become more extreme with continued population growth. With an increased premium for land, higher returns to this factor of production will become more and more important.

7.4.2. The Middle River Zone (Pakeba and Nema)

In the Senegalese part of the MRZ (Pakeba), farmers have balked at fully allocating their labor to dry season irrigation as well as at giving up other cropping activities in the rainy season. The experience of the PISO program has shown that farmers perceived the production costs as being too high per unit of output. For many farmers the basic strategy has been to await the outcome of the rainy season before committing themselves to irrigation in the dry season.

The 1984 dry season irrigated rice crop in Pakeba yielded returns to labor higher than those of any other rainy season cropping enterprise. In these circumstances, it seems rational that some farmers opted to continue irrigated agriculture into the next rainy season, if only to secure a minimum supply of foodgrains. Nonetheless, even if output of paddy were to double as a result of double-cropping, the total amount of milled rice available for an average household of 13 persons would only be 92 kg/person/year, about one half the estimated minimum requirement of 175 kg/person/year (Keita, 1984).

The continuation of double-cropping in the Sandougou Bolon area of the MRZ will largely depend on the outcome of competition for land, labor and capital. In the past irrigation has had difficulty competing for labor since cash crops have been considered less demanding but equally profitable. Without irrigation, the farming system has been perceived as being more flexible. Farmers have been able to exercise choice over the selection of cereals to grow and over the use of inputs on different crops.

The problem with overall availability of labor in Pakeba is the timing of actual labor use. Under conditions of normal rainfall and corresponding increases in labor demand (Table 7.21), the assumption that family labor is available for all crops and activities at technically efficient times is not reasonable.

Past experience has shown that farmers interrupt work on irrigated fields when the rains begin in order to plant maize, groundnuts and other cereals. There are also serious labor bottlenecks in July and August when rainfed crops receive the first crucial weeding. The result is that less labor is devoted to irrigated rice. It is important to remember the head of household's responsibility to secure food and cash income by putting traditional family fields into production at the appropriate time. In this way he annually reclaims his usufruct rights over the land he has inherited or cleared. Giving precedence to upland crops therefore fulfills a social obligation and usually makes economic sense.

With men initially allocating their labor to upland crops, women have to spend more time on irrigated rice, a very difficult task given their own upland fields and domestic chores. Ultimately, less labor than the prescribed minimum 220 MD/ha are allocated to rice and yields decline.

Climate may be the deciding factor. In the past, double-cropping of rice has been considered mainly as a fallback choice in the aftermath of a poor rainfall year. If the current pattern of climate continues indefinitely, there may be no alternative for those households who wish to stay and farm. If, on the other hand, the climate returns to a more "normal" pattern, irrigated agriculture must be competitive in a year of average rainfall in order to become a regular activity.

In response to existing economic conditions, farmers in Nema, as in Alunhari and Pakeba, emphasize low value cereal crops, with the exception of rice, in order to meet food self-sufficiency needs. Nema producers allocate at least 60 percent of their land and labor to upland cereals and rice. Irrigated and swamp rice would be more profitable under normal weather conditions and improved conditions of input delivery. AHT (1984) has calculated returns to man-day of swamp rice at D6.23/MD, making it more competitive than either irrigated rice or groundnuts under current conditions. With low current yields and high costs per hectare for irrigated rice (80 percent of net returns), yields must increase for irrigation to be a profitable activity. It was seen in Alunhari and Pakeba that yields of 5 mt/ha can be obtained, providing certain production conditions are met. If rice yields are not improved, rainfall conditions return to a more "normal" pattern, and the dry season rice crop continues to be planted late, it can be expected that farmers will shift out of relatively more costly rice production and concentrate on rainfed crops and swamp rice.

7.4.3. General Conclusions for the Gambia River Basin

A critical assumption espoused by the major development schemes in the Gambia River Basin is double-cropping with an annual cropping intensity of 180-200 percent. This is to be achieved over a 3-5 year transition period in the irrigation expansion zones.[9] These cropping intensities are considered essential to generating adequate benefit streams to help cover the capital investments foreseen for future developments. Maintenance of high yields is another requisite.

The experiences of Senegal and The Gambia make it clear that more farmers grow irrigated rice during the dry season than in the rainy season. Cultivation of irrigated rice simultaneously with rainfed crops requires access to sufficient labor or labor saving devices, a willingness to reallocate labor among crops and alter cropping patterns, and favorable returns to labor relative to other crop enterprises.

When the conditions for a favorable production environment are satisfied, irrigated rice is competitive with alternative income generating activities in the agricultural sector. These conditions include efficient and reliable water delivery systems, adequate amounts of critical inputs, proper crop husbandry, and favorable cost-price relationships.

Of the 14 villages participating in the Intensive Village Survey (IVS), rainy season irrigation in 1983 was encountered in only Nema, Tabanani and Alunhari.[10] In these villages, double season irrigators

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[9]LRDC's Bansang Nibras Pilot Project, the Jahaly Pacharr Project and the PISO program.

[10]Tabanani was near Nema and represented the same ecological zone. Only Nema was analyzed for this study.

tended to have large households compared to single season irrigators and access to mechanical plowing services (tractor plowing) for both rainfed and irrigated crops. These households also reduced or even eliminated activity devoted to at least one of the more labor-intensive rainfed crops. Alunhari farmers not only reduced the percentage of total area allocated to groundnuts but also sacrificed diversification among rainfed cereal crops. Nema farmers dropped maize from the cropping pattern. Both directed roughly 8 percent of total agricultural labor to irrigated rice. The amount of labor used for irrigated rice would have been greater had they not had recourse to tractor plowing, which not only reduces labor spent on land preparation but also decreases time spent for planting/transplanting and weeding.

Returns to irrigated rice in the rainy season differed significantly between Alunhari (D10.70/MD) and Nema (D1.75/MD). The reasons behind such disparity are not well understood and call for further investigation. Amount of fertilizer applied is probably not a likely reason, as use rates are high (500-600 kg/ha) in both cases. More probable factors are quality of crop husbandry, influenced by the competitiveness of irrigated rice with rainfed crops for available labor, and reliability and efficiency of irrigation systems. This latter requirement is directly influenced by control over input delivery and management. System failures due to poor irrigation efficiency or disruptions in the delivery system can seriously affect crop development and yields.

Returns to dry season irrigation per man-day in the Senegalese village of Pakeba are roughly comparable to minimum daily wage rates of 500 FCFA/MD. Use of irrigated perimeters increased substantially in the 1984 dry season, partially because of harvest failures experienced with rainfed cereals in the previous rainy season.

Assuming no decline in rice yields as a result of expected decreased labor allocation, returns to labor for irrigated rainy season rice, e.g. in Pakeba at 1984 price levels, are less than for maize but higher than for groundnuts or cotton (Table 7.23). Realistically speaking, however, if cost-price ratios stay the same, a rainy season rice crop may be financially sound but cannot successfully compete for labor under good rainfall conditions. Further, cost-price ratios are unlikely to remain as favorable as they have been. Input prices will not remain unchanged over time. Indeed, in the 1985 cropping season farmers faced a 50% increase in the cost of fertilizers. Without continued increases in the producer price and more control over production costs, it is unlikely that in a year of adequate rainfall Pakeba farmers would opt to cultivate irrigated rice during the rainy season.

Recent information indicates that despite decreases in state subsidies for fertilizer and diesel fuel coupled with substantial increases in 1985 producer paddy prices in the MRZ, farmers' production strategies have remained relatively unchanged.[11] The same problems of debt repayment among PISO farmers were reported to continue through the 1985 dry season (PISO Staff, Personal Communication, July 1985).

The experience of Nema, Alunhari and Pakeba in particular and the more general history of use and performance discussed in Chapter 6 argue for serious reconsideration of the criteria used for expected adoption levels of irrigation by farmers. These criteria include double-cropping, high yields, reliable input delivery, and comparative profitability relative to other on-farm or off-farm activities. Double-cropping is the exception, rather than the rule, and was only observed in the IVS sample among an elite subsample of Gambian households.

In The Gambia, the presence of master farmers appears to be a critical factor for double-cropping. Double season irrigators also have sufficient labor available to produce some mix of rainfed and irrigated crops. In section 6.2.1 it was seen that while overall perimeter use rates in The Gambia are low, and double-cropping infrequent, occurrences of double-cropping were positively correlated with the presence of master farmers or large farmers.

Master farmers are not reliant upon government sources for provision of necessary inputs or services. Master farmers are also able to exert control over operation and management of water deliver services, rather than have these decisions subject to group consensus as in farmer associations. The end result is that master farmers have cut per unit production costs by applying inputs when they are required thereby increasing yields and avoiding crop losses. Farmer associations have not

[11] The 1985 dry season producer price for paddy was 80 FCFA/kg.

demonstrated the cohesiveness and management capability of a single or small group of master farmers.

Master farmers are found only in a minority of Gambian villages. The majority of Gambian farmers neither have nor can benefit from the resources available to master farmers. Unwilling to incur debts for inputs and services which may be provided late or inadequately, farm households with fewer land and labor resources opt for the more familiar although lower yielding traditional rainfed crops. Until there are a) substantial improvements in the management of government-sponsored irrigation programs or development of an active and competitively prices private supply sector, and b) training in local perimeter management, the cropping intensities or yield levels assumed in proposed or existing irrigation schemes are unlikely to be consistently maintained.

If the erratic rainfall patterns of the past few years persist, it can be expected that farmers will opt to allocate proportionately more land and labor to drought resistant groundnuts as a hedge against failure of rainfed cereal crops. Interest in irrigated rice will be influenced by farmers' ability to control or predict production conditions and cost-price relationships.

In conclusion, the farm budgets which have been the basis for analysis in this chapter should be periodically recalculated to take into account changes in production costs and prices. This is especially relevant in the case of Senegal and The Gambia when both costs and output prices are steadily rising for all crops.

8. DISCUSSION OF PROPOSED IRRIGATION STRATEGIES

8.1. Introduction

Estimates of the potential for irrigated agriculture vary, but recent studies suggest that there are a total of 85,000 ha of potentially irrigable land, of which 53,500 ha are in The Gambia, 16,500 ha in Senegal Oriental and 15,000 ha in Guinea (AHT, 1984). If full expansion occurs, most of the area in The Gambia would be devoted to rice, while in Senegal Oriental, where soil conditions differ, irrigated crops would include rice, maize, bananas and vegetables. In the pedological study of the plains of Oudaba, Koundara and Kerouane (downstream of Kogou Foulbe), several possible crop combinations have been proposed. These include vegetable gardens, maize, sorghum and rice. In the absence of detailed hydrological and topographical studies, Senesol and FAO have proposed 12,100 hectares be developed in different crop combinations.

In the absence of dams on the Gambia River irrigated agriculture in the dry season cannot expand much beyond the 3,000 ha already developed without serious downstream effects. Indeed, continued advancement of the saltwater tongue upstream threatens existing perimeters and dry season swamp rice cultivation.

If adequate supplies of water were available the major condition to be met for the expansion of irrigated agriculture in the Gambia River Basin would be the optimal use of scarce but essential resources: infrastructure, management, water and labor. The key issue in the expansion of irrigation is how to develop production systems which are technically and economically viable for both farmers and society as a whole. Previous irrigation development schemes have often been inappropriate because the means employed to insure economic viability has not simultaneously addressed the question of viability for both farmers and society. Chapter 7 provided an analysis of the viability of irrigation at the farmer level. This chapter looks at viability from the public perspective. Experience with irrigation in the Gambia River Basin to date has been varied, ranging from total failures to the promising experience of Jahaly Pacharr. Valuable lessons can be learned from these experiences and applied to future irrigation development strategies.

There are presently three long-term strategies for the expansion of irrigated agriculture being considered by the OMVG and Member States of the Gambia River Basin (no plans exist for Guinea at the present time). Each is based on a different set of assumptions concerning the choice of technologies, scale of operation, degree of water control, organization, farmer behavior, labor use, and rates of expansion of irrigated land. From the macroeconomic perspective, the proposals are based on different estimates of capital investment, operation and maintenance costs.

The proposals are:

i) Coode & Partners' Feasibility Study for a bridge/barrage at Balingho and the development of 24,000 irrigated ha in The Gambia;[1]

ii) AHT's Kekreti Reservoir Project which includes the development of 70,000 ha of irrigated land in The Gambia and Senegal;

iii) The recent proposal by LRDC (Land Reclamation Development Consultants) to develop 30,000 ha in The Gambia in 30 to 54 years, depending on the rate of expansion.

What can realistically be expected of these proposals and for the role of irrigated agriculture in the achievement of the national goals of food self-sufficiency and increased rural incomes? These larger questions are addressed by examining four existing and proposed irrigation schemes. The underlying assumptions of each are analyzed to provide a framework for assessing their economic viability.

8.2. Alternative Irrigation Development Systems

Three alternative approaches for incorporating irrigation into existing farming systems are represented by the Jahaly Pacharr Project's irrigated perimeters, LRDC's Bansang Nibras Pilot Project, and the PISO perimeters in Senegal Oriental. A fourth scheme, based on the Jahaly Pacharr Project's improved swamp areas is included to provide an alternative to total water control and double-cropping systems.

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[1]Their study remains an invaluable source of information although Balingho alone is not a viable option.

Both the Jahaly Pacharr irrigation project and the LRDC Bansang Nibras strategies are primarily characterized as capital-intensive with centralized management, total water control and double cropping. The LRDC scheme differs from Jahaly Pacharr in that farmers are expected to perform most land of the land preparation work themselves rather than rely on project management. The PISO strategy is characterized by low capital investment, extensive farmer participation in perimeter development, and total water control, and it assumes double cropping. The Jahaly Pacharr improved swamp alternative is characterized by low capital intensity, decentralized management and only partial water control.

The sections below analyze each scheme's key assumptions with respect to compound behavior, management, integration of irrigation into the prevailing farm system, and investment, operation and maintenance costs. This analysis related these assumptions to previous observations outlined in Chapters 6 and 7.

8.2.1. Major Assumptions Concerning Farmer Response

Assumptions about farmers or farming unit responses for integrating irrigation into existng farming systems can be divided into three general categories. First, there are those made about the profitability of irrigation at the compound level and farmers' ability to pay production costs.

Second, there are assumptions about the types of changes in farming systems caused by the adoption of irrigation. Will irrigated rice production be the dominant production activity or a supplemental activity in the farming system? To what extent are compound resources expected to be reallocated to irrigation? What trade-off will the compound make between irrigated rice and rainfed crop production with respect to use of land, labor, and capital?

Third, there are assumptions about the time required between the introduction of irrigation and the achievement of optimal yields and cropping intensities through better management practices. This is a major concern for determing the economic viability of irrigation at both the farmer and project levels. How many years will farmers require to reallocate compound resources to irrigation in two cropping seasons and to master new cultivation practices and technologies? How much time is needed for the development of a reliable input and water delivery system?

These questions form the basis of specific assumptions which were made and are critical in determining the economic viability of the proposed irrigation projects. Irrigation systems based on achieving total water control have generallv required large capital investments. To cover the high costs implicit in this strategy an irrigation system must generate high yields. It is assumed that this can be achieved through the use of improved inputs, management skills and double-cropping. Without a large benefit stream which develops early, the project would produce a low or even negative internal rate of return.

Table 8.1 presents the major assumptions of the four alternative models with respect to farmer behavior, change in the farming system and transition time. Two irrigation schemes examined here in detail (Jahaly Pacharr and LRDC) assume a high degree of change in the existing farming system in a short transition period. The PISO model assumes a moderate degree of change as each compound is expected to add 0.25 ha of irrigated rice and 0.06 ha of irrigated maize to the existing rainfed farming system.[2] Compounds are not expected to forego the cultivation of any rainfed crops in order to grow irrigated crops. Cropping intensities of 180% and yields of 4 T/ha for rice and 3 T/ha for maize are expected to be achieved in a short transition period or 3 to 6 years. Only the improved swamp model requires very limited change by farmers. The swamp area cultivated is assumed to increase slightly while labor requirements remain practically the same. The addition of improved seed and fertilizers for rice are the only changes expected in the farming system.

The Jahaly Pacharr irrigation model assumes a high degree of change in cropping patterns, allocation of labor and cooperative membership. Compounds are expected to add 0.5 ha of irrigated rice while not giving up any rainfed crops or land area. Overcoming the labor bottleneck is accomplished by the extensive use of machinery for land preparation. It

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[2]Discussion of the PISO scheme draws on design and performance assumptions made in the original SONED project proposal (SONED, Vol. II, 1980) rather than on PISO program as it has actually evolved. Cost estimates, however, are based on actual experience.

TABLE 8.1.

ASSUMPTIONS ON FARM LEVEL BEHAVIOR

Assumptions	Jahaly Pacharr		LRDC	PISO
	Irrigated	Improved Swamp		
Irrigated ha/HH	0.5	.95	2.0	R/0.25,M/0.06
Decrease in Rainfed ha/HH	NONE	NONE	2.5	
Cropping Intensity	200%	100%	180%	180%
Yields T/ha DS--WS[a]	4.5--4.0	3.1	4.5--4.0	R/4.0, M/3.0
Labor MD/ha DS--WS[b]	186--174	141	158--158	220-280
Degree of Change	HIGH	LOW	HIGH	MODERATE
Transition Time for (Yields/Cropping Intensities)	SHORT (3YR/3YR)	SHORT (3YR)	SHORT (5YR/4YR)	SHORT (3YR/6YR)

SOURCES: "Jahaly Pacharr Smallholder Appraisal Report," IFAD, 1981 and "LRDC Bansang Nibras Pilot Project Feasibility Study (Draft)" July 1984, and SONED, 1980, vol 2.

NOTES: Both Jahaly Pacharr and LRDC have 2 farm models upon which they base their calculations. In order to simplify the table only the dominant farm model was used. The second farm model was very similar to the dominant model.

a) Dry Season - Wet Season.
b) Rice and Maize.

is assumed that approximately 360 man-days of family labor will be allocated to irrigated rice cultivation over only one season. This system assumes that a cropping intensity of 200% and yields of 4.5 T/ha in the dry season and 4.0 T/ha in the wet season can be achieved within a short transition period of 3 years.

The LRDC Bansang Nibras model also assumes a high degree of change in the farming system. Each compound is to cultivate a 2.0 ha rice plot with a total annual allocation of 569 man-days of compound labor. In order to cultivate this large irrigated area the compound is expected to purchase a pair of oxen and equipment as well as to use fertilizers and improved cultivation practices. In addition, the compound is expected to give up 2.5 ha of groundnuts in order to produce rice. LRDC assumes a short transition time of 5 years to reach yields of 4-4.5 tons/ha and 4 years for high cropping intensities.

Based on the previous experience with irrigation schemes (Chapter 6), current production strategies of farmers (Chapter 7) and level of farmers' resources, these assumptions about the compound's response to the introduction of irrigation are not totally realistic. This is confirmed in the relatively simplified approach of the PISO perimeters by the low utilization rate of the available area despite average yields of 5 T paddy/ha.

The issue of faulty assumptions is somewhat unfounded in the case of the Jahaly Pacharr irrigated areas where during the 1983/84 dry season average yields of 7.4 T/ha were recorded. This is significantly higher than projected yields. The cropping intensity in the 1984 wet season was 100%. One contributing factor to the high performance levels achieved at Jahaly Pacharr in the first year of the project is the considerable amount of project management time that was devoted to encouraging farmers to cultivate rice using strictly enforced cultural practices. These include precise dates for planting, weeding, and fertilizer application as well as for water delivery. In addition, project management achieved the timely delivery of adequate supplies of inputs with the assistance of the Gambian government. A question concerns who should be responsible for efficient project management after government intervention has been terminated. Experience in Gambia River Basin countries indicates that it is difficult to attain cropping intensities significantly over 100% without major commitments of both financial and human resources by project authorities and that sustained efficiency has been difficult to maintain.

8.2.2. Management and Organization

Table 8.2 summarizes the key management and organization variables of the four alternative schemes. The Jahaly Pacharr irrigation scheme is the most management-intensive. Most of the critical production decisions are controlled by project management with little participation from farmers. All heavy land development and system preparation work is done with imported machinery. Plots are divided into 0.5 hectare parcels. Some plots are subdivided, while some larger households have two or three plots. Land tenure rights are vested in the scheme with participants having user rights. Users contribute family labor for the planting, weeding and harvesting of rice. These operations are tightly controlled by project management. This is done in order to maintain water delivery schedules and the timing of critical cultural activities.

TABLE 8.2.

MANAGEMENT AND ORGANIZATION OF ALTERNATIVE MODELS

Management and Organization Issues	Jahaly Pacharr		LRDC	PISO
	Irrigated	Rainfed		
Allocation of Responsibilities				
Land Development	PM[a]	PM	PM	PM & CP[b]
Land Preparation	PM	CP	CP	CP
Canal and Pump Maintenance	PM	NA[c]	PM	PM & CP
Water Scheduling and Delivery	PM	NA	PM & CP	PM & CP
Ownership of Plot by User	No	No	NA	No
Livestock Access	No	NA	No	No
Crop Mix	Rice Only	Rice Only	Rice Only	Rice Maize

NOTES: a) PM : project management.
b) CP : compound responsibility.
c) NA : not available.

University of Michigan, Gambia River Basin Studies, 1985.

Both the LRDC and PISO models attempt to incorporate user participation to a certain degree in some management and organizational activities. In the LRDC scheme, project management is responsible for initial land development work as well as maintenance and repair of canals and equipment. However, farmers are responsible for seasonal light land preparation work. The PISO perimeters are very labor-intensive and depend to a great extent on the participation of farmers even in the land development stage. In both cases users do not own their irrigated plots. Ownership remains in the hands of project management in the case of LRDC and the cooperative in the case of PISO. None of the irrigated schemes takes livestock watering and pasturing requirements into consideration.

8.2.3. Investment, Operation, Maintenance and Recurrent Costs

The alternative irrigation systems examined here have different investment, operation and maintenance, and recurrent cost implications. These are a result of differences in degree of water control, scale of operation, use of imported technologies and technicians, and level of user participation in the development and operation of the scheme. Table 8.3 presents the investment, operation and maintenance costs of the four alternative models.

8.2.3.1. Investment, operation and maintenance costs. As Table 8.3 indicates, an expensive component in the total investment cost of all the models is land development and preparation, except the PISO alternative. This encompasses the costs of land clearing and leveling, and of dike, canal, and pump station construction necessary to achieve the degree of water control desired. In models such as Jahaly Pacharr and LRDC where high standards of water control are assumed, the land development and preparation component is larger than all the others. This is especially true in the case of Jahaly Pacharr where land development and preparation costs are more than four times greater than those of the other cost categories. This is in part a consequence of developing heavy swamp soils. While the cost of land development in the PISO scheme is not known, it is assumed to be lower, as it is very labor intensive and the soils are easier to work.

TABLE 8.3.

INVESTMENT, OPERATION AND MAINTENANCE COSTS

	Jahaly Pacharr[a]			LRDC[b] Bansang Nibras		PISO[c]		
	Irrigated		Improved Swamp					
Scale of Operation								
No. of Hectares	560		950	928		384 (d)		
No. of Compounds	1000	1000	464					
Average ha/Compound	0.5	0.95	2.0	0.25				
Total Project Costs								
Capital Investment Costs	000D	000$	000D	000$	000D	000$	MIL FCFA	000
Land Development & Prep	15877	3969	3893	973	12700	3175	n/a	n/a
Equipment	3434	859	1473	368	2700	675	n/a	n/a
Other Costs	6745	1686	2891	723	12400	3100	n/a	n/a
Total Investment Costs	26056	6514	8257	2064	27800	6950	346	768
Annual O & M Costs								
Operation and Maintenance	800	200	215	54	572	143	13.4[e]	30
Replacement	175	44	76	19	179	45	3.6	8
Management	328	82	140	35	35	9	33.5	74
Total Annual O & M Costs	1303	326	431	108	786	197	50.5	112
Total Costs per Hectare[f]	D	$	D	$	D	$	MIL FCFA	$
Capital Investment Cost/ha	46529	11632	8692	2173	29889	7472	.9008	2000
Annual O & M Costs/ha	2327	582	454	113	846	212	.279	619
Annual User Fee/ha[h]	1398	350	405	101	900	225	.133	295
Annual Recurrent Costs to the Government:	000D	000$	000D	000$	000D	000$	MIL FCFA	000$
Unrecovered Annual Costs	(500)	(130)	(47)	(12)	54	14	(927.0)	(60)
Debt Servicing[j]	409		n/a	n/a		n/a		

SOURCES:

(a) Jahaly Pacharr Smallholder Project Appraisal Report, IFAD, 1982 and supplementary project documentation. Prices for Jahaly Pacharr Project were given in 1981 Dalassi which were converted into 1983/84 Dalassi by using an index of 1.40. The allocation of costs between irrigation and improved swamp areas was made on the following basis. The costs allocated to irrigation were all those costs which were attributed in the documentation to irrigation plus 70% of all other costs. The costs of improved swamp areas were all those cost attributed to improved swamp plus 30% of the other costs.

(b) Bansang Nibras Pilot Project Feasibility Study (Draft), LDRC, July 1984.

(c) PISO, Management, Tambacounda, 1985, and SONED, 1980, vol.II.

(d) The irrigated area is broken down into 289 ha rice, 89 ha maize, and 6 ha bananas.

(e) Derived from actual O & M costs for 1983/84 for the 181 ha that were cultivated. PISO, Management, 1985.

(f) Per hectare costs were derived by dividing total costs by the number of hectares.

(g) OMVG, Indicative Plan (1984).

(h) For the Jahaly Pacharr and PISO models these are the actual user fees paid in 1983/84 and the proposed rate for the LRDC model.

(i) Annual operation and maintenance costs/ha - annual user fee/ha multiplied by the number of hectares and seasons used per year.

(j) This is the estimate the average annual debt repayment for the Jahaly Pacharr Project, IFAD, 1982.

NOTE: D4.00 = $1.00; 450 FCFA = $1.00; n/a = not available.

University of Michigan, Gambia River Basin Studies, 1985.

The contrast between alternative models in terms of investment costs becomes more distinct when looking at costs on a per hectare basis. The two models with high standards of water control and heavy project management are by far the most expensive on a per hectare basis. The Jahaly Pacharr irrigated model costs on average D46,500 ha ($11,600) and LRDC costs D29,900 ha ($7,500). These figures are similar to the cost estimates calculated for other total water control irrigation projects in West Africa, which range between $10,000 and $15,000/ha (Morris and Newman, 1984). The cost of the PISO perimeters per hectare is much lower, only 900,000 FCFA ($2,000), and reflects less reliance on imported equipment. The figure may, however, be actually somewhat higher because some of the initial investment costs may have been absorbed elsewhere in SODEFITEX's budget. An estimate of the investment costs per hectare of improved swamp at Jahaly Pacharr is D8700 ($2,200).

The PISO scheme has the highest operation and maintenance costs per hectare, but it is also the only scheme which has been operating over several years and has recorded actual operation costs. High operation costs can be partially attributed to the large proportion of land left uncultivated in a season, making it impossible to realize economies of scale and to spread fixed costs. The Jahaly Pacharr model also has high operation and maintenance costs/hectare ($582), primarily the result of extensive use of machinery. In contrast, the LRDC project's annual operation and maintenance costs are much lower, reflecting greater farmer participation in land preparation work. While annual costs for the improved swamp scheme (D454 or $113) are already the lowest of those examined here, these figures represent the high end of the scale for partial water control projects.

8.2.3.2. Recurrent costs. The estimated annual recurrent costs of each scheme follow the same pattern as investment, operation and maintenance costs. Schemes with high water control requirements generally have high recurrent costs. High standards must be maintained for pump and canal maintenance and repair if acceptable technical performance (total water control, high yields and high cropping intensities) is to be sustained in the long run.

In order for the irrigation system to be economically self-sustaining, users must be able to pay for annual operation, maintenance and replacement costs in addition to their own production costs. If these costs cannot be recovered from users, project authorities must make up the difference through subsidies or grants. For Jahaly Pacharr and PISO it appears that users are not paying for all the operation and maintenance costs. In the case of Jahaly Pacharr the annual user fee is approximately D1400 ha while the estimated total annual operating and maintenance cost is D2300 ha. For the PISO perimeters, the annual user fee is well below actual cost at 115,000 FCFA/ha ($256). The difference, 164,000 FCFA ($363), represents the total subsidy borne by SODEFITEX and the FED project grant.

The unrecovered portion of operating costs must be added to the respective government agencies' other project-related costs, which include debt servicing and the cost of input subsidies. A rough estimate of the recurrent cost of the Jahaly Pacharr Project to the Gambian government, limited to unrecovered annual operation and maintenance costs (D500,000)and debt servicing (D409,000), is D909,000 ($230,000) annually.

8.3. Some Macroeconomic Issues

8.3.1. Economic Rates of Return

Given scarce resources, public investments should be made in an activity or set of activities that are the most productive and beneficial to society. A variety of methods have been devised to assess the overall economic viability of alternative investment possibilities. The method most commonly used in project analysis is the economic rate of return (ERR).

The ERR is a measure of the maximum interest rate or return to society that a project could pay for the public resources invested in that project. In other words, it is the rate of return on invested capital for the duration of the project, usually 25-30 years.

The formal selection criterion is to accept those projects for which the economic rate of return is above the opportunity cost of capital. In theory, the opportunity cost of capital reflects society's preferences between present and future returns to resources. On a practical level, it is extremely difficult to determine the opportunity cost of capital in developing countries. For purposes of economic analysis, it is often assumed to be between 8 and 15 percent in real terms (Gittinger, 1982). Returns to investment opportunities with an ERR less than 8 percent are lower than society could obtain by pursuing other activities.

The ERR calculated in the feasibility study of the Jahaly Pacharr Project (IFAD, 1982) -- which included both the irrigated and improved swamp components -- was 8.3 over 30 years. The ERR for the LRDC Bansang Nibras Pilot Project (LRDC, 1984) was 5.4 over 40 years. These are relatively low rates of return, especially in view of the optimistic assumptions used in these calculations. In both cases the low ERR can be attributed to the high costs of land development and preparation due to the hardness of swamp soils and the need for extensive infrastructure development. In the case of the Jahaly Pacharr project, high management costs also contribute to the unfavorable situation. No ERR has been calculated for irrigation development in Senegal Oriental for OMVG-related developments.

Jahaly Pacharr consists of two components. For the purposes of the ERR analysis presented here, the project has been artificially divided into its two components -- improved swamp and new irrigated infrastructure -- with investment, operation and maintenance costs divided between them. (In Euroconsult's original ERR calculation, no such distinction was made, and costs were defined as "incremental development costs," which varied significantly from the detailed line item costs given in the firm's report.) In order to make the alternative irrigation schemes comparable, all project costs and benefits have been indexed to 1983/84 prices.

Two other changes have been introduced to render the calculation more realistic. The production of tidal rice on 100 ha during the dry season with supplemental pump irrigation has been eliminated because it is not presently in operation; and total rather than "incremental" investment costs are used. The former are significantly higher than the latter. The assumptions concerning yields, cropping intensities, input use, and timing are those found in the IFAD feasibility study.

Under these assumptions, the ERR for the improved swamp system is 3% while the ERR for the irrigated component is -2%.[3] The negative ERR for the Jahaly Pacharr irrigated rice scheme, coupled with the low ERR for the LRDC project, underscores the questionable economic viability of large, total water control, capital intensive p ojects from a macroeconomic/public point of view. Investments in this type of project become even more risky if the underlying assumptions abou: timing of cultural activities, cropping intensities, yields and the degree of change in production system at the farm level are not realized.

The estimated costs for the improved swamp scheme probably significantly exaggerates the cost for the partial water control system. If farmer participation was stressed, the costs could be greatly reduced. Cost reduction would make it a more attractive investment opportunity than the ERR estimate of 3% would suggest. However, better technical information is needed on yield potential and necessary investment costs.

8.3.2. Comparative Advantage in Irrigated Rice Production

A fundamental question concerning the allocation of domestic public resources is whether countries in the Gambia River Basin have now or will have in the future a comparative advantage in the production of rice. A country has a comparative advantage in the production of a crop if, when its land, labor, capital and water resources used in production are priced at their opportunity cost, it is still profitable to produce that crop. In other words, can the country use fewer domestic resources to produce one unit of the crop than it would use alternatively to earn foreign exchange to import one unit? If not, it would be more rational, from a strictly economic point of view, to invest these resources in other productive areas for which the country does have a comparative advantage and to import the products for which it does not.

Table 8.4 presents an estimate of the economic import parity price of rice in The Gambia. We focus on The Gambia because that is where most of

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[3]The calculation is based on project yield estimates, not the actual first year performance.

TABLE 8.4.

THE ECONOMIC IMPORT PARITY PRICE OF RICE 1983-84
THE GAMBIA

		Economic Price of Rice (Dalasis)	Official Rice Price (Dalasis)
1.	FOB Bangkok Thai 5% Broken 1983/84 US $/MT	260	
2.	Adjustment for Quality (15% of FOB Price $/MT)	221	
3.	Cost in Dalassi/MT (1.0 $ = 4.0 D)	884	
4.	Freight and Insurance D/MT	+95	
5.	CIF Price Banjul D/MT	979	
6.	Port Handling Charges D/MT	+26	
7.	Harbor Dues D/MT	+ 4	
8.	GPMB Overhead D/MT	+44	
9.	Landed Banjul Price D/MT	1063	755 (Banjul)
10.	Internal Transport & Handling D/MT	+25	
11.	Retail Value Upcountry D/MT	1088	768 (Up Country)
12.	Equivalent Value Paddy D/MT (59% Milling Rate)	642	
13.	Milling, Transport and Storage of Paddy D/MT	-80	
14.	Ex-farm Value of Paddy D/MT	562	510 (Producer Price)

NOTE: a) Based on the price of Thai 5% brokens adjusted for quality differences.

University of Michigan, Gambia River Basin Studies, 1985.

the rice will be grown. The import parity price of rice is an estimate of the price one would have to pay for imported rice in various parts of The Gambia.

The import parity price estimate is based on the FOB price of Thai 5% broken rice which is commonly used as a base price for economic analysis even though Thai 100% brokens are actually imported. Thai 5% broken rice is a higher quality rice than that produced in the Gambia River Basin countries. In order to account for this difference in quality between Thai and domestically produced rice, the reference price is adjusted downward by 15%. If to that adjusted base price are added the handling, milling, transport and other associated costs (excluding import subsidies and tariffs), the import parity price of rice at the farm gate is approximately D562/T of paddy.

The import parity price is roughly equal to the current official producer farmgate price for paddy rice in The Gambia of D510/T. However, in The Gambia the production of pump irrigated rice is highly subsidized. As a result, if all <u>production</u> subsidies were eliminated, the actual cost of producing rice in the The Gambia would be higher than the current producer price and therefore higher than the current import parity price. This would indicate that it would be cheaper from an economic point of view to import rice into the country than to pay large subsidies to produce it locally.

These figures suggest that if a capital intensive, high subsidy irrigation strategy is pursued The Gambia does not have a comparative advantage in the production of rice, especially for consumption in urban areas or port cities. However, it may have a comparative advantage for rice production if irrigation costs can be reduced, using less capital intensive methods, or food import costs increase.

These findings are similar to those of other studies of rice production in West Africa. While Pearson et. al. (1981) concluded that those West African countries[4] which did not have a comparative advantage in rice production would be able to generate higher national income by using their resources in other, more productive activities and continuing to import rice, they thought the situation might change.

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[4]Senegal was included in the study, but Guinea and The Gambia were not.

> Comparative advantage in West African rice production will not remain static. Supplies of labor coming from traditional agriculture are not infinitely elastic, and growing population density will increase the social opportunity cost of land. As a result, capital-intensive techniques are likely to increase in profitability relative to those that are intensive in the use of labor or land. Furthermore, many of the conditions that make irrigated production in the more arid regions unprofitable today -- high construction and transport costs, lack of river regulation, low population density given rise to weak local demand and scarcity of labor -- will change in the future as the major river basins are developed. It is important, therefore, to perceive the social costs and benefits of rice production in a dynamic way that will evolve with the course of West African development.[5]

A word of caution needs to be sounded with respect to the above observation. It is true that irrigated rice on the small labor-intensive scale has been shown to be financially sound in both The Gambia and Senegal at the farmer level (FAO, 1983; Pearson, Stryker and Humphreys, 1981; Casey, 1983). This means that returns to labor for irrigated cropping have been favorable in comparison with other farm activities. However, there have been two major considerations in the determination of this level of profitability. First has been the fact that paddy producing areas have faced much higher prices for imported rice than the official market price. This has been due primarily to the relative isolation of these areas (Matam and Bakel, for example, in Senegal) and correspondingly increased costs for handling and transporting of imported rice to private selling points.

The second issue is related to relative prices and costs. Paddy grown in some villages has been financially profitable given specific cost-price relationships. On the consumption side, government price control in the form of subsidies and/or taxes on imported rice can make or break the profitability of irrigated paddy. With the recent increases in consumer prices for imported rice the outlook for on-farm production is becoming better. If the increased consumer price is a reflection of increased import prices then government development authorities can be

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[5]Scott Pearson, J. Dirck Stryker, Charles Humphreys, et al. <u>Rice in West Africa: Policy and Economics</u> (Stanford, California: Stanford University Press, 1981).

confident that pursuit of the irrigation development strategy is a sound long-run objective. On the other hand, if increased prices only reflect increased taxation of imports, then more serious attention must be given to whether or not material resources are better used to develop artificially cost-effective domestic paddy production or import less expensive food grains, including rice.

The second part of the calculation is related to costs. While consumer prices for rice and producer prices for paddy have been increasing, so have production costs. Senegal and The Gambia are gradually eliminating subsidies on all major production inputs thereby increasing farmer production costs. Under these changing conditions it is necessary to monitor import and consumer rice prices, production costs and the farmgate price received by farmers. The relationship between these three factors will be important in evaluating whether domestic resources are being put to their best use.

National strategies of food self-sufficiency have been compromised in recent years due to a persistent trend of low and poorly distributed rainfall. Irrigation holds out some hope for meeting the self-sufficiency goal while at the same time reducing the drain on foreign exchange earnings for rice imports. However, savings in foreign exchange on rice imports must be compared with the foreign exchange costs of sustaining irrigated rice production with domestic resources. Up until recently it has been conclusively shown that the domestic resource cost for irrigation expansion and development for paddy production has been more costly than importing rice. This relationship must be constantly reevaluated.

One last observation stands out. In the short-term to medium-term, Member States would be best advised to adopt an agricultural development strategy based on low capital investment to minimize debt service costs. Part of this strategy can be based on irrigation development which insures some degree of water control if favorable economic conditions exist. This implies an approach to irrigation which is based more on the small perimeter strategy which could gradually evolve into larger, less labor intensive schemes once current constraints on capital are reduced.

9. CONCLUSIONS AND RECOMMENDATIONS FOR IMPROVING AGRICULTURAL PRODUCTION AND EXPANDING IRRIGATED AGRICULTURE

9.1. Introduction

The major objectives of the OMVG Member States, to the attainment of which they expect irrigation development to contribute, are to reach food self-sufficiency, increase agricultural productivity and improve rural incomes. Indeed, these objectives are also shared by the rural populations who have attempted to incorporate irrigated rice into their production systems.

To evaluate the continued feasibility of the irrigation development strategy, Chapters 6, 7 and 8 have discussed the historical experience of irrigation development in the Senegal and Gambia River Basins, explored the profitability of incorporating irrigation into current farming systems, and investigated the national strategies for promoting irrigation. This final chapter summarizes the experience thus far gained and outlines the conditions and criteria under which irrigated agriculture could become a successful component of existing farming systems in the Gambia River Basin.

The critical assumptions for successful expansion of irrigated agriculture are that the costs of irrigation will ultimately be sustainable and willingly incurred by either national development authorities or farmers and that outside donor participation will be phased out. Sustainability means either that the value of output from irrigated agriculture consistently exceeds the costs of irrigation development, operation, and management, or that any excess cost can be subsidized by other productive sectors of the economy. Experience to date is that production of irrigated rice for urban consumption has been a net drain on national economies because less expensive rice is available on the international market.

Serious questions remain about the realism of key assumptions underlying existing and proposed irrigation development schemes. These questions give rise to the concern that the host countries will have difficulty maintaining high performance standards after initial donor investments have been terminated. If so, recurrent costs will become a serious drain on scarce public financial reserves compared with relatively cheaper rice imports. In addition, it is clear that a strategy of import substitution for rice based on capital-intensive irrigation, from an economic point of view, is not currently cost-effective for countries in the Gambia River Basin.

What can be done to meet the Member State objective of increasing food production? The economic projections given in Chapter 8 can be regarded as evidence of weakness in irrigation expansion schemes as currently conceptualized, yet conclusions drawn from these plans can aid in the redesign of development strategies. The potential to produce high yielding, high value crops with minimal interference from the vagaries of climate, which irrigation provides, becomes increasingly valuable in the face of declining rainfall, a rapidly growing population, lack of alternative employment opportunities and increasing reliance upon food imports and assistance. In addition, there are secondary and intangible benefits from irrigation which are difficult to quantify but which are of major importance. These may include improved national food security, improved nutritional status, increased knowledge, higher levels of technical inputs, and better management capabilities. Finally, there is the fact that over time, the nature of constraints can change radically.

To satisfy the objective of supplying urban markets, and have some domestic stocks to offset periodic fluctuations in world food prices, government planners have opted for large-scale commercialized irrigation in which a parastatal or private firm acquires land and manages the production enterprise. Such a strategy would be suited to a centralized input distribution and marketing network and could permit the important economies of scale which, in theory, contribute to reduced production costs. Unfortunately, most of the evidence thus far shows no improved production or marketing efficiencies when large projects of this type are implemented.

Large-scale irrigation development projects have so far been found to increase the land development cost per hectare considerably while only marginally increasing overall operating efficiency (i.e., application, conveyance, and pumping efficiencies) of the irrigation system. For example, the Jahaly Pacharr scheme has shown that for high development costs only a comparatively small increase in operating efficiency was attainable. In comparison, development costs of the older schemes were kept at a lower level because of their small-scale and labor-intensive development approach. More importantly, overall operating efficiency on the best schemes are, in general, only marginally lower than that of Jahaly Pacharr. In other words, the returns per unit of investment have been shown to be higher on less capital-intensive schemes.[1]

On the other hand, the experience of Jahaly Pacharr, now in its second year, may refute many of the observations of farmer resource allocation presented in Chapter 7. Previous irrigation projects have not benefited from Jahaly Pacharr's intense management. Neither have they achieved Jahaly Pacharr's 200% cropping intensity, its yields of 7 mt/ha, and its high rate of debt repayment. Both the debt repayment rate and cropping intensity of the project strongly suggest that participants are satisfied with the level of returns to their resource investment. Further proof of satisfaction is the high demand for participation in the scheme. Although the feasibility of maintaining such a system over an extended period of time remains to be demonstrated, Jahaly Pacharr has shown that farmers are responsive to what they perceive as a profitable and relatively risk-free undertaking, and are willing to alter their production systems to participate in such a scheme. Jahaly Pacharr has raised expectations among producers that they will continue to benefit from machine land preparation and leveling. There may be future difficulties if those expectations are not met.

In tailoring an irrigation development strategy for the Gambia River Basin, planners must balance national goals of rice import substitution with the interests of local producers, the majority of whom are smallholders. Governments may choose investment strategies ranging on a continuum from totally commercialized production to smallholder subsistence production. Choices must also be made on a continuum of capital-intensive versus labor-intensive development strategies. Although options at each end have their positive attributes, the trade-offs in choosing one strategy over another must be carefully considered in relation to national and producer objectives.

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[1]GRBS Working Document No. 64, "A study of irrigation and irrigated perimeters in The Gambia," by Lamin Jobe.

With capital-intensive irrigation (i.e., mechanized cultivation, weeding, harvesting, etc.), the problems of incorporating irrigation into diversified farm family enterprises can be circumvented and may provide the opportunity for a more rapid increase in production levels. A disadvantage is that large foreign exchange investments would be required for imported machinery and management expertise. On the other hand, a strategy of labor-intensive commercial irrigation could be adopted whereby tenant farmers or wage laborers are employed. This would limit mechanization costs but would have an adverse impact on the existing social and production systems. Able-bodied adults would leave their family farms for the promise of year-round wage labor and a class of landless laborers could be created unless other alternative farming activities and lands became available.

While a single development strategy of commercial irrigated production may support the national goal of rice import substitution, it is not the best option when considering the interests of the local producers. If the development objective shifts to self-sufficiency for individual farm families, then planners may opt for smallholder schemes which would be introduced gradually to allow the necessary time for incorporating irrigation into existing farming systems. The trade-offs in terms of national goals are the slow rate of development implicit in developing a sustainable smallholder scheme and the limited marketable surplus generated for urban consumers in the short run.

Perhaps the most appropriate strategy for the expansion of irrigated agriculture in the Gambia River Basin is one which combines elements of commercialized production and smallholder subsistence production. For example, a strategy may be developed whereby smallholders begin irrigating primarily for family consumption, provided that returns to labor are high enough. Once returns to family labor are competitive with other alternatives, the scheme can be gradually expanded to allow farmers to increase their areas until eventually they produce a larger marketable surplus. This is a more reasonable option for The Gambia than for Senegal Oriental, where the amount of land available for expansion of irrigated rice is limited. Another option is to support the larger master farmers as commercial farmers while simultaneously developing smallholder schemes meant only to generate crops for local consumption.

Irrigation should be viewed as integrally related to rainfed agriculture rather than envisioned as the sole solution to the issue of food security. If climatic conditions do not deteriorate further, the majority of basin dwellers in the year 2000 will still be relying upon rainfed agriculture.

9.2. Conclusions and Recommendations

Below are conclusions and recommendations for irrigation development from microeconomic and macroeconomic viewpoints, presented concurrently to underline their interrelatedness. Macroeconomic elements refer to those variables outside the control of farmers which define the limits of their production environment. Microeconomic elements refer to those within the farmers' realm of control. Constraints and solutions to constraints can be defined as technical, economic or social in nature, though the distinctions can be artificial. Technical constraints are related to the physical and engineering components of the irrigation system. Economic constraints can be defined as structural, managerial, or those related to the allocation and use of labor, land and technology. Social constraints include the current social organization of production which is intertwined with land tenure, division of labor, equity, household resource use strategies and decision making.

9.2.1. Micro Level Considerations

9.2.1.1. Household responses to irrigation projects. The experience with irrigated agriculture reveals two basic characteristics of farming systems in the basin.

i) A rural household's primary goals are food security for consumption, minimization of production risks and uncertainty, and increased income. The choice of cropping patterns, use of labor and technology are a reflection both of the need to meet these goals concurrently and of the means available.

ii) Irrigation is generally incorporated into existing farming systems. It is always practiced in association with other farm enterprises in the rainy season. Jahaly Pacharr was designed for participants to continue to grow rainfed crops. As one would expect, the mobilization of labor is more difficult during the rainy season than during the dry season.

Unrealistic assumptions about the response of households to the introduction of irrigation are common to all previous project designs and are reflected in the analysis of farm budgets (Chapter 7). For example, the competition between double-cropped rice and rainfed crops has been underestimated. In addition, the amount of underutilized family labor available for irrigated agriculture has been exaggerated. Most projects assigned a zero opportunity cost to family labor and viewed the compound as the sole unit of analysis and the compound head as the sole decision maker. They neglected the fact that compound members have obligations to outside production and consumption units as well as acting in their individual interest.

Further, there has been a consistent underestimation of the inducements that would move farmers to make a major change in the existing farming system or to adopt a complex and demanding set of irrigated farming practices for two cropping seasons. Previous projects failed to take into account the adherence of farmers to a flexible and multienterprise system which spreads production risks over several activities.

The response of households to irrigation must be monitored in the light of what appears to be the deepening severity of drought conditions. In the Senegal River Basin, for example, irrigated rice is progressively becoming the only option available to farmers in the absence of rainfed harvests in either 1983 or 1984. Under these circumstances the costs of irrigation may be more legitimately compared to the costs of supporting hundreds of unemployed persons in urban areas. If climatic conditions continue to deteriorate, this same scenario could be relevant to the situation in the Gambia River Basin.

Chapter 7 revealed that irrigated rice generates higher returns, both per hectare and per man-day of labor, compared to all other presently cultivated rainfed crops in the Gambia River Basin, with the exceptions of improved maize and groundnuts. However, labor is not significantly diverted to irrigated rice in the rainy season, nor has unutilized labor in the dry season been employed to expand area in cultivation on existing irrigated perimeters.

Labor as a constraining factor in the rainy season is evident during the short but labor-intensive critical periods of planting and weeding. Evaluation of labor use over one-month periods tends to mask brief but crucial labor shortages confronting households. The fact that more households are active in irrigation in the dry season suggests that labor is less a limiting factor than in the rainy season.

It needs to be underscored here that many of the older schemes have poor or non-existent drainage systems. Consequently, rainy season production under flooded conditions does not produce the yields which would induce farmers to substitute irrigated rice for rainfed crop production.

In the dry season, labor is not diverted to other crops, and the primary income-earning alternatives are to seek wage employment. However, statistics from the basin point to a low likelihood of success in the search for off-farm employment. The unattractiveness of rice is partly a result of the dessicating heat of the latter months of the dry season, which coincide with peak demands for weeding, harvest and threshing. Despite the difficulties of finding off-farm employment, the appeal of wage labor is enhanced by the fact that the worker receives immediate pecuniary rewards, which may not be the case in agriculture, especially if one is a dependent youth working on the collective family plot.

9.2.1.2. Gradual development pace. An experimental approach continues to be appropriate for expanding irrigated agriculture. Since presently no project has been itself successful over time, a variety of schemes need to be tested. Projects need to be as site-specific as possible and tailored to meet the specific resource endowments of particular zones, although to do so will come at an increased cost.

Experience in the Gambia River Basin and other West African nations argues for a gradual approach to expanding irrigated agriculture. Households have not typically opted for irrigated farming as the primary family enterprise; irrigation has generally constituted one alternative, among others, as a supplemental source of income and food.

A gradual expansion approach does not expect an immediate transition to intensive irrigated agriculture. Though some farmers have had experience with irrigated rice production, the use of technology and the recognition of the need for precise timing of farming operations can create significant changes in their farming system, and time is required to adapt to these changes. Experience from the Senegal River Basin tends to show that too rapid a transition to irrigation in areas already cultivated leads to program failures.

9.2.1.3. Farmer goals. The predominant goals of farmers are food security and risk minimization. Increased income is, for most farmers, relegated to a slightly lower priority. This ranking is exemplified by allocation of a significant proportion of cultivated area to the lower yielding and less profitable rainfed cereal crops which constitute the staple food of households. In Senegal (Pakeba), where drought conditions have seriously reduced cereal crop yields, farmers are emphasizing the more drought-resistant cash crops, groundnuts and cotton, but use revenue earned from sales for the purchase of food staples.

A further example of the priority assigned to food security is farmers' use of irrigated rice primarily as a food crop and secondarily as a cash crop. Primary consideration of rice as a consumption crop persists despite its relatively high producer price and marketability through government agencies. Although in some Gambian compounds up to 50% of the rice harvest has been reported to be sold, this only occurs when the harvest from the rainfed cereals is believed sufficient to meet household consumption needs for the year.

Farmer adherence to risk minimization strategies was likewise revealed in Chapter 7. Crop mixes emphasize minimization of risk: diversification over a number of crops to accommodate annual variability in rainfall distribution, gradual abandonment of late maturing varieties in response to apparent transitions in climate, and selection of crops requiring low levels of purchased inputs to minimize losses in case of crop failure. In the face of unstable physical and policy environments, it is more than likely that farmers will retain strategies to diversify their production patterns. Under such circumstances it would be more realistic to plan for incremental rather than total incorporation of irrigated agriculture into existing production systems.

9.2.2. Macro Level Considerations

9.2.2.1. Management and technology. Management and technology play a significant role in determining the level of crop output and returns to investment. Crop development in both the rainfed and irrigated sector is highly correlated to quality of crop husbandry, which in turn is influenced by farmer decisions in the allocation of labor and inputs. Delays in completing critical operations, seeding and weeding in particular, can cause substantial reductions in yield.

The contribution of improved technology to crop development and output depends on how it is used. All too often its use is haphazard, due to incomplete information dissemination and guidance. Poor maintenance of irrigation systems by farmers is an important factor in low yields and high production costs. These results tend to discourage participants, and result in lower cropping intensities, poor loan repayment and even abandonment of the perimeter. Improper use of fertilizers compromise their potential to improve crop development and results in wasted investment.

Technical efficiency of irrigation systems is achieved through a combination of elements:

i) the quality and consistency of perimeter soils;

ii) the quality of land clearing and leveling operations, and of canal, bund and dike construction;

iii) the layout of the drainage system;

iv) the efficiency and reliability of pumps;

v) the maintenance of major canal and diking systems and the degree of water loss due to seepage.

Water delivery systems have for the most part been inefficient because of poor topographic studies, inadequate land leveling, poor construction of drainage ditches, canals, and dikes; frequent pump breakdown; lack of spare parts for pumps and equipment; and high water losses associated with seepage from unlined canals. The results have been high water costs to farmers or increased subsidy burden on the part of the project implementation authority.

9.2.2.2. Consistent agricultural policies. Uncertainty over a range of agricultural policies combined with change from year to year create confusion among producers. The uncertainties concern credit, the availability and price of inputs, government-set output prices, and differences in policies between different crops. Uncertainty has been intensified due to national concerns over foreign exchange requirements and recommendations of donor agencies. The outcome has been producers' ability to exploit government indecision on the one hand, and a lack of confidence in government policies and decisions on the other.

Discrepancies in agricultural policies between different crops helps to explain why farmers do not necessarily engage in enterprises capable of yielding the highest returns to land or labor. Uncertainty over obtaining required inputs or the obligation to repay production credit regardless of yield weighs heavily in farmer decision making. The creation of an environment where farmers can decide with some degree of confidence how to best allocate their resources, particularly labor, would be best done if government avoided policy decisions which cause constant fluctuation in the cost of inputs and the price of outputs. This includes any policy decisions regarding the reduction or removal of production subsidies.

9.2.2.3. Need for reliable input delivery system. The unavailability of certain inputs at critical moments for irrigated agriculture can offset the usefulness of others, making it impossible to achieve good yields and high incomes. It also undermines farmers' ability or willingness to repay credit. In The Gambia, farmers are dependent on the Gambian Cooperative Union (GCU) and the GPMB, and in Senegal on PISO or OFADEC for the provision of inputs. Poor quality and insufficient quantities delivered at inappropriate times are a frequent occurrence except in the PISO and Jahaly Pacharr schemes. In The Gambia, late land preparation by the government-administered tilling service is also a major constraint.

Management of most irrigation projects needs to be improved. Training in commodity procurement, financial management, and logistical planning should be provided to project administrators. Overall project administration must itself be monitored and evaluated against performance criteria. The option of allocating input distribution rights to the private sector should be seriously considered.

9.2.2.4. Experimentation with improved traditional rice cultivation. A great deal has been written about the potential for improved traditional or nonpump-irrigated rice production in The Gambia

(FAO, 1983; World Bank, 1984; Coode and Partners, 1983) and in Senegal Oriental (Louis Berger, 1984). Low cost land improvements in bunding, diking and drainage construction which result in a higher degree of water control, in association with improved crop husbandry techniques, can result in important increases in yields for bottomland, swamp, and mangrove rice cultivation. Table 9.1 presents estimates of present and potential yields for the different rice ecologies. These yield assumptions are speculative and need to be tested at the farm level in order to determine the actual yield potential.

There are presently two models in The Gambia for improving swamp rice production, the improved swamp component of the Jahaly Pacharr project and the Freedom From Hunger Campaign (FFHC). These two projects should be closely monitored to assess the actual costs and yield potential of improved swamp production.

TABLE 9.1.

YIELD ASSUMPTIONS FOR IMPROVED TRADITIONAL RICE
(kg/ha)

	Present Average	Potential Progressive Farmer	Research
Rice (Paddy)			
Bottomland	980-1,200	1,500-1,750	2,000-2,500
Swamp	1,000	2,000	3,000
Mangrove	680	1,500	2,700

SOURCE: Staff Appraisal Report, The Gambia Agricultural Development Project II, April 20, 1984.

University of Michigan, Gambia River Basin Studies, 1985.

9.2.2.5. Sustained effort for applied agricultural research. In order to respond to the continuing technical problems of agricultural production, the Gambia River Basin countries have use for applied agricultural research programs. Two essential characteristics of such programs are that they should be systems-oriented and decentralized to better address production problems which are specific to particular ecological zones.

A systems approach towards research would not only focus on crop research, but identify ways to integrate livestock into an environment where traditional grazing patterns will be constrained by the expansion of irrigation. Additional crop varieties comprised of forage crops, cowpeas, sorghum, fruits, and other vegetables could be tested under irrigation conditions.

Technical trials on fertilizer use and suitability for particular soils and crops, testing and multiplication of seed varieties (particularly cold-tolerant varieties), and selection of effective pest control methods are all areas where additional research would be beneficial. In addition, the costs and returns associated with the use of new and improved technologies should be thoroughly evaluated through on-farm trials before farmers are encouraged to adopt practices for which neither they nor a government subsidy could sustain the costs.

As noted in Chapter 7, the inconsistent availability of power tillers and tractors appears to have induced farmers to substitute animal traction for land preparation. Further investigation is needed into the environmental conditions under which animal traction is presently used and ways to extend this less expensive means of land cultivation.

9.2.2.6. Agricultural extension services. An important element in the improvement of agricultural production in the Gambia River Basin is the availability of trained agricultural extension agents and their level of expertise. There is currently a shortage of field extension agents adequately trained in either irrigated or rainfed agricultural production. Training programs could be developed in coordination with local agricultural research institutes. They could be organized along the same lines as the recently instituted N'Diaye Training Center that SAED has developed for extension agents in the Senegal River Basin, or agents from The Gambia and Senegal Oriental could be sent there for short courses.

9.3. Some Short-term Recommendations

The further expansion of irrigated agriculture in the Gambia River Basin is dependent on the construction of one or more dams. Current estimates are that it will be at least 8 years before the completion of any of the dams. This provides the Gambia River Basin countries with the time necessary to strengthen and develop the agricultural institutions, supporting services and local managerial abilities essential to the successful expansion of irrigated agriculture. In this period, much can be learned from the monitoring and evaluation of ongoing irrigation projects.

In both The Gambia and Senegal Oriental there is considerable underutilization of existing perimeters. In the immediate future, efforts should be focused on obtaining higher use rates and production levels from these. Current problems of low debt repayment, unreliable input supplies and inefficient water delivery systems must be resolved before there is any further investment in new irrigation. If these problems cannot be resolved with the relatively small number of hectares involved, they will only be aggravated on a larger scale.

Rehabilitation and possible consolidation of existing perimeters in both countries should be programmed, with selection based on the assessment of the perimeter's economic potential. Rehabilitation will require land development to assure more efficient water delivery and adequate drainage. Standardization and replacement of obsolete pumps will also be necessary. Farmer participation in the rehabilitation and management of these perimeters should be actively encouraged.

It is dangerous to assume that rural producers should bear all the burdens of a complete transition to irrigated agriculture with its attendant risks. Rural populations still have good reasons not to switch entirely to irrigated from rainfed agriculture. At the same time, cultivators are responsive to new opportunities, new crops, and ways to improve their livelihood. What institutions will implement irrigation programs, to whom will they be responsible and what organizational forms will be introduced in the rural areas are critical questions for the future. In addition, security of land tenure will become increasingly important. Two major social concerns will be women's access and rights to irrigated land and access and rights of those who are currently land-poor.

Past experience suggests that irrigation projects will not succeed without the utilization of farmers' knowledge and their willingness to experiment.

Finally, during the pre-dam phase, efforts should be concentrated on strengthening linkages between OMVG and other river basin authorities in Africa to benefit from their experiences in development planning and implementation.

10. MONITORING AND EVALUATION

10.1. Monitoring, Evaluation and Rural Development

How one thinks about rural development has significant implications for monitoring and evaluation. In the Gambia River Basin, a case can be made that the World Bank's Sector Paper on Rural Development applies:

> Rural development is a strategy designed to improve the economic and social life of a specific group of people -- the rural poor. It involves extending the benefits of development to the poorest among those who seek a livelihood in the rural areas. The group includes small-scale farmers, tenants and the landless (1975: 3).

While OMVG's development strategy affects more than just the rural sector, its emphasis upon irrigation and national food sufficiency establishes a very strong rural development component. To assure that intended rural beneficiaries receive benefits will require more attention to what is socially feasible than to what may make sense for engineers and planners technically. It will require a shift away from planning from above (an economic-rational decision making model) to a more interactive model in which there is a learning process with respect to underlying goals and objectives. The social environment in which development takes place is not passive but active and reactive.

River basin development starts with people. The beneficiaries of such development are not only people who grow irrigated rice but also those who will benefit from domestically produced rice, improved transport and navigation, and hydroelectricity. Monitoring will involve a series of indicators to determine whether or not these intended beneficiaries receive benefits as planned. Physical, economic, organizational and cultural factors exist which will make it difficult, but not impossible, for project management to monitor events and projects in the basin closely.

10.2. Monitoring and Evaluation Defined

The World Bank and many other development organizations make a distinction between monitoring and evaluation.[1] Monitoring assesses whether project inputs are being delivered, are being used as intended, and are having an initial effect as planned. Monitoring is a project activity that is an integral part of day-to-day management. It implies periodic internal reviews at different levels of the organization to ensure that the project is working as planned and to make improvements as necessary.

Evaluation assesses the overall project effects, both intentional and unintentional, and their impacts. "Evaluation will draw on the data generated by the monitoring system to help explain the trends in effects and impact of the project. Data generated by the monitoring system will help to explain the trends in effects and assess impact of the project" (World Bank 1981: 4). It is possible that monitoring data may reveal significant shifts from expectations. In this instance an ongoing evaluation may be required to examine the assumptions and premises on which the program was based.

In sum, while evaluation and monitoring are closely linked, evaluation addresses the larger issues of meeting project or program objectives while monitoring stays close to the everyday functioning of the project or program.

10.3. Application to the Gambia River Basin

River basin development has many phases and dimensions. Because it is international in scope and diverse in its development activities, monitoring and evaluation become both more important and more complex. In the case of the Gambia River Basin, planning efforts have just begun on such factors as the timing of dam construction, the availability of water, the numbers of people to be resettled, the integration of social and economic concerns with public health measures, the location of

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[1]See <u>Handbook on Monitoring and Evaluation of Agriculture and Rural Development Projects</u> (Washington, D.C.: the World Bank, 1981).

resettlement communities, and the construction and location of irrigation perimeters. The institutional framework in which irrigation, navigation, transportation, hydroelectric, and other developments are to be managed has not been decided upon. It is not clear what development model OMVG and the Member States will choose.

With these uncertainties in mind and without knowing what agencies will be carrying out irrigation development and dam impact mitigation (the major emphases of this report), we tender in outline form some suggestions for monitoring and evaluation.

10.4. Institutional Issues

There are a series of institutional questions that need some resolution prior to institutionalizing a monitoring and evaluation system in the Gambia River Basin. These are:

- What agency or agencies will be charged with irrigation development? How will these old or new agencies work with the relevant ministries in Member States?
- What organization or committee will coordinate the activities between OMVG and relevant Member State ministries?
- Will there be one monitoring system for <u>each</u> of the Member States or one for <u>all</u> the Member States?
- How will institutional mechanisms (including the monitoring system) take into account possible differing orientations to development, varying administrative capabilities, disparate levels of participation and varying land tenure rights?
- How will the relations between donors and riparian states be organized to assure both long-term donor support and the meeting of recurrent costs?
- To avoid redundancy, extra costs and the utilization of scarce human resources, can a single monitoring system be developed that will satisfy all donors?

At the local level, there are a series of issues revolving around the relationship between project or program management and local residents. Because of the international character of the Gambia River Basin, there are transportation and communication difficulties between different parts of the basin. Nonetheless, management needs to be informed in a timely manner of relevant events and developments. Recent work suggests it is desirable to involve beneficiaries in the process of monitoring and evaluation. Indeed, the distance of the main project management from the beneficiaries may pose problems in the absence of forms of self-monitoring and evaluation. This can be done by choosing key individuals in selected villages and training them how, in both written and unwritten ways, to follow indicators chosen by the monitoring unit(s). These villagers, once trained, would be visited on a regular basis by staff for further training and for information gathering. This implies the critical importance of a strong field staff.

10.5. Resettlement

Resettlement gives another dimension to monitoring and evaluation. Relocation is an externally imposed and pervasive change whose social impact is enormous. With resettlement comes a range of changes that threaten traditions, especially those related to village and family life, land use, farming practices, food supply and distribution. It usually creates greater population density but can afford greater accessibility to social services and education.

> People and sociocultural systems respond to forced relocation in predictable ways, predictability being possible because the extremely stressful nature of relocation restricts the range of coping responses available to the majority during the period that immediately follows removal (1982: 267).[2]

There are compelling reasons to opt for a separate resettlement agency which includes its own monitoring unit. Because of the different tasks involved in resettlement on the one hand and irrigation development on the other, and because a monitoring unit should be responsible to management, the best strategy appears to have at least two different monitoring units. Further, the types of information to be sought and the

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[2]Thayer Scudder and Elizabeth Colson, "From Welfare to Development: A Conceptual Framework for the Analysis of Dislocated Peoples" in Involuntary Immigration and Resettlement: The Problems and Responses of Dislocated Peoples, Art Hansen and Anthony Oliver-Smith, eds. (Boulder: Westview Press, 1982).

problem solving approaches will be distinct. The major goals for irrigation development are higher rice yields and the enhancement of producer incentives. The major goals for resettlement are the finding of new lands, the establishment of new communities, and the provision of livelihood until those communities become viable. Coordination will be very important, however, if resettlement occurs in new irrigation zones. For example, disease problems may be important for both resettlement and irrigation.

Paul Pelissier, a geographer who has profound knowledge of many portions of the Gambia River Basin, believes that one of the reasons for the low population density along the Gambia River and the Koulountou in eastern Senegal is the presence of onchocerciasis. A team directed by Dr. Michel Lariviere[3] found that almost the entire survey population in the zone had microfiliaria in their skin. The presence of onchocerciasis and the health status of the new villagers in eastern Senegal need to be closely monitored. Our own experience in the Kekreti zone revealed high proportions of blind elders (particularly men) in villages close to the river.

10.6. Monitoring

There is a clear overlap between monitoring and evaluation. Indeed, the reason for gathering information about the performance of projects and programs as they are implemented is to give management knowledge of what is happening so that questions can be raised and changes made if necessary. It would be desirable to give to management an incentive to share such knowledge with representative river basin groups so that the interactive process may occur.

The following list of subjects to be monitored is only meant to be suggestive.

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[3]The results of this survey are in Bulletin de la Société Medicale d'Afrique Noire de Langue Française, in an article entitled "Aspect actuel de l'endémie onchocerquienne au Sénégal Oriental," no. 9 (1964), p. 290-295.

- Administration

    1. Progress in construction;
    2. Financial disbursement figures;
    3. Procurement and staffing.

- External and Technical Conditions

    1. Environmental data: rainfall, river flow, evaporation;
    2. Soil moisture levels.

- Economic Data

    1. Availability and price of rural wage labor;
    2. Credit operations: amount and type of credit extended, rate of repayment, level of indebtedness;
    3. Availability, timeliness of delivery, cost and actual use of fertilizers, pesticides, seed, traction equipment, traction animals and other agricultural inputs;
    4. Extension services: type and amount provided and used;
    5. Efficiency of irrigation systems, state of repair, water usage at the field level, payment of fees;
    6. Crop disposal: percentage consumed, sold to creditors, sold on the market or to cooperatives;
    7. Crop prices, livestock prices.

- Social, Nutritional and Health Data

    1. Types of irrigation organizations, number of members, female participation, frequency of meetings, assets;
    2. Utilization rates of health services, numbers of days lost to illness;
    3. Nutrition (see the monitoring annex in Water-Associated Diseases and Gambia River Basin Development).

- Outputs

    1. Increases in cropped area (irrigated and rainfed), production (by crop) and yields;
    2. Increases or decreases in women's agricultural labor time
    3. Increased rate of utilization of irrigated perimeters, percentage of double-cropping;

4. Shifts in cropping patterns;
5. Increased urban consumers' acceptance of indigenous rice;
6. Improvements in social indicators: health, literacy;
7. Increases in transportation, commercial and light industrial activity.

10.7. Evaluations

One distinction between monitoring and evaluation is that monitoring is designed to improve ongoing activities while evaluation is to aid planning and decision making for the future. Evaluations examine how a program is meeting its strategic objectives and assess its impact. Evaluations look at nonproject households or villages to compare their performance with participating units in order to determine what changes the project has induced. The results help decision makers determine whether fundamental changes will be required.

In the Gambia River Basin there are several criteria by which projects will be judged. How often an assessment is made depends upon the purpose of a project, but a limited yearly evaluation combined with a fuller evaluation after a longer period is a reasonable strategy. The criteria include the following:

i) Economic criteria

- returns to investment in irrigation;
- returns per man-day in agriculture, both irrigated and rainfed;
- relative performance of different sized perimeters and returns to farmers in them;
- employment creation: the number of people employed or supported by dam and irrigated perimeter construction, by new perimeters, by increases in transportation, commercial and light industrial activity, and by related developments.

ii) Migration

- rates of migration to and from dam construction zones and to new irrigated perimeters;
- degree to which patterns of migration in irrigation development areas differ from those in nonirrigation areas.

iii) Administrative criteria

- level of performance of irrigation developments with respect to stated goals as well as compared to the record of other projects: degree of mechanisation, accountability, stability and Africanisation;
- level of performance of administrative agencies with respect to supplying necessary agricultural inputs, education services and health care.

iv) Social criteria

- level of participants' well-being (including diet, health, education, etc.), changes in income, improvement or decline in nutritional status.

An expanded system of monitoring as suggested in the Water-Associated Diseases and Gambia River Basin Development can be used in an overall evaluation of socioeconomic benefits. The assessment should seek to determine who is benefitting and who is losing from new irrigation schemes by comparing the incomes and services received by participants with those of others in the rural and urban sectors. Attention will also have to be given to equity issues with regard to women and casual or paid labor within the irrigation zones and in the dam impact zones.

The next step will be to asses the overall impact of river basin development in its various dimensions upon different sectors of the population and national economies. Impacts could include:

i) technology changes in agriculture: overall shift to a more intensive agriculture with much greater use of purchased inputs and animal traction or mechanization;

ii) decline in percentage of food imports;

iii) much greater diversity in employment opportunities as a result of the creation of new enterprises in light industry (particularly to support agriculture), transportation, and commerce;

iv) decline in fossil fuel imports due to the availability of hydroelectricity;

v) increase in traffic and commerce both across the river and along it as a consequence of bridge construction and reservoir creation;

vi) greater income from fisheries.

In sum, an evaluation would determine the actual effects of projects designed to attain the goals of OMVG and the Member States.

10.8. The Phasing of Monitoring and Evaluation

The work of monitoring and evaluation can be divided into phases. In our view, the present need is to create as soon as possible a monitoring unit which could begin work on the methodologies and framework for gathering environmental, technical, economic, and social data.

The monitoring units' work can be outlined in accordance with three phases. The following list is suggestive, not exhaustive.

10.8.1. Preconstruction Phase

- Collect information from the field on changes in agriculture; for example, shifts in marketing patterns, changes in technology, increases or decreases in labor migration, etc. The collection of information should be clearly related to specific needs of OMVG and basin residents.

- Provide information to the OMVG about socioeconomic conditions in the basin to see if the development models proposed appear realistic given current conditions.

- Provide analysis of major problems in the basin as conditions continue to change. This may provide the means by which goals can be modified and alternatives adopted if conditions warrant.

- Determine the effectiveness of plans to bring benefits to the designated population groups (smallholders, women, resettled populations, etc.).

10.8.2. Dam Construction Phase

- Work with resettlement agency to monitor the implimentation of resettlement plans and populations' responses to those plans. Identify problems and suggest solutions.

- Work with irrigation authority to monitor irrigation developments. Identify problems and propose solutions.

- Identify problems between contractors and local populations in the construction zones.

- Lay groundwork for adding an evaluation role to monitoring activities.

10.8.3. Postconstruction Phase

- Evaluate success of resettlement programs in developing viable alternatives for resettled populations. Where they are not succesful, provide suggestions for changes.

Evaluate irrigation perimeters. Report on performance, changes in conditions, degree to which goals and production targets are being met.[4]

i) benefit-cost analysis;
ii) assess effectiveness of extension systems and linkages to research systems.
iii) assess health, nutritional status and level of satisfaction of irrigation farmers.

10.9. Communication and Resources for Monitoring and Evaluation

In order to make monitoring and evaluation most effective, there need to be clear statements of project goals and objectives and how they are to be met. Once these are established, a list of indicators can be designed to show whether or not project inputs are being received, used as intended and having the effects that are intended.

The most time and resource consuming parts of monitoring are surveys of beneficiaries. There needs to be a limit to the areas surveyed, but at the same time there should be a mechanism to identify what may be affecting overall performance or negatively impacting upon the beneficiaries in nonsurveyed areas. That is why beneficiary involvement in monitoring and evaluation makes good sense. It provides an official means to ensure that voices at the local level are heard but does not guarantee that they will be heard.

The monitoring and evaluation unit should be designed to utilize local communities for their knowledge of their environment and its possibilities. The creative and constructive use of local knowledge and organizations. and a recognition of peasant farmers' abilities, will greatly enhance the chances of successful development.

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[4]A relatively complete system for monitoring irrigation systems is to be found in Monitoring Systems and Irrigation Management: An Experience from the Phillipines by Ronald Ng and Francis Lethem (Washington, D.C.: the World Bank, 1982).

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