CONSEIL AFRICAIN ET MALGACHE POUR L'ENSEIGNEMENT SUPÉRIEUR
01 BP 134 OUAGADOUGOU 01 (BURKINA FASO)
TEL (226) 25 36 81 46 - FAX (226) 25 36 85 73 - Email: cames@lecames.org

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## CTS : Sciences Naturelles - Agronomie

Candidat : Afouda Jacob Yabi, Agroéconomiste

Maître de Conférences

Faculté d'Agronomie

Université de Parakou

BP : 123, Parakou ; Bénin

E-mail : ja_yabi@yahoo.com

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Institute of Agricultural Economics and Nutrition of
Justus-Liebig-University of Giessen

# Agricultural Projects and Sustainable Development of Rural Areas in Benin: Impact Assessment, Participation and Adoption Decisions

PhD Thesis defended on 06th, may 2004

**by:**
**Jacob Afouda Yabi**

**Directed by:**
**Prof. Dr. Siegfried Bauer**

**Members of the jury:**

1- Prof. Dr. P. M. Schmitz : President ; Full Professor ; University of Giessen, Germany
2- Prof. Dr. H. Boland : Member ; Full Professor ; University of Giessen, Germany
3- Prof. em. Dr. Dr. h.c. F. Kuhlmann : Member ; Full Professor ; University of Giessen, Germany
4- Prof. Dr E. – A. Nuppenau : Reviewer ; Full Professor ; University of Giessen, Germany
5- Prof. Dr. S. Bauer : Reviewer Full Professor ; University of Giessen, Germany

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I am much grateful to all my colleagues. I particularly thank Mrs Alice Palmantier, Mrs Jacqueline Köhler, Mrs Heidi Narberhaus, Mr. Rüdiger Wehr, Mr. Lila Karki, Mr. Victor Afari-Sefa, Mr. Richard Mulwa, Mr. Raphael Omolehin and Mr. Silvère Tovignan for their assistance in the beginning and final preparations of the work. I am also particularly grateful to Dr. Leupolt for his comments and recommendations. I owe special thanks to Mrs Etsegenet Walel, Mrs Parveen Shahnaj, Mr. Achille Jaza Folefack, Mr. Hubert Adoukonou, Mr. Serge Gérard Nzinkeu, all my neighbours of Eichendorffring, Haus B, Rooms 01-15 in Giessen (Germany), Mr. Ousmane Sylla, Mr. Landry Bom and all my football team colleagues of S.V. Dörf-Güll for having together nice time. I am also indebted to Mrs Philomène Biaou, my mother, sisters and other members of my family for their moral support throughout my stay far away from home.

Finally, I wish to thank the DAAD, *Deutscher Akademischer Austauschdienst* for its financial support without which this study would not have been carried out.

## Preface

The study is part of series of analyses of the economic development and social problems in Benin, carried out within the DAAD Program "Agricultural Economics and Related Sciences" at the University of Giessen, Germany. The underlying empirical and methodological research, including a half-year field study has been done in the period between 2000 and 2004 and has led to a PhD Degree for the author.

On one side, this study assesses the impact of agricultural projects on sustainable development of stakeholders in rural areas of Benin. For this, the with-without approach of impact evaluation has been applied. The results show that the projects have a positive impact on agricultural productivity, food consumption and soil fertility conservation. In addition, a qualitative analysis of opinions of local farmers about the impacts and usefulness of the projects is presented.

In the second part farmer's decision to participate in the projects and to adopt the modern technologies is analysed. The results show clearly the key factors of participation, namely human capital, availability and access to inputs. Giving these results of the study, the author recommends a set of policies for improving the success of projects and the sustainability of agricultural development, particular for the poorest.

For the editors: Siegfried Bauer, University of Giessen, Germany

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## Abbreviations

ADF: Asymptotic Distribution-Free

ANOVA: Analysis of Variances

ASECNA: Agency for Air-Navigation Security in Africa

BMZ: Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (German Federal Ministry of Economic Cooperation and Development)

CARDER: Center for Agricultural Development at Regional Level in Benin

CDF: Cumulative Distribution Function

CES: Constant Elasticity of Substitution

CGE Models: Computable General Equilibrium Models

CIF: Cost-Insurance-Freight

DWLS: Diagonally Weighted Least Squares

EMU: European Monetary Union

FAO: Food and Agricultural Organisation

Fcfa: Currency of Benin (1€ = 656Fcfa)

FOB: Free-On-Board

FUPRO: National Federation of Cotton Producers Associations in Benin

GDP: Gross Domestic Product

GLS: Generalized Least Squares

GNP: Gross National Product

GTZ: Deutsche Gesellschaft für Technische Zusammenarbeit (German Society for Technique Cooperation)

GV : Associations of Cotton Producers at Village Level in Benin

GWLS: Generally Weighted Least Squares

HDI: Human Development Index

IDRC: International Development Research Center

IFAD: International Funds for Agricultural Development

IFPRI: International Food Research Institute

IMF: International Monetary Fund

INSAE : National Institute for Statistics and Economics Analysis in Benin

LDC: Less Developed Countries

LT: Local Technology

ML: Maximum Likelihood

MT: Modern Technology

NGO: Non-Governmental Organization

OECD: Organization for Economics Cooperation and Development

OLS: Ordinary Least Square

ONASA: National Office for Food Security in Benin

PRA: Participatory Rural Appraisal

RTS: Returns To Scale

SAM: Social Accounting Matrix

SAP: Structural Adjustment Program

SEM: Structural Equation Modeling

UA: Utility Analysis

UDP: Provincial Union of Cotton Producers Associations in Benin

ULS: Unweighted Least Squares

UNDP: United Nations Development Programme

USLE: Universal Soil Loss Equation

USPP : Union of Cotton Producers at District Level in Benin

# 1 INTRODUCTION

The rural sector plays usually an important role in the development of different countries. Less Developed Countries, in particular, depend on this sector for most of their survival and development resources. Agriculture, which is the main activity of these areas, employs between 70% and 80% of the active population. Additionally, the sector allows the underdeveloped countries to balance their budgets through earnings of foreign currencies from exports. Besides, local rural people ensure food consumption from agricultural production, what allows them to guarantee food security.

Unfortunately, rural areas are confronted with severe problems, which slow down their progress and make the survival of local people more difficult. Natural resources such as land, forest and water are more and more gradually degraded. The decline in land fertility involves the decrease of agricultural productivity. Coupled with the decline and the instability of export product prices, the degradation of natural resources leads to a drastic decrease in agricultural incomes. Moreover, international institutions like Food and Agriculture Organisation (FAO) worried about the fact that a large portion of rural people have food insecurity problems, which is getting regrettably worse, especially in Sub-Saharan Africa. This situation draws nowadays a dark picture of rural areas, and the hope of local people for better living standards decreases drastically.

At the same time, mainly funded by developed countries, international institutions such as GTZ, WORLD BANK, FAO, UNDP, etc. and Non-Governmental Organizations (NGOs) have contributed ceaselessly to the development of rural areas. In general, actions are completed through agricultural projects. The projects are often designed, planned and implemented to help the rural people to develop agriculture and to have access to more stable income. The technical assistance provided by some of the projects has contributed to strengthen the capacities of rural people through education, training and institutional supports. Regrettably, since decades, the contribution of agricultural projects to development of rural areas has improved so little the living conditions of rural people. Actually, weaknesses in conception, management, monitoring and evaluation of agricultural projects have been among the main factors that have precluded the complete achievement of the expected goals.

Taking into account this limited sustainability of agricultural projects, questions remain to know if they are really suitable to allow development of rural areas, chiefly in Sub-Saharan Africa, and if so in which conditions.

## 1.1 Background Information

### 1.1.1 Importance of Agriculture

Economic progress world-widely slowed down towards the end of last century. However, agricultural production contributed variably in economy building. The sector had been the development motor in high-income countries before they relay on industry. In contrast, low-income countries continue to depend in great part on agricultural production. For instance, 26% of Gross Domestic Product (GDP) in Less Developed Countries was provided by agriculture in 1999. Likewise, it supplied at the same time 15% and 27% of GDP in Sub-Saharan Africa and South Asia respectively, while the contribution in European Monetary Union (EMU) was only 2%. In the case of Benin, 75% of the active population was employed for agricultural production in 1998. At the same time, this sector contributed to 70.2% to the overall export incomes and 39% to the GDP (WORLD BANK, 2001).

Based on the previous discussion, it is possible to conclude that improving agricultural production will have a positive impact on the economic performance and development of low-income countries and of Benin in particular. Nevertheless, Table 1.1 shows that service and trade sector represents the largest share of GDP. Though trade in Less Developed Countries depends widely to export of agricultural products, the reserved economic performance of agricultural production could probably be due to the numerous problems that the sector has to face.

**Table 1.1: Structure (%) of the Gross Domestic Products in the World, 1999**

| Regions | Agriculture | Industry | Service and Trade |
|---|---|---|---|
| Sub-Saharan Africa | 15 | 29 | 56 |
| South Asia | 27 | 26 | 47 |
| Latin America & Caribbean | 8 | 30 | 62 |
| Less Developed Countries | 26 | 30 | 44 |
| European Monetary Union | 02 | 27 | 71 |

Source: WORLD BANK, 2001

### 1.1.2 Development Problems of Agricultural Sector and Rural Areas

#### 1.1.2.1 Degradation of Natural Resources

The Earth Summit of Rio stressed, "*it is urgent to arrest land degradations and launch conservation and rehabilitation programmes in the most critically affected and vulnerable areas*" (AGENDA 21, 1992). Actually, land and forest degradation became serious problems in the last decades.

The first unpleasant finding is that deforestation is widespread. During the 1980s, an estimated of four million hectares of forest were lost each year in Asia and the Pacific. Likewise, Africa lost an estimated of 47 millions hectares of forest. In 1995, 19 millions hectares of forest had been lost, which is equivalent to the size of Senegal. Only for the period 1990-95, the annual rate of deforested area in Africa was about 0.7%, a slight decline with comparison to the 0.8% of 1980-90. The highest rates were recorded in the most western parts of the continent. Losses have been particularly high in countries such as Uganda, where forest and woodland cover shrunk from an estimated of 45% of total land area in 1900 to only 7.7% by 1995 (FAO, 1999). The destruction of the forests is mainly a result of clearance for agriculture and induces closely land degradation.

In 1992, developing countries in Asia and the Pacific, which accounted for just less than 54% of the world population (nearly 3000 million people) had only 17% of the world's land resources due to degradation. In the Philippines, for example, it is estimated that soil erosion carries away a volume of soil equivalent to one meter deep over 200,000 hectares every year. In India, some 144 millions hectares of land are affected by either wind or water erosion. In Pakistan, 8.1 millions hectares of land have been lost because of wind erosion and 7.4 millions hectares due to water erosion. In the meantime, GBESSEMEHLAN (1988), BIAOU (1995) and DISSOU (1992) showed also the accelerated degradation of natural resources in Benin. Furthermore, according to VAN DER POL et al (1993), soil erosion rises 30 billions tons of land loss yearly in *Adja* area of Benin. At the same time, 3,900 tons of nitrogen and 1,400 tons of potassium are registered as annual deficit of soils, mainly due to agricultural activities. The situation would be justified by strong pressure on natural resources due to demographic increase, since land and forest capitals are inextensible.

#### 1.1.2.2 Natural Resources Degradation and Socio-economic Development

Forest and land degradation led to decline in soil fertility and hence to decrease in agricultural productivity. Worse, the term of trade has not been improved for export-oriented economies. Consequently, world development indicators published by the WORLD BANK reported frequent decline in value of agricultural sector added to economy. These aspects led inevitably to stagnation or even worsening of the economy of Less Developed Countries. Sub-Saharan Africa suffered, for example, a decline in Gross Domestic Product (-0.3%) in 1990-2000. Moreover, regions where export of agricultural products contributed highly to economy building such as Sub-Saharan Africa and South Asia had the lowest Human Development Indexes in 2000 (0.47, 0.53 and 0.41 for Sub-Saharan Africa, South

Asian and Less Developed Countries respectively, Table 1.2). Regrettably, the decline in efficiency of the primary sector affected more strongly the rural areas than the urban areas since most of their people survive of agricultural production.

**Table 1.2: Gross Domestic Product (GDP) and Human Development Index (HDI) in the World, 2000**

| Regions | GDP (PPP US$ thousand billions) | GDP per Capita (US$) | GDP per capita Annual Growth Rate 1990-2000 (%) | Human Development Index (%) |
|---|---|---|---|---|
| Sub-Saharan Africa | 1,034.4 | 1,690 | -0.3 | 0.47 |
| South Asia | 3,347.3 | 2,404 | 3.3 | 0.53 |
| Latin America and Caribbean | 3,679.7 | 7,234 | 1.7 | 0.72 |
| Less Developed Countries | 664.4 | 1,216 | 1.3 | 0.41 |
| OECD | 26,525.3 | 23,569 | 1.7 | 0.91 |
| World | 44,002.4 | 7,446 | 1.2 | 0.72 |

Source: UNDP, 2002

Actually, analysis of the rural poverty (relative or absolute) reveals that it is of a big dimension and knows a certain expansion. Incomes are extremely weak. For instance, with an annual income of 121,000Fcfa[1] (185€) on average per household in rural areas, more than 50% of Benin rural households either, lives below poverty line, or are vulnerable to poverty (UNDP, 1999). An overview of Table 1.3 and Figure 1.1 illustrates that agricultural producers are the poorest of the Benin society, and rural areas more vulnerable to poverty than urban areas.

Taken into account the difficult economic situation of farmers in rural areas, international institutions and governments of Less Developed Countries have developed strategies for improvement of agricultural production and development of rural areas through agricultural projects.

**Table 1.3: Some Poverty Indicators in Urban and Rural Areas of Benin, 1997**

| Activities Categories | Poverty Incidence | Poverty Depth | Poverty Seriousness |
|---|---|---|---|
| Urban Area | | | |
| Agricultural Producers | 0.6747 (0.0371)[a] | 0.2073 (0.0112) | 0.0836 (0.0099) |
| Independent Operators | 0.4272 (0.0254) | 0.1155 (0.0094) | 0.0452 (0.0050) |
| Employed Persons [b] | 0.3184 (0.0280) | 0.0812 (0.0100) | 0.0308 (0.0054) |
| Rural Area | | | |
| Agricultural Producers | 0.9666 (0.0062) | 0.6304 (0.0082) | 0.4467 (0.0086) |
| Independent Operators | 0.9248 (0.0254) | 0.5294 (0.0249) | 0.3420 (0.232) |
| Employed Persons | 0.8949 (0.0435) | 0.5167 (0.0391) | 0.3306 (0.0342) |

a: The numbers in brackets are standard errors; b: Private and Public
Source: UNDP, 1999

[1] Fcfa is legal currency of Benin. 1€=655Fcfa.

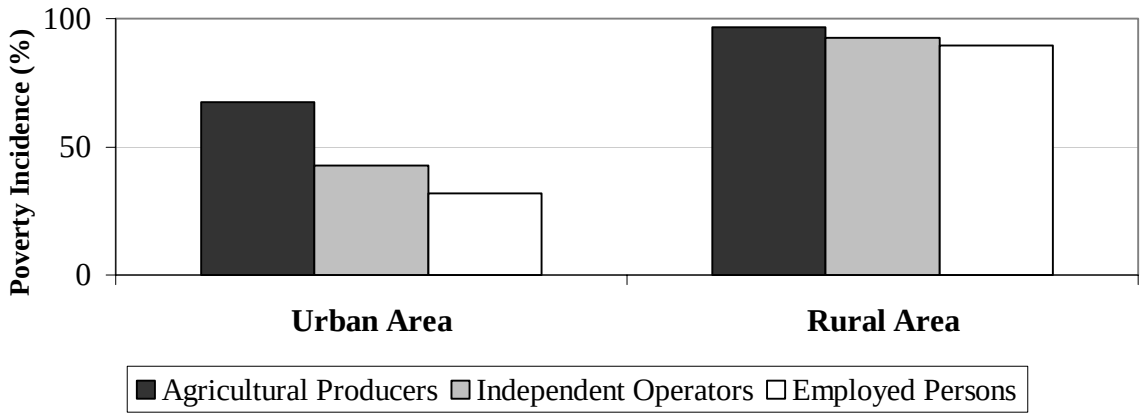



**Figure 1.1: Poverty Incidence (% of Population) in Benin, 1997**
Source: UNDP, 1999

### 1.1.3 Agricultural Projects and Development of Rural Areas

#### 1.1.3.1 Historic Aspect: From Financial to more Technical Assistance

Until the end of the 1980s, agricultural projects have been designed and planned to solve problems of natural resources degradation, to improve production systems and subsequently to contribute to rural development. Financed by development partners, they popularize and diffuse introduced packages of agricultural technologies and modern management of land and forest imported from developed countries. For instance, the WORLD BANK, FAO, GTZ, etc., supported projects that focused on diffusion of high yielding varieties, mineral fertilizers, pesticides, herbicides, fungicides, modern anti-erosive techniques, modern techniques for forest protection and other cultural practices. In the same time, efforts were done to promote participatory approach and modern governance (FAO, 1989; WORLD BANK, 1990, GTZ, 2000). During this period, emphasis was more put on financial assistance to reduce poverty in rural areas.

From the beginning of the 1990s, development projects have been more oriented to technical assistance even though the financial assistance was indispensable. In fact, it came into view that the development will be sustainable if the local people hold the ownership of development actions and programs. Therefore, in the early nineties, German Technical Cooperation, and hence the Gtz too, began to focus on the importance of political and institutional frameworks for development in general. They also worked on the development and harnessing of existing and newly created capacities. The GTZ saw capacity development as the process of strengthening the abilities or capacities of individuals, organisations and societies to make effective and efficient use of resources, in order to achieve their own goals on a sustainable basis. In short, the capacity development was viewed as

investment for sustainable development. This is done by investing in people, organizations, institutions and policies. Therefore, most local governments got technical supports to establish special development programs, which focused on reinforcement of local community capacity as one of strategies to eradicate poverty and support to decentralization process in rural areas. To succeed, following objectives are often kept for the programs: (1) transfer of appropriate knowledge and technologies to poorest and most vulnerable groups of rural local people; (2) transfer of responsibility to local communities regarding process of decisions making and taking that concern their survival conditions; and (3) creation and widening of a productive basis that is able to generate sustainable development of rural local people.

#### 1.1.3.2 Contribution of Agricultural Projects to the Development of Agriculture and Rural Areas

The executed projects contributed to increase the capacity of rural communities auto-promotion by helping them to increase agricultural productivity and incomes, as well as to improve access to social services. The construction and rehabilitation of social infrastructures such as schools, illiteracy elimination centers, health centers and selling points of pharmaceutical products allowed to increase the enrolment rate of schooling and to improve health of the population. In addition, the rural hydraulics and sheepfolds improve access to drinking water. The credit sector introduced into rural areas in association with specialized institutions allowed to facilitate access of rural people to credit, to increase local saving and to improve in a significant way household incomes in intervention zones. The transfer of knowledge also favored internalization of concepts relative to environmental protection, nutrition, sanitary prevention and improvement of production systems at community level. However, due to weaknesses, the outputs do not, for the moment, satisfy widely the expectations of local communities.

This view on projects, outlined here, gives only brief and general perspectives on roles they are expected to play in development of rural areas, though it helps specify the study problem. Later in following chapters, more extended perspectives on projects are developed.

## 1.2 Weaknesses of Agricultural Projects and Problem Statement

According to the previous discussion, it can be concluded that the projects have brought positive effects on agriculture development, but as stressed above, weaknesses exist. Although modern technologies have provided growth for

agricultural sector of developed countries, they have, unfortunately, involved some problems for most Less Developed Countries. For example, they have caused new ecological problems such as natural resources degradation, bio-diversity loss, pollution by chemical substances and reduction of environment assimilation capacity, as well as disturbance of socio-economic and cultural norms established in rural areas (NETHERLANDS COOPERATION, 1996). As a result, local people have rejected most of them. Therefore, many projects have neither achieved their objectives nor been sustainable, as early stressed by HYDEN (1982) and HART (1983), and lately by PREUSS (1994), COLLION and RONDOT (1998). For example more than 50% of agricultural projects are reported less of efficiency and, rarely, impacts remain after 2 or 3 years of activity cessation. The consequences of such inefficiencies are much money spent, more economic loss and increase in external debt (more than 10% of Benin external debt is yearly due to the finance of most important agricultural development projects; INSAE- PNUD, 1998).

Inefficient internal organization with large services, complex administration and high cost, which end to low working was known to be the most important constraints of projects. For instance, between 40% and 50% of all devoted funds for project activities were spent for administrative management, giving hence poor finance for field actions. Taking into account recommendations of some studies, development actors reconsidered design and organization of new projects by improving their capacity regarding field actions. Regardless of that effort, problems remain such as more accelerated erosion and soil fertility decline, and more accelerated forest degradation due to extensive agricultural systems. From these, how sustainable are agricultural projects in Benin?

In some part of the world, agricultural projects have contributed widely to improve productivity and sustainability regarding natural resources management and development of rural people. For example, the yield increases achieved in India in wheat and maize production due to agricultural projects since 1965 avoided the additional clearing of 50 millions hectares of forest and fallow land. Besides, an increase in productivity on the already cropped land of 0.1% yearly during the next 15 years compensates for 25 millions hectares of rainfed cropland (BOSCH, 1996). Consequently, how do projects affect sustainability of agricultural production in Benin? Could they contribute to sustainable development of rural areas. If so, under which conditions?

The second most important criticism formulated against the projects is that they are remote from the beneficiaries. In fact, CONROY et al (1988); REIJNTNES (1994); MATOWANYIKA (1997) and DANGBEGNON (1998) stressed in their studies

that quantitative and qualitative differences existed between project supply and demand of local people. According to them, agricultural projects in order to achieve their objectives need socioeconomic and cultural changes of local people in practices. Consequently, emphasis must be put on farmers' living and production conditions, their knowledge and organizations in order to provide what they need for sustainable development. For instance, neo-classic theories of economic production such as theory of profit maximization (RICARDO), theory of factors margin productivity (WALRAS) and labor theories of value and utility may sometimes be relevant to small household production and could determine farmers' decision taking. Nevertheless, many interests of agricultural households (food and economic survivals, production risk minimization, protection of social statue and maintenance in the socio-cultural environment of the village) affect also the production organization. Hence, the more supply of agricultural projects is incompatible with farmers' objectives above mentioned, the more they fail providing technological change and agricultural development (OLIVIER DE SARDAN, 1995; BIERSCHENK and al., 1993 and SELLAMNA, 1999). In that case, what are the real demands of local people for their development? Which are satisfaction opinions of rural people as feedback of development supply provided by agricultural projects? How these affect their decisions of participation and adoption of modern technology?

In other way, how much do management and goal achievement of agricultural projects affect beneficiaries and their decisions of participation and adoption? Finally, searching of production systems economically viable and ecologically acceptable in Benin, how can management, goal achievement and impacts of agricultural projects be improved to achieve sustainable development of rural areas?

## 1.3 Objectives and Hypotheses of the Study

### 1.3.1 Objectives

The study aims in general at analyzing management and impacts of agricultural projects on sustainable development of local people, as well as key factors of participation and adoption in order to derive suggestions which could lead to better sustainability. Specifically, the study considers following objectives:

(1) to describe the cycle of agricultural projects (actors, design and objectives, activities, internal organization, stakeholders' participation, etc.) and to evaluate their goal achievement.

(2) to study socially and economically households, to characterize their farming systems and food consumption pattern, as well as to estimate impacts of projects on productivity, technical efficiency, food consumption, soil degradation and capacity building of beneficiaries.

(3) to identify factors that affect decisions of participation in agricultural projects and adoption of modern agricultural technologies.

(4) to derive suggestions and recommendations for policy takers and makers as well as projects' actors with respect to improvement on design, management, monitoring, goal achievement and impacts of the projects for better sustainability.

### 1.3.2 Hypotheses

According to the study objectives, following hypotheses are expressed and tested:

(1) the better management of projects and participation of beneficiaries are, the better they achieve their goals.

(2) agricultural projects have positive impacts on productivity, on technical efficiency and on food consumption. In addition, they help farmers to avoid soil degradation and improve their capacity building.

(3) human capital, perception on satisfaction of production, of consumption and of soil fertility, as well as availability and access to production inputs affect positively decisions of the farmer to get involved in agricultural projects and to adopt modern technologies.

## 1.4 Limitation of the Study

The study of agricultural projects seems not to be easy because of the context in which they are negotiated and implemented. In particular, there is a whole secret often surrounding their politico-legal characters. As Benin is a less-developed country characterized by a budget deficit, the finance of the projects comes from external funds so that the international community plays key financial roles. Therefore, especial economic and political interests could be better privileged. The present study is not able to encircle and analyze in a deeper way the negotiation and finance conditions of agricultural projects with the financiers. The complexity of the subject brought hence some bias to the collected information. However, a variation of sources allowed to limit these biases and to have rather reliable data at project level. In addition, the tiredness of local people with regard

to the output of the projects, which in fact would change little their conditions of increasingly difficult life, made painful the information collection. The use of appropriate methods of collection helped to correct and to minimize the errors as well as possible at household level.

In normal conditions, to have very reliable data, it is important to follow the farmer in time because his memory is very short: " cost route " survey experimented successfully by many researchers. In case of agricultural projects, the method could help to have data for dynamic analysis of impacts and sustainability. The time availability did not, regrettably, allow using this method. The possible errors bound to the used method were made significantly weak by an integrated usage of various tools of collection. However, the validity of the empirical results should view closely to static analysis like the study approached impact assessment and estimation of decisions factors.

As third limitation of the study, the impact assessment was more concentrated at household and community levels. The analysis did not explore, for example, the impacts on employment, on aggregated macroeconomic indicators such as GDP, HDI, goods/factors prices and inflation, etc., at region or country level.

Finally, limitations due to models used for data analysis are later developed in related sections.

## 1.5 Organization of the Study

After the current chapter, the first part of the study briefly presents the economy state of Benin (Chapter 2) with a particular accent on rural areas. It provides also the place and role of agricultural projects regarding economic development policies of the country.

The theoretical framework presented in Chapter 3 outlines possible definitions and conceptualizations of agricultural projects and production sustainability by underlying related indicators. From literature, conditions for projects' sustainability are illustrated as conceptual framework of the study to show potential factors to consider such that agricultural projects could better achieve their goal of rural development. Following the main outcomes from this literature review, the methodological approach developed gives the guiding thread followed in sampling, collecting and analyzing data as well as interpreting the main findings. Chapter 4 outlines field study process and establishment of database. Criteria for choice of agricultural projects, sampling methods and data collection methods, and tools are thus detailed. Likewise, the selected projects and study zone are described by pointing out factors, which could induce differential of

project impacts and modern technologies adoption by stakeholders. In Chapters 5, the main findings of field study are outlined. It explores characteristics of local people as beneficiaries of projects. The target is put on their socio-demographic characteristics, agricultural production systems, food consumption patterns and income structure, their institutional arrangements and capacity.

Chapter 6 goes on describing the cycle of the selected projects from design and conception to evaluation. Besides, their goal achievement (Utility Analysis) are evaluated. The correlation between design, management and monitoring quality of the projects and their utility values are also estimated to identify factors of goal achievement (objective 1 of the study). In the final part, relationships between the selected projects and the local people are explored.

In Chapter 7, econometric models are developed to assess impacts of projects on production efficiency, on food security and on soil degradation using contact and goal achievement indexes (objective 2 of the study). Besides, qualitative analysis tools are used to evaluate impacts of the projects on capacity building and opinions of local people about the impacts and projects' usefulness.

The Structural Equation Modeling (SEM) developed in chapter 8 leads to estimate factors affecting farmers' decisions to get involved in agricultural projects and to adopt modern technologies. The study uses goal achievement analyzed in Chapter 6 and stakeholders' opinions of satisfaction with the impacts assessed in Chapter 7 to estimate factors that affected their participation and adoption decisions. Therefore, key factors that could lead to projects' sustainability are clearly identified (objective 3 of the study). In the last section of the chapter, effects that scenarios of improvement on design, management, monitoring and goal achievement, as well as on impacts can have on participation and adoption decisions, and on sustainability of the projects were analyzed.

Finally, Chapter 9 concludes the study by putting together all the study results to show what sustainability of the projects means and how it can be achieved and maintained. From these, suggestions and recommendations are derived for policy-makers and actors involved in projects design, management and monitoring, and for external actors to improve on design, management, monitoring and goal achievement, as well as on impacts of the projects (objective 4 of the study). Questions, which can be objects for future studies are also outlined to solve limitations of the study.

# 2 OVERVIEW OF THE ECONOMY

Coastal country of western Africa, Benin Republic, known former as Dahomey has borders with Nigeria in the East, Togo on the West, Niger and Burkina Faso in the North, and with the Atlantic Ocean in the South. Of little stressed relief, the country extends over a total surface of 112,620 $km^2$ (1/3 Germany), among which 23,220 $km^2$ of the land are with agricultural activities. Grounds are 85% of ferruginous type. Generally speaking, the country can be subdivided into three big agro-climatic zones spread from the South to the North:

(1) a subequatorial zone which covers the South of the country. This one knows approximately 240 rainy days distributed in two periods: from March to end of July, then from September to middle of November;

(2) a Guineo-Sudanese zone in the center with 200 rainy days distributed in a single season going from April till October;

(3) a zone of Sudanese type with semi-arid tendency with 145 rainy days. It extends from Parakou's latitude to the North of the country. In this part of Benin, the rains come between May and September.

The population, which was estimated at 5,409,000 inhabitants in 1995 and at 5,937,000 inhabitants in 1999 (1/13 of Germany) knew demographic growth rate passing from 2.7% during the period 1973-1980 to 3.2% between 1980 and 1991 and returning to 2.36% between 1991 and 1999. This population, essentially rural, is concentrated in the South of the country, but it is possible for some years, to observe an important drift from the rural land such that the urban population crossed from 27% in 1980 to 42% in 1998. The rural people are mostly employed in agricultural sector. They mainly produce maize, beans, groundnuts, cassava, yam, millet, etc. as food crops and cotton, oil palm, coffee, etc. as cash crops (UNDP, 1999).

The economy of the country depends largely on agriculture with cotton export and informal trade between the much larger country Nigeria. It remains weak in spite of a net improvement that began in 1990. Although the trend of the most development indicators shows a net positive tendency since the 1990s, the country remains less-developed with in 1998 a Human Development Index (HDI) of 0.38 and a rank of development level of 145 (with respect to 174) according to the WORLD BANK (UNDP, 1999).

## 2.1 Historic Review of the Economic Reforms

The analysis of the economy progress drives to consider two different periods. Before the 1990s, the economy was the State planned one with wide engagement of the government. As a result, the system appeared to be inefficient. Indeed, all activity sectors knew in 1989 a grave crisis characterized by: (1) a questioning by the population of the system based on Marxism-Leninism, (2) a strong decline in growth rate and per capita income, (3) a fast degradation of economic and social infrastructures, (4) a pointed crisis of liquidity, (5) an escalation of internal and external imbalances, (6) a crisis of generalized non-liquidity and (7) an accumulation of payment of internal and outside arrears. This situation led the authorities to set up with Bretons Wood's institutions and development partners the Structural Adjustment Program (SAP). Hence, the option focused on the State planned economy was abandoned.

Since the 1990s, Benin knew on the whole four Structural Adjustment Programs which aimed at: (1) cleaning up the economy, (2) raising internal and external imbalances, (3) accelerating the economic growth, (4) encouraging private initiatives, (5) proceeding to State disengagement on productive activities and (6) rehabilitating the banking sector.

The reform series made touched practically all the activity sectors of the economy. One notably retains: (1) the State disengagement on productive activities, (2) the reform of the administration and banking system, also of the industry, trade and agriculture sectors; and (3) the rescheduling of the foreign debt. The reforms were made through liquidation of public companies considered not viable and privatization or reorganization of those considered still viable.

In agricultural sector, the “Centre d’Actions Régionales pour le Développement Rural” (CARDER) was created after the military putsch of 1972 in each province to develop agricultural production and to improve living conditions in rural area. An overview evaluation of this institution proved its incapacity to satisfy the fixed objectives. In fact, the CARDER worked more administratively than made and sustained development actions for local rural population. With the reforms of the 1990s, the CARDER was restructured through some projects. Its administration was eased and most attributes were transferred to Non Governmental Organizations (NGOs) and Farmers’ Associations. Likewise, the commercialization of agricultural products was privatized and committed to private economic operators.

In short, the reforms gave a new breathing to all economic activities. The output of the various implemented measures of adjustment were widely satisfactory, and the economy took up with growth and very encouraging registered performances.

## 2.2 Performance of the Economy since the 1990's

Benin is a country of Sub-Sahara Africa, which belongs to low-income countries according to its GDP per capita. From this, it would be better to analyze its economic performance in comparison with the economic progress in Sub-Sahara Africa and low-income countries.

As developed former, the phase before the 1990 is characterized by a negative performance of the economy. In this period, the annual average growth of 2.5% of GDP is very low in relation to the average of low-income countries (4.7%). However, Benin was among the best performers in its geographic area (Sub-Sahara Africa) where the average growth was the worst of the world (1.7%).

During the period 1990-1999, the reforms made in all activity sectors seemed to be successful and allowed the best annual average growth of GDP of 3.15% when those of low income countries and Sub-Sahara Africa stayed at 1.96% and 0.99% respectively (Table 2.1). However, rapid population progress offset this GDP growth such that the improvement in GDP per capita was negative (Figure 2.1) for the three categories of economy.

**Table 2.1: GDP and its Growth (%) in Benin, Sub-Sahara Africa and Low Income Countries, 1980-1999**

| | GDP ($Millions) | | % Growth of GDP* | | GDP per Capita ($) | | |
|---|---|---|---|---|---|---|---|
| | 1990 | 1999 | 1980-1990 | 1990-1999 | 1990 | 1999 | % Growth (1990-1999) |
| Benin | 1,845 | 2,369 | 2.5 | 3.15 | 396.35 | 387.85 | -2.14 |
| Sub-Sahara Africa | 297,444 | 324,097 | 1.7 | 0.99 | 639.75 | 547.54 | -14.41 |
| Low Income Countries | 878,364 | 1,033,244 | 4.7 | 1.96 | 459.74 | 428.39 | -6.82 |

Source: Source: WORLD BANK Data Base, 2000 *: Annual Average Growth

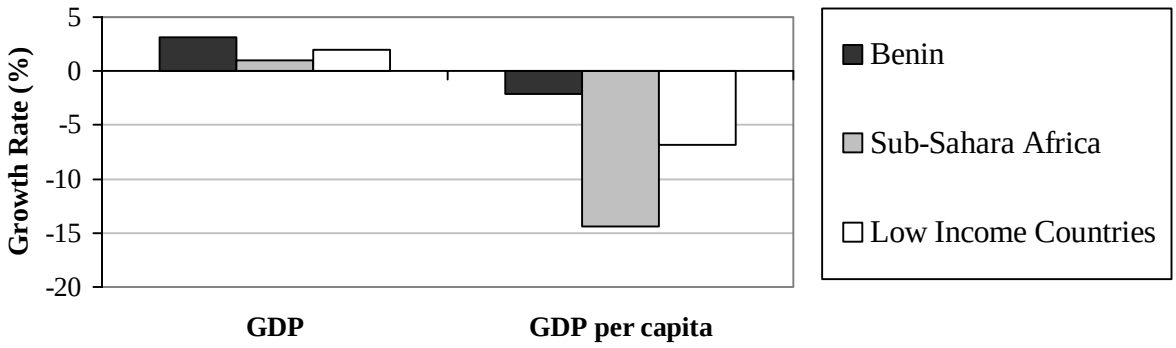



**Figure 2.1: Growth of GDP (%) and GDP per capita in Benin, Sub-Sahara Africa and Low Income Countries, 1990-1999**

Source: Source: WORLD BANK Data Base, 2000

Although the analysis drives to a satisfactory take-off of the economy balanced by rapid population growth, the situation is not the same when analyzing sector by sector. The data in Table 2.2 and the Figure 2.2 show an increase in the contribution of agricultural sector to GDP, which crossed from 36% in 1990 to 38% in 1999. However, the situation is more explained by the performance decrease of the service sector (51% to 48%) and the none-significant improvement of the industry rather than a real progress of agricultural production.

As it is the case in most Sub-Sahara Africa and low-income countries, the situation of the economy characterized by a very low development of industry sector is a serious weakness. Indeed, the industry sector based more on creativity provides better productivity and income, and has the advantage of more employment. To develop the economy, policy should put more emphasizes on small manufacturing industries and progressively on large industries.

**Table 2.2: Structure of Output (% GDP) in Benin, Sub-Sahara Africa and Low Income Countries, 1999**

| | Agriculture | | Industry [a] | | Manufacturing | | Services | |
|---|---|---|---|---|---|---|---|---|
| | 1990 | 1999 | 1990 | 1999 | 1990 | 1999 | 1990 | 1999 |
| Benin | 36 | 38 | 13 | 14 | 8 | 8 | 51 | 48 |
| Sub-Sahara Africa | 18 | 15 | 34 | 29 | 17 | 16 | 48 | 56 |
| Low Income Countries | 29 | 26 | 31 | 30 | 18 | 19 | 40 | 44 |

Source: WORLD BANK Data Base, 2000 Note: a: Includes also Manufacturing

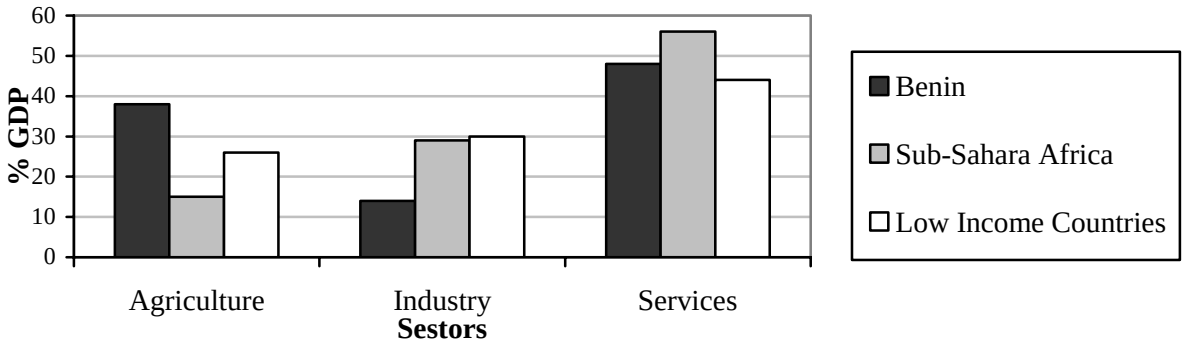



**Figure 2.2: Structure of Output (% GDP) in Benin, Sub-Sahara Africa and Low Income Countries, 1999**
Source: WORLD BANK Data Base, 2000

## 2.3 Agricultural Sector

### 2.3.1 State of the Sector

Despite the importance of agricultural production for the economy, its progress is not good as it could be. Since the 1980s, political and economical efforts led to improvement of the agricultural sector around 5% of annual average growth

(5.1% in 1980-1990 and 5.3% in 1990-1999; Table 2.3 and Figure 2.3). The situation would be due essentially to little harmonic in established policies. Before the reforms in the agricultural sector, policies were more oriented towards high cereals production for food security. Many maize varieties of high yielding were introduced and extension was focused on improved cultural techniques. In the same moment cash crops retained less attention from the government. After the reforms of the 1990s, the country was more opened to external markets because of privatization, and export appeared more profitable. The policies changed into developing cash crops production rather than the food crops. As result, the orientation change in agricultural policies constrained the sector to little significant improvement.

**Table 2.3: Annual Average Growth (%) of Agricultural Sector in Benin, Sub-Sahara Africa and Low Income Countries, 1980-1999**

| | 1980-1990 | 1990-1999 |
|---|---|---|
| Benin | 5.1 | 5.3 |
| Sub-Sahara Africa | 2.3 | 2.7 |
| Low Income Countries | 3.0 | 2.5 |

Source: WORLD BANK Data Base, 2000

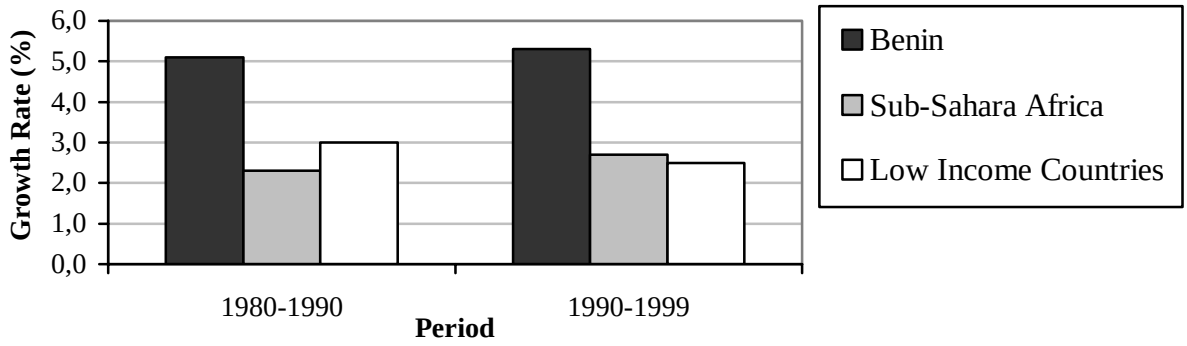



**Figure 2.3: Annual Average Growth (%) of Agricultural Sector in Benin, Sub-Sahara Africa and Low Income Countries, 1980-1999**
Source: Source: WORLD BANK Data Base, 2000

## 2.3.2 Main Cultivated Crops

The main objective of agricultural producers often remains to ensure food security in their households. Maize, as first basic food, is at the head of main crops in Benin considering its surface. In 2000/2001, the cultivated area in maize represented approximately 32% of all agricultural surfaces. In second position, cotton production comes with 19% as main cash crop that benefited from the agricultural policies, which were introduced in the 1990s. In the third position are tubers and roots such as cassava and yam, which are the second main basic foods after maize with 14% and 8% respectively, as well as sorghum (9%) because of its food

importance in the Northern (Table 2.4). The controversial aspect of production of some main crops, which would be harmful to environment, rests on its extensive character as the evolution of cultivated surfaces proves. The Table 2.5 and the Figure 2.4 show an annual average increase of 15% of cotton areas that is approximately 55,900ha of forest destroyed every year. Indeed, these last years agricultural policy was focused on cotton production to improve the term of agricultural trade. Consistently, the other crops especially food suffered from it, what laid down again the problem of food security guarantee in most vulnerable regions of the country.

**Table 2.4: Cultivated Area, Production and Yield of Most Main Crops in Benin, 2000/2001**

| Crops | Cultivated Area (ha) | Production (metric ton) | Yield (Kg/ha) |
|---|---|---|---|
| Bananas | 2,500 | 13000 | 5,200 |
| Beans | 115000 | 77,518 | 674.1 |
| Cassava | 260000 | 2,800,000 | 10,769.2 |
| Coconuts | 12000 | 20000 | 1,666.7 |
| Groundnuts in Shell | 90000 | 80,670 | 896.3 |
| Maize | 600000 | 662,958 | 1,104.9 |
| Millet | 45000 | 33,664 | 748.1 |
| Oil Palm Fruit | 21000 | 220000 | 10,476.2 |
| Rice | 24600 | 44000 | 1,788.6 |
| Seed Cotton | 372,427 | 362,841 | 974.3 |
| Sorghum | 170,000 | 136,371 | 802.2 |
| Yams | 155,000 | 1,773,363 | 11,441.1 |

Source: FAO Data Base, 2000

The production level of these main crops is characterized as well by the same importance order as their cultivated areas. The very strong rise of harvests of yam and cassava is due to the weights relatively brought up by their roots and tubers, rather than to the performance of their production. The analysis of production evolution shows that cotton remains the only cash crop, which had a strong increase since 1990 with 10.4% of annual average rate of its production growth. Rice, which always remains marginal in term of production, progressed with 18.25% of growth notably because of the policy of local product consumption adopted since the CFA currency devaluation. In addition, cassava production that benefited from lands made supple by successions of cultures has been improved, and constitutes nowadays an economic alternative to cotton production. As regards other crops, the growth of production turns around 3-5% and denotes the weak productivity of the farming sector in spite of the improvement efforts (Table 2.5).

The yields obtained in 2000/2001 for most of crops proved an extension production. They were lower than what are expected in intensive cultivation. Their trends between 1990 and 2000 showed also no better improvement. Worse, cotton

yield suffered a drastic decline (-3.78%) while agricultural policies were conceived for an improvement of its production through agricultural credit, insecticides and mineral fertilizer distribution, popularization of improved agricultural techniques, etc. According to many research findings, the situation would be explained by the less control of modern technologies by farmers. Besides, popularization and input distribution (insecticides, mineral fertilizers, etc.) are reported to be none transparent, and the system does not consequently work as expected. Likewise, the annual average growth of 2% for the other crops drives to declining agricultural added value of producers (Table 2.5). In fact, the low yield of production induces a very low output. Since some of production costs are fixed and non-compressive, agricultural sector become low profitable, what would explain low revenue and uncertain economic survival in rural area.

**Table 2.5: Annual Average Growth (%) of Cultivated Area, Production and Yield for main crops in Benin, 1990-2000**

| Crops | Cultivated Area | Production | Yield |
|---|---|---|---|
| Rice | 12.59 | 18.25 | 5.02 |
| Maize | 3.25 | 5.86 | 2.52 |
| Millet | 0.61 | 2.97 | 2.34 |
| Sorghum | 2.19 | 3.10 | 0.89 |
| Cassava | 7.32 | 10.93 | 3.36 |
| Yams | 5.00 | 5.15 | 0.15 |
| Beans | 2.31 | 4.51 | 2.14 |
| Groundnuts in Shell | 1.63 | 3.83 | 2.16 |
| Coconuts | -0.00 | 0.00 | 0.00 |
| Oil Palm Fruit | 3.18 | 5.81 | 2.55 |
| Seed Cotton | 14.72 | 10.39 | -3.78 |
| Bananas | 0.00 | 0.00 | 0.00 |

Source: FAO Data Base, 2000

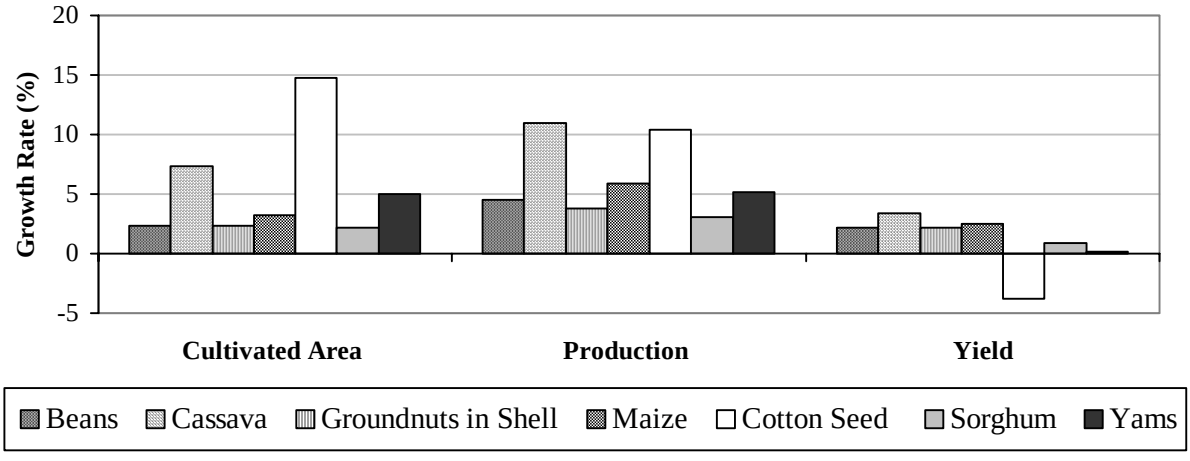



**Figure 2.4: Annual Average Growth (%) of Cultivated Area, Production and Yield for main crops in Benin, 1990-2000**
Source: FAO Data Base, 2000

### 2.3.3 Livestock and Fishery

The livestock sector remains still little developed and concentrates in the North of the country. For example, it represents only approximately 4% of the GDP and 25% of the added value of the entire farming sector. Cattle constitute the most important livestock, and had a better evolution than the other animal species (4% of average growth between 1987 and 2000). Indeed, during several years, efforts done through projects of livestock development were concentrated to improve the cattle production, what induced consequently almost stagnant state of poultry and deterioration of sheep production with respectively 0.9% and -2.98% of annual average growth rate between 1987 and 2000 (Table 2.6 and Figure 2.5). In general, the livestock system is still traditional and characterized by rambling freedom of animals. In this context, agricultural projects should have for essential objectives in restructuring the sector by making it crossing from traditional to modern system, while emphasizing the bio-quality of animal products.

**Table 2.6: Animals Number in Benin, 1987-2000**

| | Cattle | Poultry | Goats | Pigs | Sheep |
|---|---|---|---|---|---|
| 1987 | 896,403 | 22000 | 927,610 | 420,200 | 830,768 |
| 1988 | 925,200 | 23000 | 969,600 | 436,850 | 821,440 |
| 1989 | 942,800 | 24000 | 993,678 | 458,700 | 846,000 |
| 1990 | 1,080,000 | 23000 | 1,016,700 | 462000 | 869,100 |
| 1991 | 1,088,000 | 23000 | 1,041,100 | 515,100 | 892,800 |
| 1992 | 1,141,000 | 22000 | 1,120,000 | 513,000 | 920,000 |
| 1993 | 1,190,000 | 18000 | 1,180,000 | 536000 | 940,000 |
| 1994 | 1,223,000 | 20000 | 1,190,000 | 555,200 | 960,000 |
| 1995 | 1,294,000 | 22000 | 1,000,000 | 565,500 | 575,000 |
| 1996 | 1,350,000 | 25000 | 1,012,962 | 584000 | 601,183 |
| 1997 | 1,398,600 | 27000 | 1,020,000 | 580000 | 668,066 |
| 1998 | 1,345,000 | 29000 | 1,087,000 | 470000 | 634,000 |
| 1999 | 1,438,100 | 23000 | 1,182,527 | 470000 | 644,997 |
| 2000 | 1,500,000 | 23000 | 1,182,527 | 470000 | 644,997 |
| Mean | 1,200,864 | 23,143 | 1,065,979 | 502,611 | 774,882 |
| Standard deviation | 189,619 | 2,587 | 86,560 | 52,506 | 133,856 |
| Annual Average Growth (%) | 4.04 | 0.87 | 1.26 | 1.11 | -2.98 |

Source: FAO Data Base, 2000

The fishery sector like the livestock is not so successful (2% of the GDP, 10% of the added value of the farming sector). The activity occupies better waterside populations of wet zones of the Southern which supply the biggest part (57%) of fishery products. In general, there is no significant increase in fish catch in Benin (Table 2.7 and Figure 2.6). Worse, in a study on the management of natural resources in wet zones of South-Benin, ONIBON (2000) reported a light decline in fishery production (-0.35%). This little performance would be due to the

degradation of natural resources (heap of stream beds, forest destruction around streams, etc.) and to the weak of good management of institutions in charge of fishery sector in Benin. However big efforts were done during the last years with notably a development of fish breeding, but they remain insufficient by supplying only 17.7% of fishery products (Table 2.7).

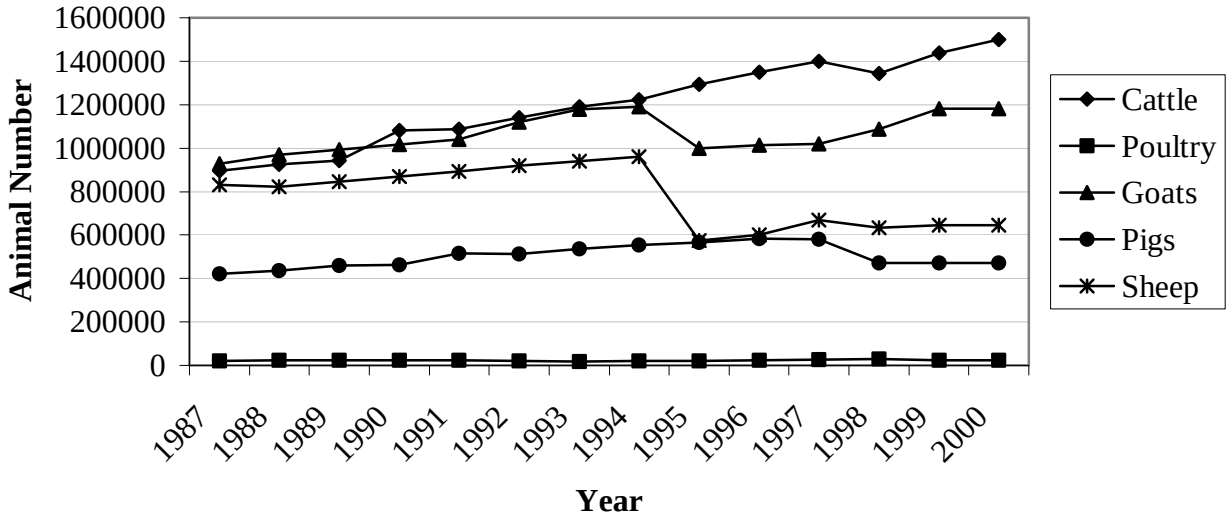



**Figure 2.5: Trend of Animal Number in Benin, 1987-2000**
Source: FAO Data Base, 2000

**Table 2.7: Fish Catch (in metric ton) in Benin, 1987-1998**

| | Freshwater Fish Catch | Marine Fish Catch | Fish Culture Catch | Total Fish Catch |
|---|---|---|---|---|
| 1987 | 21,351 | 14,196 | 6,356 | 41,903 |
| 1988 | 23,266 | 9,028 | 4,973 | 37,267 |
| 1989 | 22,626 | 11,325 | 7,909 | 41,860 |
| 1990 | 20,830 | 10,115 | 7,289 | 38,234 |
| 1991 | 19,046 | 9,374 | 6,663 | 35,083 |
| 1992 | 18,171 | 7,937 | 6,380 | 32,488 |
| 1993 | 22,698 | 8,762 | 7,761 | 39,221 |
| 1994 | 22,612 | 9,603 | 7,717 | 39,932 |
| 1995 | 27,430 | 9,087 | 7,862 | 44,379 |
| 1996 | 25,101 | 9,821 | 7,253 | 42,175 |
| 1997 | 24,375 | 12,414 | 6,982 | 43,771 |
| Mean | 22,501 | 10,151 | 7,013 | 39,665 |
| Standard Deviation | 2,646 | 1,819 | 885 | 3,684 |
| Annual Average Growth (%) | NSC [a] | NSC | NSC | NSC |

Note: a: NSC=No Significant Change
Source: FAO Data Base, 2000

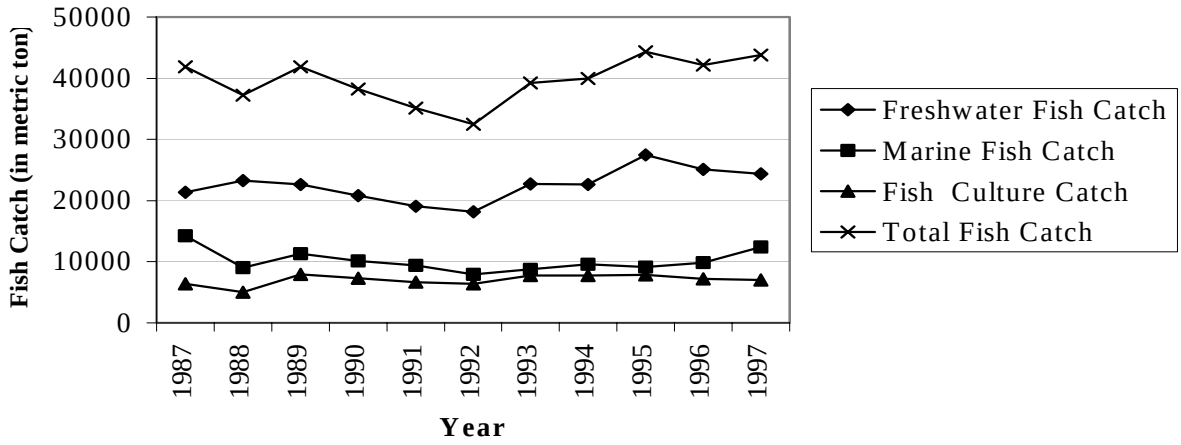



**Figure 2.6: Trend of Fish Catch (in metric ton) in Benin, 1987-1998**
Source: FAO Data Base, 2000

### 2.3.4 Weaknesses of the Sector

The previous sections illustrates that the most important weakness of the farming sector can be summarized as inefficiency. During several decades, the orientation of agricultural policy was led according to interests of political and administrative authorities and not to the needs of producers. From 1990s, the reorganization of agricultural services and the privatization of certain sector units furnished an opportunity of agriculture development. Regrettably, all these reforms are characterized by a bad managerial process with interest conflicts, which offset efforts done, and drive to low performance of the sector. For example, since the opening of the cotton sector to privates, it registered a loss of more than 5% of its added value to GDP. Besides the agricultural productivity of Benin stays one of the weakest of the less-developed countries, with an annual added value of 558US$ per worker. To take out agriculture of this pathetic state, special emphasis should be put therefore on good governance, especially during the management of rural development projects.

Additionally, agricultural production that is essentially seasonal, is confronted with multiple problems among which can be mentioned: absence of a rural land titling, difficulties of credit access, little control of water distribution (only 0.5% of total cultivated land is irrigated), weakness of mechanization and isolation of certain production zones due to inappropriate infrastructures. As regards the exports of farm commodities, there is also little diversification and development of markets, essentially, due to low and asymmetric information.

## 2.4 Industry and Service Sectors

As explained before, industry is less developed in Benin with low contribution to GDP (14%) and employment (5%) in 1998. Most of industries are manufacturing with processes of primary commodities. However, textile, bier, cement and energy industries represent some of big industries, etc. The sector experienced no notably progress in the 1980s, and the growth remains today very weak (3.4% in 1980/1990 and 3.8% in 1990/1999). However, the situation of Benin is better than other countries of Low Income Group and Sub-Sahara Africa between 1990 and 1999 (respectively 2.8% and 1.5% of annual average growth; Table 2.8).

In opposite to the industry sector, services contribute more to development (47% to the GDP). The production in the sector includes different taxes and commissions due to services. Though the sector progressed in 1990/1999 with 4.4% of annual average growth, the result remains very weak according to the sector importance (Table 2.8).

**Table 2.8: Annual Average Growth (%) of Industry and Services in Benin, Sub-Sahara Africa and Low Income Countries, 1980-1999**

| | 1980-1990 | 1990-1999 |
|---|---|---|
| Industry Sector | | |
| Benin | 3.4 | 3.8 |
| Sub-Sahara Africa | 1.2 | 1.5 |
| Low Income Countries | 5.4 | 2.8 |
| Service Sector | | |
| Benin | 0.7 | 4.4 |
| Sub-Sahara Africa | 2.4 | 2.4 |
| Low Income Countries | 5.6 | 4.7 |

Source: WORLD BANK Data Base, 2000

## 2.5 Trade and Trade Balance

The democratization and economic liberalization of the 1990s favored trade development. Even if important part is made in informal way with Nigeria, the fact remains that the biggest part of exchanges is formal and controlled by the State. The analysis of the export structure shows that cotton often contributes to more than 75%, the other products as crude oil and manufactures being marginal. Under this circumstance, the economy is always vulnerable to cotton price variation at world market level, and to overcome the situation it is necessary to develop another products for export diversification and reinforcement.

For imports, capital goods represent approximately 50%, followed by food (30%; Table 2.9). The proportion relatively raised by food import is largely due to the very low level of food technology and to the weak production of some food crops

as rice and wheat, whereas their consumption in households seems to be very important.

Exports increased since 1990, but they cannot compensate imports. Altogether, there is a deficit of trade balance, what demonstrates the weak of commercial competitiveness of the country, as it is the case for most less developed countries (Figure 2.7).

**Table 2.9: Trade Structure (US$ millions) in 1990/1999/2000 in Benin**

| Structure | 1990 | 1999 | 2000 |
|---|---|---|---|
| Total Exports (fob) | 118 | 236 | 246 |
| Ginned Cotton | 80 | 194 | 208 |
| Crude Oil | 26 | n.a. | n.a. |
| Manufactures | n.a. | n.a. | n.a. |
| Total Imports (cif) | 298 | 461 | 453 |
| Food | 78 | 141 | 139 |
| Fuel and Energy | 31 | 59 | 80 |
| Capital goods | 157 | 258 | 254 |

Source: WORLD BANK Data Base, 2000 n.a.: Not Available

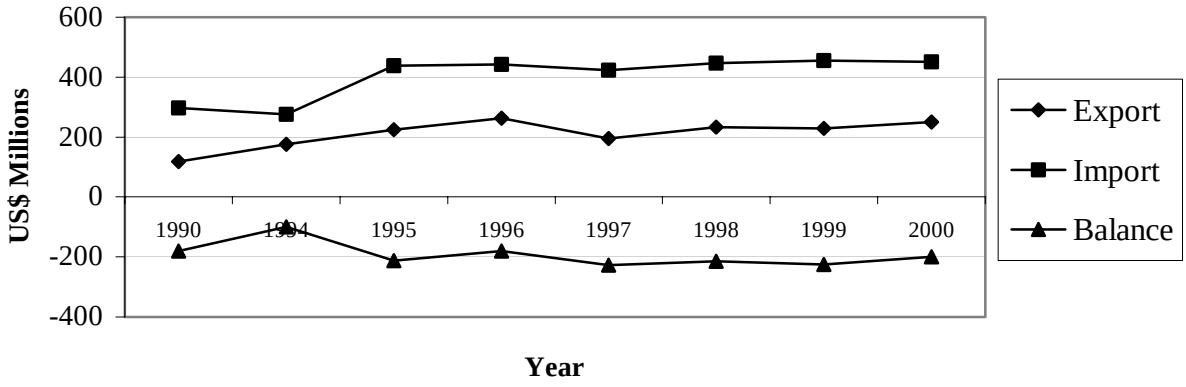



**Figure 2.7: Trade and Trade Balance (US$ Millions) of Benin, 1990-2000**

## 2.6 Employment and Revenue

The working population of Benin represents more than 47% of the total population. More than 90% of active persons are in the informal and agricultural sector. Under-employment remains high because of massive deletions of employments during these last years in public companies, trimming of work

force, end of recruitments and arrival of 160,000 young people every year on employment market. This situation, which is not shining, deteriorates every year. For instance, the unemployment rate declared in spite of reduction that the informal sector contributes to, was 12% in 1994 with a constant tendency to increase. Regrettably, the non-existence of real employment policy does not give hope to young groups.

Regarding the revenue, the level of annual incomes estimated at 113,300 FCFA (US$ 162) per capita in 1994 is characterized by marked differences between rural and urban circles, between sexes and according to activity sectors. In rural areas, they are estimated at 60,200 FCFA (US$ 86) per capita against 158,300 FCFA (US$ 227) in urban environment. The expenditure for food consumption also varies according to professional characteristics. While farmers and assimilated, workers and service staffs spend between 54% and 60% of their incomes on food consumption, the intellectual and liberal occupations spend respectively 46% and 37% of their incomes. It is advisable to add that the inflation, due to devaluation, reduced of more than 50% the real income of Benin citizen, what sometimes forces him to adaptations, which make durably his life conditions precarious (UNDP, 1999).

## 2.7 Education, Food Consumption and Health

### 2.7.1 Participation in Education

Education is very important for the development since it permits creativity and high productivity. The participation of Benin population in education has been improved since the 1980s. In particular, the primary education knew in 1997 a gross enrollment ratio of 78% of relevant age group, due to especial programs settled by the government for primary education. However, the efforts done are weak to let the student across into secondary or tertiary education, so that one observes a decline in gross enrollment ratio for them (respectively 18% and 3% of relevant age group in 1997 for secondary and tertiary educations). Such situation of education, similar in most less developed countries does not allow regrettably to high creativity, production and economic development.

Regarding informal education, the estate is worse. In rural areas, more than 60% of the population is analphabet, what constitutes the main constraint of modern technologies adoption and harms roughly agricultural productivity.

### 2.7.2 Food Consumption

Different types of food consumption can be identified according to agro-climatic zones. In the North, sorghum and millet are basic foods in wet season; maize, yam, cassava, bean and groundnut are additional, but the consumption of maize increases in dry season. Meat is rarely present in the meal, even for breeders (luxury food, intended for sale). In the center and southern, maize replaces sorghum as basic food and cassava substitutes itself for yam as additional food. Beans are consumed in small quantity but the palm oil is more frequent than in the North. Fish is consumed in fishermen's communities of the Southern and in households of coast cities (Cotonou, Porto Novo). Rice and wheat are parts of food in urban environment. According to observations collected within the framework of food program and nutritional surveillance started in 1986, the average calorie contribution was in this time about 2,100 kcal per capita daily, but there are very strong disparities because of the existence of zones and risk groups of food insecurity. In 1997, the calorie and protein available funds were estimated respectively at 2,487 kcal per capita daily (among which 906 kcal coming from cereal) and 60 g per capita daily (of which 24 g coming from cereal). According to Food and Agriculture Organization (FAO), Benin food balance (difference between supply and demand) is satisfactory since production supply covers widely the need for domestic consumption (Figure 2.8). Nevertheless, food assistant concerns on average, a year, some thousand tons of maize, wheat, sorghum, rice and vegetables for zones and groups of risk of food insecurity.

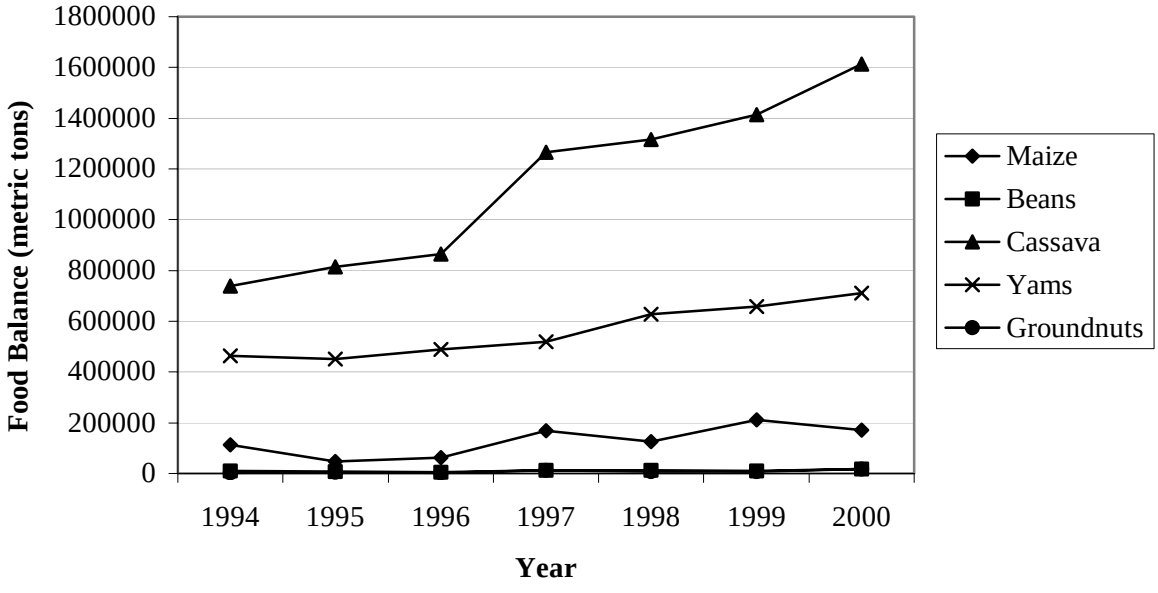



**Figure 2.8: Trend of Balance of Staple Food (metric tons) in Benin, 1994-2000**

### 2.7.3 Health

The improvement of population health constitutes the most preoccupation of the government. Indeed, the healthier the producers are, the higher the productivity is. In Benin, the majority of the population are confronted with sanitary problems notably malaria, pointed respiratory infections, diarrheic diseases, traumatism and anemia. These five affections represented to them 70% of the causes of consultation during the last five years. Other problems identified in this sector are: (1) the weak frequency of sanitary training, (2) the difficulties of accesses to sanitary cares, (3) the insufficiency of human and financial resources, (5) the insufficiency and the precarious state of sanitary infrastructures. Besides, infant and under-five mortality rates of respectively 87 and 145 per 1,000 live births in 1999 proved the very precarious health of this age groups, particularly in rural areas where access to sanitary infrastructures is more difficult. Happily, the development of especial health programs drew to notable progress. For example, the child mortality rate decreased by 30% during the last 20 years, the number of hospital beds evolved from 2,800 in 1985 into 4,300 in 1994 and the rate of consultation in modern health services crossed from 16.4% in 1985 to 35% in 1996. At the same period, the life expectancy crossed from 48.3 years in 1985 to 55.1 years in 1994. Nonetheless, actions should be pursued to get better population health.

## 2.8 Rural Development Policy and Agricultural Projects

The following section develops the evolution and the impacts of agricultural policy in Benin. It explores as well the place and role of agricultural projects in agricultural policy and rural development at the country level.

### 2.8.1 Agricultural Policy as Export Oriented

#### 2.8.1.1 Evolution of Agricultural Policy in Benin

Agricultural policy followed the government form and changed consequently. Before the 1990s, the communism option of military government led to trade monopole by the State. All the activity sectors are held and controlled by the government, which implemented a strategy for price control. The consumer protection became high while that of producer was low. With an international economic context opposite to such system, it appeared rapidly inefficient, since the International Monetary Fund (IMF) and the WORLD BANK ensured frequent pressure trough Structural Adjustment Programs (SAP).

In 1990, the dictatorial regime was abandoned and a democratization system was experimented with trade liberalization. Most of activity sectors are transferred to private operators, and the price control was little whereas the government ensured taxes and tariff for import and export. Likewise, specific program of producer's formation were settled through trainings and seminars in order to help them holding henceforth their responsibilities of production control. Although the consumer protection is low with the new system, it is reported to be efficient. In fact, export increased and the government won foreign currencies through export during the four years following the change in economic policy orientation.

During this hopeful situation of the economy, the devaluation in 1994 of the local currency with respect to that of French increased the export, but the import decreased since foreign products became more expensive (Table 2.10).

**Table 2.10: Evolution of Agricultural Policy and its Impacts in Benin**

| Periods | Form of Government or Economic Events | Agricultural Policies | Consumer Protection | Producer Protection |
|---|---|---|---|---|
| Before 1990 | Communism and Trade Monopole by the State | Intern Price Control | High | Low |
| 1990-1994 | Democratization and Trade Liberalization | Little Price Control<br>Tax and Tariff<br>Producer Formation | Low | High |
| After 1994 | Trade Liberalization and Devaluation | Export Increase<br>Import Decrease | Very Low | Very High |

### 2.8.1.2 Impact of Devaluation in Export Case

The Figure 2.9 presents the impacts of devaluation in export case on net national welfare. $P_w$ is the world market price, $P_i$ the domestic price before devaluation, $P'_i$ the increased domestic price after devaluation, $(Q_e-Q_i)$ the export quantity under $P_i$, $(Q'_e-Q'_i)$ the export quantity under $P'_i$, ES the export supply curve and ID the import demand curve. Hence, the net national welfare is computed as:

| | | | |
|---|---|---|---|
| Consumer surplus gain: | -a-b | (<0) | (2.1) |
| Producer surplus gain: | a+b+c+d+e | (>0) | (2.2) |
| Change of government revenue: | -d+h+f | (>0 or <0) | (2.3) |
| Net national welfare: | c+e+h+f | (>0) | (2.4) |

The positive producer gain proves a positive effect on producer protection and the negative consumer gain a negative effect on consumer protection. Altogether, the net national welfare is positive: the overall impact of devaluation is positive.

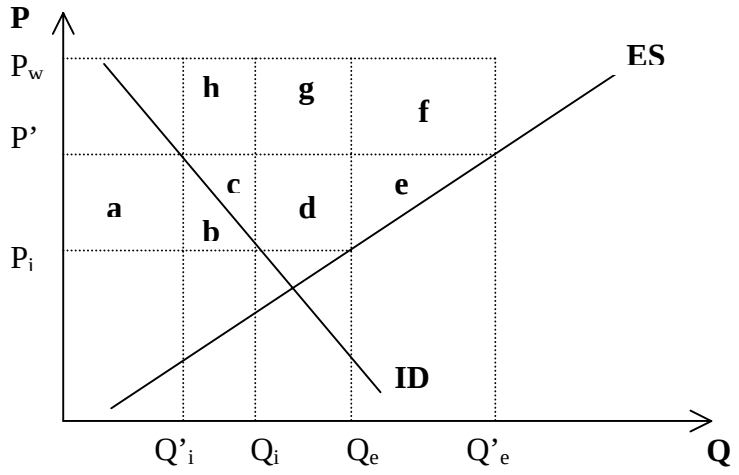



**Figure 2.9: Impact of Devaluation in Case of Export**

Even if the devaluation was expected to more build up the export and to enlarge the win of foreign currencies, the effect is lower than expected, what proves the following analysis for cotton production. Let $p_1$ be cotton price index after devaluation and $p_0$ before, $v_1$ and $v_0$ those of production inputs respectively after and before the devaluation, $Q$ the production quantity and $C$ the production cost. The Nominal Effect (*NE*) of devaluation on cotton production can be written as:

$$NE = \frac{p_1 - p_0}{p_0} = \frac{100 - 50}{50} = 100\ \% \qquad (2.5)$$

The result of 100% of nominal effect represents the expected effect of devaluation. However, such expected effect does not take into account the price variation (due to devaluation) of production inputs, which are mostly imported, what the Effective Effect (*EE*) does. Hence, considering the production costs due to inputs, the effective effect is:

$$EE = \frac{(p_1.Q - v_1.C) - (p_0.Q - v_0.C)}{(p_0.Q - v_0.C)} \qquad (2.6)$$

The estimated effective effect (*EE*) in 1996 (2 years after the devaluation) was 25%, what demonstrated clearly that the effect of devaluation is lower than expected. The fact is that the country depends more on import than export because of the deficit of trade balance. Obviously, some recent studies stress the decrease

in effective effect of devaluation and in few years there will be no-effect if no strategy is developed to enlarge the export and to improve the trade balance.

The foregoing discussion explained widely the purpose of agricultural policy established by the government. Reinforced by devaluation effect, agricultural policies are expected to improve production, to enhance export volume and thereby to increase gain of foreign currencies. In order to achieve such goals, various programs and projects are evenly promoted in agricultural sector, with emphasis on cash crops for export improvement.

### 2.8.2 Role and Political Context of Agricultural Projects

The change of the regime system in 1990 drew to a new politico-legal context of projects in particular in agricultural sector with establishment of appropriate structures and concepts of development. The famous concept of development known as the "*Minimum Common Social*" was developed in 1996 to ensure equal chance of development to socio-professional groups of the society (children, women, poorest populations, none employed persons, etc.). Through the concept and by precise development programs or projects especially in rural areas, the government aims at (1) implementing a program of intensification of management capacities, (2) developing in best the potential of human resources of the country, (3) stressing the fight against poverty; (4) promoting the integration of women to development, (5) formulating and implementing a national policy of employment and (6) intensifying the fight against environment degradation. However, it is possible to argue that agricultural projects would be designed and implemented to support agricultural policy, although the statements above are claiming officially that they are oriented toward development of rural communities.

To achieve such ambitious purposes of development, legal structures are created and kept politically under Ministries' guardianship to supervise management of programs and projects. Among them, the "*Center of Sustainable Development of Benin*" under the "*Ministry of Development Planning and Economic Reforms*" is the most important. It was created from a development cooperation between the Netherlands and Benin and has in charge execution and control of the sustainable development agreement between the two countries, as well as all related programs and projects. In addition to the center, extension services are kept under the "*Center of Regional Action for Rural Development*" under the "*Ministry of Rural Development*". Since the creation of the politico-legal structures mentioned above, the output is miscellaneous and hopeless. Even if they have helped to reinforce a good management of agricultural projects, their political characteristics offset the hope of their working. It is always reported some political

interferences that affect negatively transparency management and good governance of most of them.

### 2.8.3 NGOs and Agricultural Projects

Since 1990, national and international Non Governmental Organizations (NGOs) are legally recognized and authorized to initiate, to finance or find financial donors and to execute projects, what will accompany the government initiatives with its international partners. Since then, more than 60% of agricultural projects are reported to involve national or international NGOs. This permitted to reinforce contacts with local populations and to improve their participation intensity. In expectation of future decentralization, the NGOs are planned to play a central role because they are "apolitical". However, their internal organization and working should be improved. Indeed, most of the NGOs, in particular national would exist for satisfaction of personal interests of the promoters rather than for real development of local populations, seeing their number relatively high (more than 1,500 national NGOs are registered in Benin). Actually, respectable NGOs are very few in Benin. Some are fictive and not conform to selection criteria for implementing development activities that they take the responsibility to do, since the government control is low and inefficient. In addition, it is possible to report less than 10% of national NGOs, which follow correctly statute texts, established rules, ethic and moral behavior supposed to be guidelines of their working. To let the NGOs assuming successfully their role in decentralization context, the government has to reinforce the control, to identify and to forbid the fictive ones from working, and to support institutionally and financially the serious ones.

### 2.8.4 Producer Associations and Agricultural Projects

The democratization option brought in general free association to citizens, and in particular to agricultural producers. Hence, associations of producers are created country widely. The organization includes the "*Fédération Nationale des Unions des Producteurs* (FUPRO)" at country level, the "*Union Départementale des Producteurs* (UDP)" at province level, the "*Union Sous-Préfectorale des Producteurs* (USPP)" at district level and the "*Groupement Villageois* (GV)" at village level. In addition, it is possible to identify associations of women producers, associations for agricultural credit, association for local development, etc. The institutional progress facilitated contacts with farmers and improvement of their participation. The producer organizations, unthinkably economically powerful finance their activities by additional refund of cotton production that the government pays to them. For example, they assure distribution of inputs

production within farmers, supervise cotton commercialization and transport to industry for primary process and use the refund to satisfy their financial contribution to agricultural projects (15% to 20% of total finance). The holding of such responsibilities that the government transfers them builds and reinforces farmers' capacity of management, what is wishful for success of agricultural projects in decentralization context. However, there is a need for more institutional and financial supports from government, as well as more control since some weaknesses handicap achievement of these associations. First, they are only focused on cotton production and recent crisis in the sector heart them roughly. Second, recent studies ended to bad financial management by some association heads who turned away much money. Hence, the government support must go on controlling, training and searching ways for diversification of production and income generating activities.

### 2.8.5 Agricultural Projects and Credit Use

The most important and difficult transfer of competence that producers' associations hold remains the management of local banks for mutual agricultural credit. Former under public services control, the local banks faced bankruptcy during economic crisis of the 1990s. Through the local bank, producers can have credit of 20% to 24% of annual interest rate under specific criteria securing money recovery. Additionally, cotton producers benefit from fertilizer and insecticide credits according to their planned cultivated areas. Furthermore, some agricultural projects and NGOs donors whose activities consist of providing agricultural credit target mainly women and poor producers. Since 1990, agricultural credit has increased, and 60% are reported to be provided by development actors through projects. For instance, average credit disbursed were 1,000fcfa (1.5€) and 2,500fcfa (4€) per ha yearly in 1990 and 1999 respectively. However, the farmers complain about the weak of credit, the hardness of criteria and the inequity in loans disbursement since the richest producers are privileged. Conversely, the loan banks and donors worried about the credit recovery. For instance, the main serious problem of agricultural credit is the low money recovery (less than 50% of credit are recovered) since agricultural activities are characterized by high risk: variation of climate, negative actions of insects and predators, instability of prices, etc. Likewise, the target on only cotton production for credit attribution increases the risk of non-recovery. In reality, the local banks for mutual credit nowadays experience survival difficulties, essentially due to the crisis in cotton sector and to some opacity in credit attribution.

### 2.8.6 Agricultural Projects and Inputs Use

The distribution of physical production inputs (fertilizer, insecticides, seeds of high yielding varieties, etc.) as credit conducted to an increase in inputs use. For instance, fertilizer use increased from 1.1 kg per hectare of arable land in 1979/1980 to 21.2 kg in 1996/1998. Likewise, the annual average growth of insecticide liter used per hectare of arable land was estimated at 1,500% in the same period. However, the increase is disproportionately in favor of Borgou province (the biggest cotton growing area in Benin) with 2,500% and 2,100% of growth rates of fertilizer and insecticides use respectively. Even if the use of agricultural inputs rose, the production output stayed lower than expected. As earlier discussed, the annual average growth of yield is around 2% for most of cultivated crops and negative for cotton (-3.78%). The weak of the control of most inputs use such as required quantity, period, techniques, etc. due to low formal and informal education levels of producers could largely explain the offsetting of inputs use effort. Nevertheless, the organization of trade and distribution has played also negatively a key role. It is possible to remember the scandalous affair of inputs, which harmed roughly cotton sector. In 1998/1999, out-of-dated insecticides have been traded and distributed to farmers for cotton production, and as a result, the yield declined from 1020kg/ha in 1996/1997 to 855kg/ha in 1998/1999, i.e. a decline of 16.2%. From this the government reinforced the control of input trade and distribution, even though responsibilities are transferred to private economic operators. In addition, emphasis is put on improvement of extension service and education of producers.

## 2.9 Concluding Remarks

The economy has been improved since 1990, but the progress remains very weak. Mostly related to agricultural sector that plays a key role, the economy performance suffers from the difficult take-off of the sector. In fact, in spite of high efforts done through agricultural development projects to advance productivity, some weaknesses added to low transparency and bad governance in management offset the outputs so that the sector still is in Benin the less profitable in comparison with the group of Less Development Countries. At the same time, it is recognized low improvement of the industry sector and international trade where the balance remains negative. Hence, the contribution of agricultural projects to development of rural areas appears to be very important. This chapter outlines partially the importance of agricultural projects, while following chapters focus deeper on their impacts. However, the next chapter develops first the conceptual framework and the methodology approach of the study.

# 3 CONCEPTUAL FRAMEWORK AND METHODOLOGY

Studying agricultural projects and assessing their impacts on sustainable development appear to be a delicate exercise. The various concepts, indicators of sustainability and approaches of impact evaluation should be understood and clearly defined. A critical review of different approaches presented in this chapter provides the conceptual framework of the study with illustrations from the literature. Different definitions are given and the complexity of impact assessment as well as sustainability of agricultural projects outlined. These help to understand the objectives assigned to the study and to develop the research methodology.

## 3.1 Conceptualization of Agricultural Projects

### 3.1.1 Definition of the Concept

According to FREUD (1985), development projects are specific forms that have taken interventions of external helps in developing countries. They include finance, action, organization and coordination for economic growth. Regarding agricultural projects, they put more emphasize on improvement of agricultural productivity and in last decades on natural resources management. In addition, any project, which targets food security, education, health, capacity building and infrastructures in rural areas can be considered as agricultural project. Therefore, any development project implemented in rural area is generally viewed as agricultural project. Subsequently, this study takes into account development projects implemented in rural areas. According to their goals, agricultural projects are expected to induce in rural areas positive economic, socio-cultural, institutional and environmental impacts. These lead to sustainable development for poorer social groups or poorer regions through equity in income distribution.

In literature, various conceptualizations are done with regard to agricultural projects. Nevertheless, the study considered two conceptualizations, which are more relevant to its analytical approach: agricultural projects viewed as institutions and as supply and demand markets.

### 3.1.2 Agricultural Project as an Institution

According to the definition of the concept, agricultural project supposing an organization, can be considered as an institution. MARGOLUIS and SALAFSKY (1998) and others have for example developed the concepts of designing, managing and monitoring development projects. They considered a project as an iterative cycle, which goes through a series of steps in a process. The project starts

by the clarification of its mission and the design of conceptual model based on local conditions. After the management and monitoring, the results are used to adapt and learn for improvement, and the cycle starts again. They proved a positive correlation between quality of design, management and monitoring and success in goal achievement of agricultural projects. However the most important institutional aspect of development projects remains the factors giving such quality of design, management and monitoring, known as those of project effectiveness (Japan International Cooperation Agency, 1999).

Earlier, FREUD (1985), BIERSCHENK (1988), ELWERT and BIERSCHENK (1988) stressed that agricultural projects are executed in dynamic systems where many conflicts of interests occur and harm the quality of the management, and hence the sustainability of projects. They distinguished three pole of interests: (1) the international donors, (2) the local government and NGOs and (3) the local populations as beneficiaries. Accordingly, development will be successful only if the implicated actors try to join their different interests to build it. Regrettably, it is rarely the case. Moreover, the lack of beneficiary participation was identified as a reason for the failure of many development efforts (KARL, 2000). For instance, CERNEA (1991) reported an analyzing of 25 World Bank-financed projects that were re-evaluated several years after the financing was terminated, in order to assess the long-term sustainability of these projects. Thirteen of the projects were found to be non-sustainable. Although the primary reason was insufficient financing, the lack of farmers' organizations and participations of the primary stakeholders in project formulation and implementation was considered a contribution factor. Consequently, participation of local population in design, management and monitoring is considered this last decade as an institutional key for projects' sustainability. OAKLEY (1988) has interpreted participation along three broad lines: (1) participation as contribution, i.e. voluntary or other forms of input by rural people to predetermined programs and projects; (2) participation as organization, either externally conceived or emerging as a result of the process of participation and (3) participation as empowerment, enabling people to develop skills and abilities to become more self-reliant, and to make decisions and take actions essential to their development.

Each broad line of the interpretation of agricultural projects as institutions seems to be very important for their sustainability. Taking into account the previously mentioned discussions, this study analyses the extent and quality of project design, internal organization, monitoring and process evaluation system, and local people participation. These help evaluate goal achievement of agricultural projects.

### 3.1.3 Agricultural Project as a Market: Supply and Demand Determinants

Understanding the working process of agricultural project leads to consider it as a market product where the demand and supply determine a price. A various literature about the cost-benefit analysis by supposing a cost for agricultural project has recognized explicitly a price, a demand and a supply. The Figure 3.1 is an illustration of agricultural project market. The demand is done by local populations to improve their living conditions and to have a development chance. The cost, i.e. the price that they are willing to pay can be interpreted as: (1) voluntary or other forms of input in money or in nature for their contribution to project; and (2) political support that they give to the government through vote in the localities where democratization is established. In the other side, the government is the supplier of agricultural project through cooperation agreements or arrangements with international development institutions. The price that the government is willing to pay by providing projects to local people can be interpreted as: (1) direct payment or debt contracts; and (2) political or other forms of support that it gives governments of developed countries through international political or financial agreements. The system works exactly like in a market of product, the equilibrium price $P_0$ being established when the demand equal the supply. For instance, when the demand increases and the supply does not vary, i.e. higher need of projects for development but no change of supply, to benefit from projects, local populations are willing to pay a higher price $P_1$ by raising their participation in projects. In contrast, when the supply becomes higher and the demand does not change, i.e. no significant change of project demand for development but more supply of projects, local populations are willing to pay a lower price $P_1$' by reducing their participation in projects.

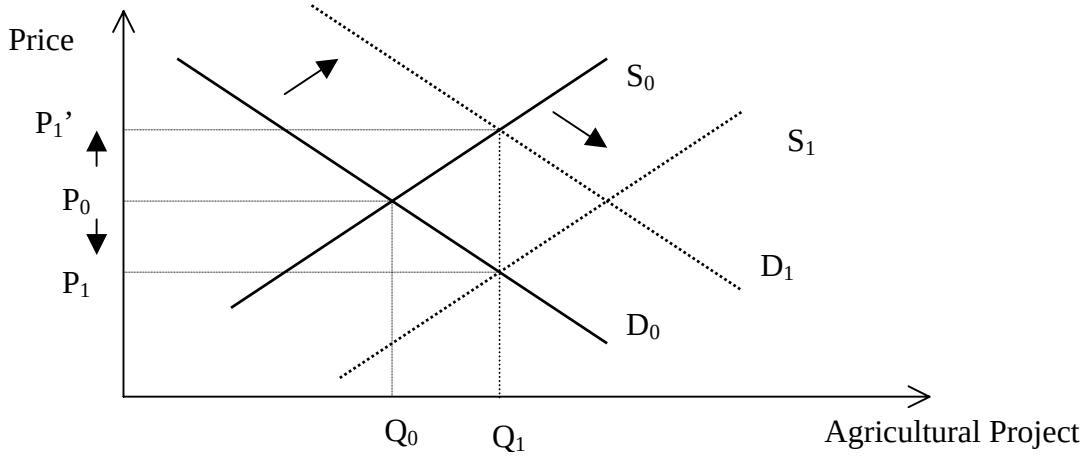



**Figure 3.1: Illustration of Agricultural Project Market**

Conceptualizing agricultural project as a product market shows two important aspects of its working and impact analysis. First, as stressed CONROY et al (1988); REIJNTNES (In FAO, 1994); and recently DANGBEGNON (1998), there are qualitative and quantitative differences between demand formulated by beneficiaries and supply provided through agricultural projects. In that case, rural populations are no longer willing to participate and the projects consequently would fail reaching their development goals. Second, according to beneficiaries the utility or benefit that they have from projects, i.e. impact on their living conditions would not weigh-off the cost, i.e. what they have paid for, so that they would reject the projects. From these, the study assesses impacts of the projects on beneficiaries and compares these impacts with development demand of beneficiaries.

### 3.1.4 Impact Evaluation of Agricultural Projects

#### 3.1.4.1 Types of Evaluation

A comprehensive evaluation is defined in the literature as an evaluation that includes monitoring, process evaluation, cost-benefit evaluation, and impact evaluation. Yet, each of these components is distinctly different.

As previously discussed, monitoring will help to assess whether a project is being implemented as planned. A project monitoring system enables continuous feedback on the status of project implementation, identifying specific problems as they arise. Likewise, process evaluation is concerned with how the project operates and focuses on problems when delivering an specific service.

Cost-benefit or cost-effectiveness evaluations assess project costs (monetary or non-monetary), in particular their relation to alternative uses of the same resources and to the benefits being produced by the project. The method is not straightforward regarding agricultural development projects. Indeed, some benefits are indirect and determination or estimation would be complex.

Finally, impact evaluation is intended to determine more broadly whether the project had the desired effects on individuals, households, and institutions and whether those effects are attributable to the project intervention. Impact evaluations can also explore unintended consequences, whether positive or negative, on beneficiaries. Regarding the study, analyses are more focused on process, monitoring and impact evaluations.

#### 3.1.4.2 Impact Evaluation as Complex Task

Recently, the debate has concerned with the self-sustainability of the projects (GTZ, 2000). As the project impact often does not remain longer after the project execution, there is a need of new appraisal approach conceptions to take into account together impacts and their sustainability. Since then, development experts showed that the capacity of development projects to ensure the Third World development is problematic. Thereby, evaluating impacts and success, regarding assigned objectives, as well as their sustainability, have become a must for any development actor today.

In one hand, seeing that the impacts and success for non-agricultural development projects are direct, their evaluation seems to be classic: assessment of economic indicators as cash flow, internal profitable rate, economic return, environmental impacts, etc. In the other hand, for agricultural development projects, the settlement of evaluation indicators is more complex since some impacts and success are indirect. Those impacts incorporate socio-economic, institutional and cultural changes of rural populations in agricultural development processes and in welfare. The Utility Analysis (UA) developed by many experts of international institutions has been mainly used for agricultural projects appraisal (KIRKPATRICK 1994; SARBECK 1994). Unfortunately, the concepts focused more on achievement of planned objectives and failed in showing the impacts on beneficiaries, and factors, which opposed the sustainability of impacts such as institutional factors, factors of behavioral change of local populations, etc. Hence, international institutions have learned that the impacts of a project are often unforeseen.

The decisive question of project success is not whether planned results have been achieved, but what results have been achieved, whether they are for all involved actors satisfaction and whether they will remain longer after the project execution, or in short, whether the project is sustainable. Actually, the success of projects is often appreciated in different ways according to involved groups or actors. For instance, a project will be a success for the government if it helps to develop agricultural production and to raise export gains. In contrast, local people would better appreciate a project, which allows them to improve their living conditions. As well, the project's team would be satisfactory if assigned objectives are relatively achieved. Consequently, the methodological approach and indicators developed to assess impacts of projects and to measure their sustainability aims at focusing on impact acceptance by different actors; however, predominantly by beneficiaries.

### 3.1.4.3 Principles of Impact Evaluation: *Before-After* versus *With-Without* approaches

By evaluating projects, the central problem is how to isolate and to estimate their impacts on the target groups. Since many other exogenous factors that are not related to the projects' execution (government policy, market conditions, former experiences, etc.) have also influence on target groups evolution, appraisal approaches of projects seem to be difficult. Literature review proposes two methods with different concepts of measurement: the *Before-After* and *With-Without* approaches. The first uses information from location where the project exists or from farmers involved in the project by comparing data on current conditions with baseline data on conditions before the project was introduced. The second compares conditions in a location where the project exists or of farmers involved in the project with another where the project does not exist.

In Figure 3.2 adapted from BAUER (2000), it is possible to show an illustration of the two approaches of project evaluation. The *Before-After* method proves an improvement of the income (B-A). However, following the *With-Without* approach, the impact of the project is negative (B-C). The positive effect of *Before-After* appraisal could be the result of other exogenous factors that influence as well the income variation.

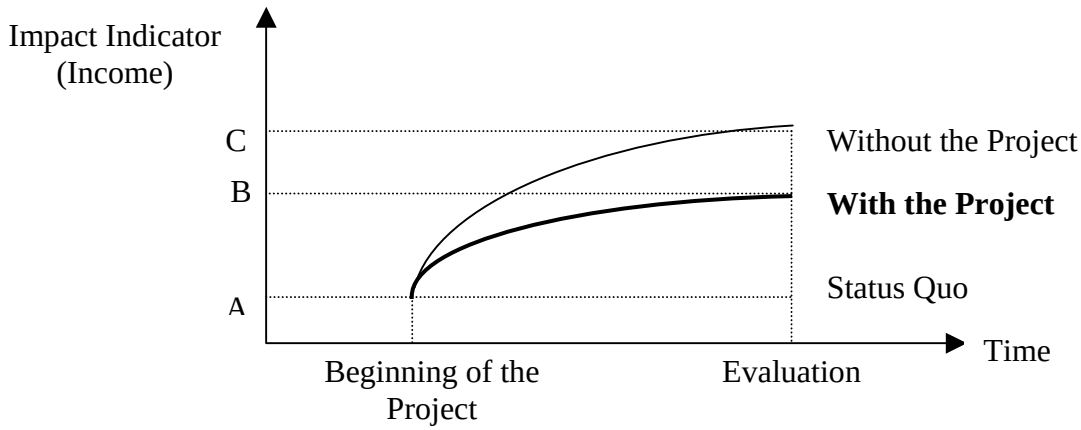



**Figure 3.2: Illustration of Project Impact**
Source: BAUER (2000)

According to KERR and KOLAVALLI (1999), two problems occur with the *Before-After* approach. First, the researcher must take care to distinguish between the development impacts of agricultural projects with that of other exogenous factors that also have changed over time. For example if the execution of the project coincided with a government policy that made greater price of agricultural products, it would be important to distinguish the effect on farm revenue under the project versus the effect of price increase. Second, with the *Before-After*

approach, often baseline data are not available. In this case, the researcher may be able to construct baseline data based on respondent's memories, but it is likely to be error-prone for many types of information, what seems to be the case in the current study. In fact, due to very low level of education, most of the farmers do not record information in conserved archives.

By isolating the exogenous influences, the *With-Without* approach is designed in a consequent way to estimate only the project impact. Besides the data availability with this approach, there will be analytical problems. In short, the researcher should select the two groups "with" and "without" so that the existence or not of the project constitutes only the difference, i.e. unobserved exogenous variables are significantly null. The key analytical challenge associated with this problem as suggested by KERR and KOLAVALLI (1999), PITT et al. (1996) is to design the sample in such a way that the "with" and "without" groups are randomized, so that there are no unobserved exogenous factors that systematically distinguish them. However, as they suggested, the study combined the two approaches to evaluate impacts of the projects. The "*with-without*" was used for quantitative analysis and the "*before-after*" for qualitative analysis.

## 3.2 Concept of Sustainability in Agricultural Production

### 3.2.1 Definition of Sustainability

The role that natural resources play upon economic growth and living standard of less developed countries was clearly proved during the last century. For example, land, forest and water constitute the most important inputs for agricultural raw material production. The issue is, however, how should we treat natural resources in order that they can make economic growth and living standard last, keeping them in being for long time, what refers to "sustainability". This aspect appeared as a new criterion and focused strongly on natural resources management and rural development.

Despite the common acceptance of this new concept of natural resources management and development, the meaning and definition differ from authors, so that the use of sustainability criterion does not contribute to a better understanding of what development is. However, the definition given by HARRINGTON (1992, p.5) could at best summarize different positions. The term in his point of view expresses the ability of an agricultural system to maintain its productivity when subject to stress or perturbation, the availability of resources over time, in particular with regards to future generations, and the continued growth in agri-

cultural productivity while maintaining quality and quantity of resources devoted to agriculture.

However, discussions remain to know if modern agriculture has or not better performance to sustain natural resources management and development than traditional one, each school developing arguments to justify its position. To give his own approach, REIJNTJES (In FAO 1994, p.22) stressed that recent studies seem to confirm that local conditions almost dictate responses to sustainability and the best systems are in general those practiced by the farmers themselves, integrating modern and traditional practices, as responses to demographic pressure, trade opportunities and disposability of resources endowment (land, labor and credit). Hence, criteria of project and development sustainability that are mainly considered in the study come from the environment of local populations.

### 3.2.2 Indicators of Sustainability

#### 3.2.2.1 Overview of Sustainability Indicators

According to the meaning of sustainability, it is difficult to define its indicators. Various studies and literature provided series of sustainability indicators for agricultural production system regarding the context. In general way, those are classified into three groups. The first group includes economic indicators, which allow measuring the economic performance of the system: productivity, economic efficiency, profit, etc. As economic activities take place in environment and drive to external effects, the second group of indicators contains environmental ones: degree of pollution, degree of degradation, etc. The environmental indicators refer to damage that the system induces to environment and which hinder the availability of resources over time with regard to future generations. The last groups take into account social, cultural and institutional aspects of the external effects on producers. For instance, if the system drives to disturbance of social, cultural and institutional arrangements in the village, it will not be longer sustainable. In following section, theories related to specific sustainability indicators are widely developed.

#### 3.2.2.2 Productivity and Efficiencies

The efficiency of input use appears to be the most important issue of economic efficiency. SCHULTZ (1964) and others have argued that, given their access to resources, peasant farmers combine inputs in a manner, which yields maximum profits. According to economic theory of production, profit maximization is obtained when the marginal profit with respect to input used is null. Let suppose for example in a purely physical concept of production function that Q denotes

the quantity of a specific output, C the related cost and π the profit. Hence, the profit function can be related to production and cost functions as:

$$\pi = Q - C = \pi(X) = Q(X) - C(X) \tag{3.1}$$

where *X* represents the quantities of a given input employed in the production process. From the equation (3.1), the marginal profit is defined as:

$$\frac{\partial \pi}{\partial X} = \frac{\partial Q}{\partial X} - \frac{\partial C}{\partial X} \tag{3.2}$$

The profit maximization drives to:

$$\frac{\partial \pi}{\partial X} = 0 \Leftrightarrow \frac{\partial Q}{\partial X} - \frac{\partial C}{\partial X} = 0 \Leftrightarrow \frac{\partial Q}{\partial X} = \frac{\partial C}{\partial X} \tag{3.3}$$

From this, the profit is maximized when the marginal production is equal to the marginal cost. Hence, discussions often switch rapidly from profit maximization to production maximization and cost minimization.

According to the work of FARRELL (1957), to maximize the profit, the producer should combine and allocate efficiently inputs of production by taking into account the production cost. He decomposed overall economic efficiency into technical and allocative components. The technical efficiency is defined as the skill of the producer to obtain maximum output from a given set of inputs while the allocative efficiency is the use of factors, given input prices, in proportion, which maximize producer profits. The diagram of Figure 3.3 shows the efficiency indices as developed by FARRELL. Farms located on this isoquant use the least amounts of inputs $X_1$ and $X_2$ to produce a unit of output. Farmers A, B and C being on the isoquant are supposed to be technically efficient, but not farmer D. The measure of technical efficiency of D is given by *OC/OD*. Given relative inputs prices, the isocost line PP' indicates the minimum cost of producing one unit of output, and so, overall economic efficiency is greatest at the point A on the unit isoquant. Since point R has the same level of costs as A, FARRELL proposed that overall economic efficiency of farm D could be measured as *OR/OD*, with *OR/OC* representing allocative efficiency. The overall economic efficiency can be hence decomposed as:

*OR/OD=(OC/OD)*(OR/OC)* (3.4)

or

Economic Efficiency= Technical Efficiency * Allocative Efficiency (3.5)

Given these definitions, farm A would be economically efficient, farms B and C would be technically efficient but not allocatively efficient, and farm D would be neither technically nor allocatively efficient.

In case of agricultural production in rural Benin, input prices are not sometimes available or are the same for different producers. The estimation of allocative efficiency appears thus complex or inappropriate. Likewise, cotton represents the most important cash crop. Thereby, by applying economic efficiency, the study focuses therefore more on impact of agricultural projects on technical efficiency of cotton production.

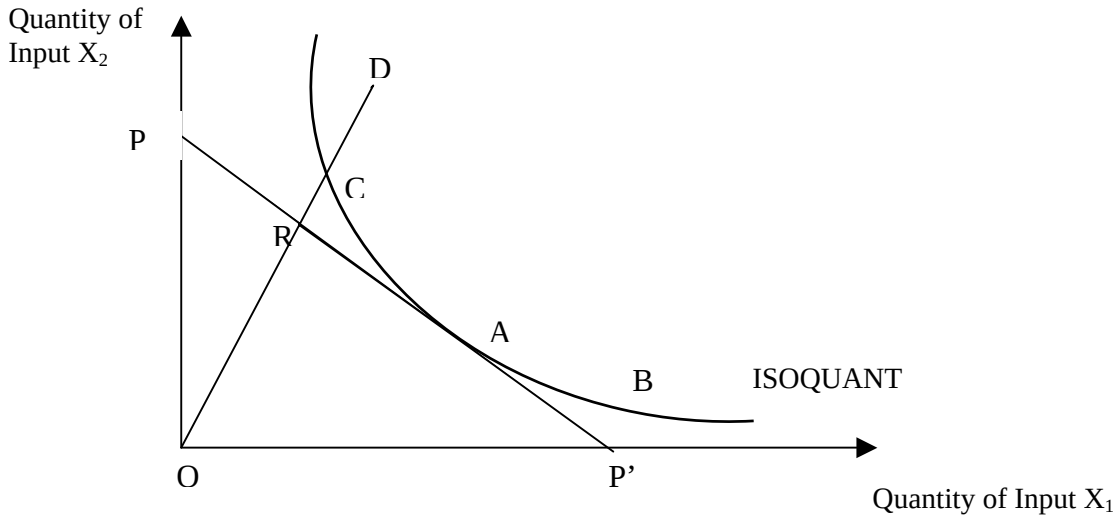



**Figure 3.3: Input-Oriented Measure of Technical, Allocative and Economic Efficiencies**
Source: FARRELL (1957)

### 3.2.2.3 Environmental Indicators

The environment progressed far less well in the development of project appraisal until recently. As argued WILSON (1997), one of the problems, of course, is that there always has been some hostility to the idea of bringing environmental concerns into project appraisal. This hostility has tended to reflect two opposite viewpoints. The first known as "development first" school of thought has tended to argue that only are environmental concerns not a priority for developing countries, but environmental regulations and investments actually as a drag on economic growth and hence on the whole process of development. A more recent manifestation of this approach has arisen with the abuse of the "environmental KUZNETS curves" (GROSSMAN and KRUEGER, 1991; CROPPER and GRIFFITHS, 1994; SHAFIK, 1994; PEARSON, 1994). The functions trace out the relationship between environmental degradation and income growth, and prove no necessary

relationship between income growth and environmental quality. The second argument against incorporating environment into development planning comes from some environmentalists who argued that the environment is somehow not the same kind of commodity as the ones we look at in investment appraisal. Another version of this school thought is that the environment is different because environmental assets have intrinsic value unrelated to any concept of anthropocentric value (PEARCE, 1994). However, some studies reported the importance of the environment and the indispensable assessment of project impact on environmental quality. For instance, air pollution studies in some urban areas suggested a focus on the transport sector rather than the traditional power station sector, although health damage from the latter can be significant but lower than that from the former. In fact, health benefits rather than economic benefits are the major item in the overall benefit of air pollution control in cities in the developing world (WILSON, 1997). Moreover, a review of over 80 studies of water quality and quantity control reveals that the projects are not economically efficient, but benefit environmentally in the way that improved water and sanitation can be expected to reduce diarrhea mortality by 55-60 per cent and morbidity by 25 per cent (ESREY, 1990). Pursuing elsewhere the same issue with respect to the conservation of renewable resources such as tropical forests, the picture is the same. Potentially, the economic value residing in conserved natural assets is huge, and including environmental concerns into impact assessment of projects is reported to be indispensable.

In rural Benin, as it is the situation in most Less Developed Countries, rather than air or water pollution, deforestation and land degradation are the most important environmental concerns that harm local people development (GBESSEMEHLAN, 1988; BIAOU, 1995; DISSOU, 1992). The study considers hence impact of agricultural projects on deforestation and soil degradation as environmental issues.

#### 3.2.2.4 Socio-institutional and Cultural Indicators

As earlier developed, sustainability does not mean only economic efficiency of production. Sustainability expresses also a long-term remaining, and for this, project impact on socio-institutional and cultural environment of beneficiaries should be positive and accepted for them.

By developing production efficiency, economics have not neglected distributive concerns. The early project appraisal manuals showed how, in principle, distributive concerns could be integrated into project appraisal through the use of social “prices” reflecting distributive weights (SQUIRE and VAN DER TAK, 1976). Indeed, many project appraisals were executed using social rather than pure

efficiency prices. That is to assess equity of benefit distribution within stakeholders.

Moreover, food security has appeared to be also an important socio-cultural indicator of sustainability, and hence of project acceptance by local rural population since small poor farmers are reported to target their production to secure food in their household. According to IFAD (2000), households are considered food secured when they have year-round access to the amount and variety of safe foods their members need to lead active and healthy lives. Thus, household food security has three key dimensions, the availability of food, access to food, and utilization of food on which impact assessment of agricultural projects should focus.

The healthy live provided by food security drives to human capital known to be an important social indicator of sustainability. The word includes education level, health, skill of decision taking and management, etc. of project stakeholders. Hence, the capacity of projects to build human capital took a key place in impact assessment of agricultural project. More widely, it is pointed out to development actors that projects should be designed and financed to build local capacities and to develop the ability of local people to manage and negotiate themselves development activities, i.e. institutional and empowerment supports (CLAYTON et al, 1998; UPHOFF, 1989 and MCALLISTER, 1999). The capacity building is viewed as very important for sustainable development and many institutions such as GTZ, WORLD BANK, UNDP, etc. have oriented their supports toward more technical assistance to achieve better capacity building of local people.

Accordingly, this study tries to assess impact of agricultural projects on food consumption and capacity building of local people considered as the most important socio-cultural and institutional indicators of sustainability. In particular, the capacity building is held in the study as key indicator for sustainability of the projects.

## 3.3 Sustainability of Agricultural Projects

The previous section has outlined what sustainability means in agricultural production and rural areas that the projects are expected to develop. This section completes the discussions by explaining and exploring conditions for sustainability of agricultural projects. These help to draw the conceptual framework of the study.

### 3.3.1 Impacts of Agricultural Projects on Production Sustainability

Many studies explored the impact of agricultural projects on sustainability. In Central America, a number of agricultural projects have promoted soil conservation or soil recuperation technologies that were benefit for the farmers through increase in productivity (BRUNCH, 2001). Likewise, the study of DOPPLER and BOTHE (1999) showed that the adoption of *Cassia siamea* in rural Benin improved the soil fertility and agricultural productivity and led to an increase in the overall family income. This helped to reduce poverty of many rural farming households. As a result of increase in productivity and income, food security knew also improvement.

According to FAO database, increase in agricultural productivity and in income over years due to agricultural projects has undoubtedly raised food availability and kept food prices low, providing critically important benefits for extremely poor households that spend more than half their income on food (KERR and KOLAVALLI, 1999). Arguing in the same way, the International Food Research Institute (IFPRI) reported that the project "Improving Food Security in Bangladesh" implemented since the 1980s permitted to increase in significant way availability of and access to food in Bangladesh rural areas (IFPRI, 2001). In countries where starvation is disastrous for rural people, various implemented agricultural projects allowed to avoid malnutrition diseases and death, mainly for children. For example, the International Development Research Centre (IDRC) found that 30 projects implemented in Ethiopia that focused on agriculture and water management saved more than 25% of rural communities from starvation, malnutrition diseases and death. As regard reinforcement of capacity and skill of rural communities, a statistical analysis of 121 rural agricultural projects in Asia, Africa and Latin America, supported by 18 international agencies, found that their implementation have strengthened community organizations and the acquisition of new skills. Women empowerment has been benefit for gender issues in many cases (RUDQVIST and WOODFORD-BERGER, 1996).

The foregoing discussion shares idea that agricultural projects, in general, induces somehow positive impacts on local people during their implementation. This shows an optimistic view of technology adoption leading to poverty alleviation through positive effects on consumers' food prices, producers' incomes, and laborers' wage incomes. In this scenario, higher productivity, better natural resource management and poverty alleviation are mutually reinforced and lead to achievement of a sustainable food system (WINKLEMAN, 1998).

In contrast to optimistic point of view above, the pessimist one sees the overall process of project implementation and technology adoption in agriculture biased

towards wealthy people so that the poor are made worse off. The rich get richer while the poor get poorer, and the result is social unrest and a decidedly unsustainable food system. The key relationship according to this framework is that technologies, policies and institutions are biased in favor of wealthy farmers who have unequal access to assets to begin with. Their incomes rise when they adopt the improved technologies while poorer, non-adopting farmers' incomes fall, many agricultural workers are displaced, and some of those who remain suffer from overexposure to poisonous chemicals (WINKLEMAN, 1998; KERR and KOLAVALLI, 1999).

### 3.3.2 Sustainability of the Impacts

The sustainability of impacts appears nowadays the most important issue that development actors have to deal with. In general, after the termination of a project the impacts do not remain longer due essentially to cessation of adoption of technologies diffused by the project. According to KOTTAK (1991) who analyzed ex post project evaluations of the World Bank, the most significant reason explained the non sustainability of the impacts was that attention to socio-cultural issues of beneficiaries were neglected during implementation. He found that impacts of projects that were socio-culturally compatible and based on an adequate understanding and analysis of the social conditions remains longer after the termination of the projects. The arguments of KOTTAK calls for the conclusion that as far as project implementation meets socio-cultural conditions of the stakeholders, they will be involved in and will adopt the modern technologies diffused. Thus, the impacts will remain and sustain, may be after the termination of the project.

In their studies, LANGYINTUO (1996), GLEHOUENOU and GALIBA (1996) and SAMANTHA (2001) proved the positive correlation between satisfaction that the stakeholder has concerning production, household consumption and soil fertility and his participation in agricultural project. They also concluded that human capital of the farmer, availability of and access to production inputs affect in significant way the decisions of participation in projects and adoption of modern technology. Besides these previous factors, agro-ecological conditions influence the availability of and the access to productive inputs, which at the end determine the possibility of participation and technology adoption (HEERINK et al, 1996).

As far as those factors affect the decision of participation in projects and technology adoption, they will be undoubtedly key factors to consider for sustainability of the impacts. From this, the conceptual framework developed for

the study aims at understanding not only goal achievement and impacts of agricultural projects, but also the key factors for the impacts' sustainability.

### 3.3.3 Conceptual Framework of the Study

According to GTZ (2000) and various development institutions, an agricultural project is sustainable if it provides positive impacts, which remain for long-term even after the project termination. Therefore, the concept does not mean the project is implemented indefinitely, but during a planed time with positive impacts, which remain for long-term after the project termination. From these, sustainability of a project may depend on two interrelated aspects. First, through participation of local people and goal achievement, agricultural projects affect production systems, consumption pattern, institutional arrangements, natural resources management, human capital, etc. of beneficiaries. These are viewed as their impacts on sustainability of agricultural production and rural areas development. As feedback, the beneficiaries judge the projects from opinions of satisfaction with the impacts, and decide whether they could or not continue to participate and adopt modern technology that are popularized and diffused. These two aspects are required simultaneously, and taking singly, any of them may be necessary but not sufficient for sustainability of agricultural projects. For instance, an efficient project with positive impacts may not be sustainable if the beneficiaries think the project solve little their development problems and lower thereby their participation. Likewise, high participation of local people may not necessary lead to full goal achievement and positive impacts of a project. Actually, the system works like 3 cogged wheel training each other: (1) good design, management and monitoring, which provide high goal achievement are expected to induce positive high impacts, (2) the impacts are expected to enhance participation of beneficiaries and (3) continuous high participation is necessary for high efficient management and goal achievement to produce continuously positive high impact, and the system starts again until termination of the project. When failure occurs in one of the 3 processes, sustainability may not be any more achieved. From these, the conceptual framework of the study is drawn to analyze and evaluate on one side quality of design, management and monitoring, as well as goal achievement and impacts of the projects, and on the other side to identify factors that affect participation and adoption decisions of beneficiaries (Figure 3.4), recalling the study objectives described in Chapter 1.3.

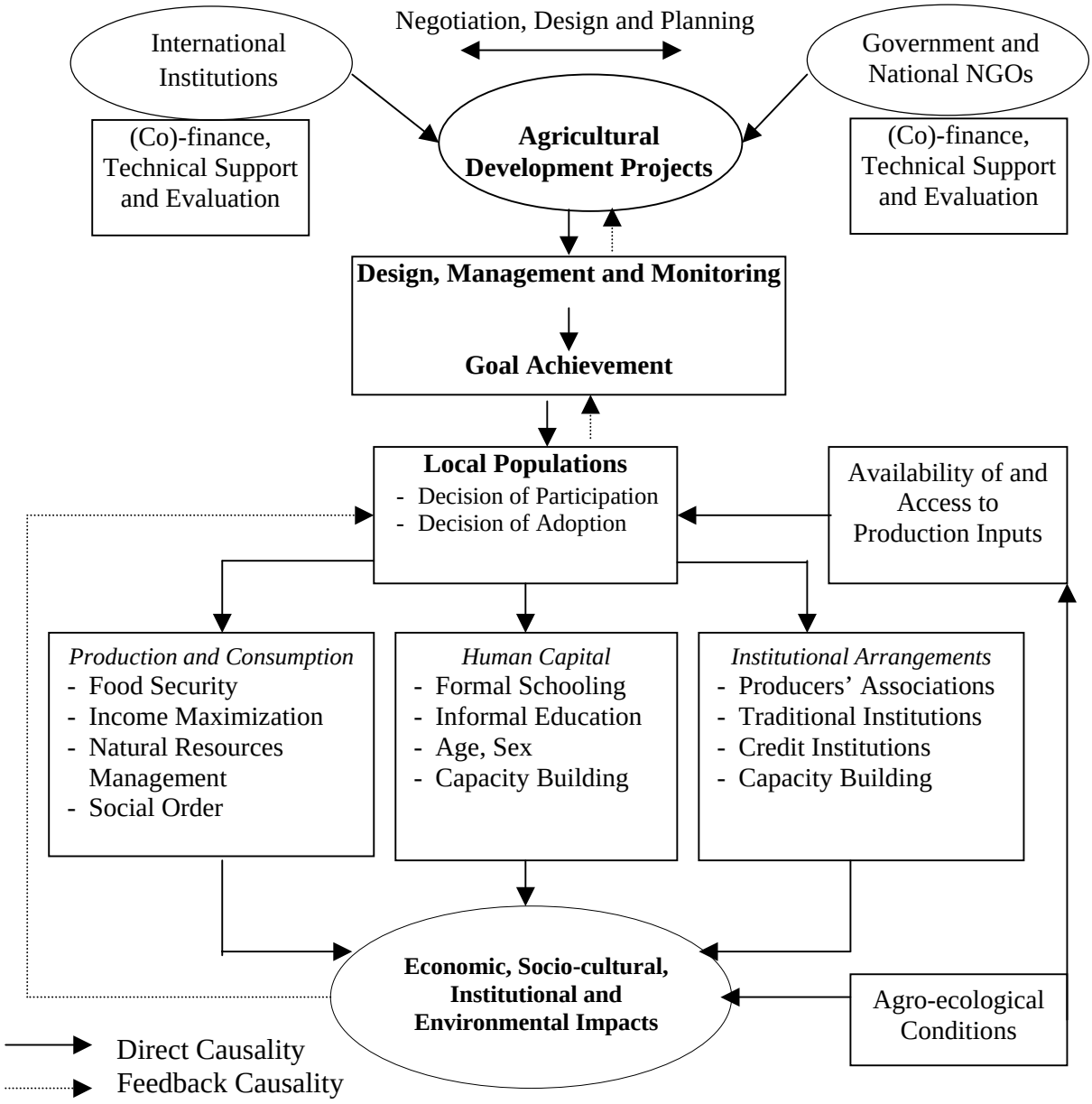



**Figure 3.4: Conceptual Framework of the Study Illustrating the two Interrelated Aspects of Agricultural Projects Sustainability**

## 3.4 Methodological Approach

### 3.4.1 Methods for Impact Evaluation

Methods for impact evaluation found in the literature were more based on the *With-Without* principle of evaluation. They included systematic comparison, indicator trend function, econometric models and more complex system modeling (BAUER, 2000).

#### 3.4.1.1 Systematic Comparison

The systematic comparison consists in comparing systematically for a development indicator the "*with*" group with the "*without*" group to show differences, which express the project impacts. Regarding agricultural projects, sustainability indicators would determine the indicators of comparison. Furthermore, the comparison can be done at plot (parcel) level, at producer or household level or at village or region level by taking into account the "*with*" and "*without*" items. Various statistical analyses such as Mean Comparison, Analysis of Variances (ANOVA), Discriminant Analysis, Factor Analysis allow to complete scientifically the comparison and to have reliable conclusion.

According to BAUER (2000), the systematic comparison does not provide reliable results in following cases:

- when all the groups are similar and participate in the project. In the case, isolating the "without" group seems to be difficult.
- when the groups are relatively similar according to the indicators chosen for comparison. If the impact of the project is not enough adequate to induce systematic differences regarding the indicators of comparison, the method will not furnish reliable results.
- when the overall effects of a set of project is relatively marginal in comparison with another influence factors.

#### 3.4.1.2 Indicator Trend Function

This method consists in estimating a trend function from data of observation periods before the project implementation. By supposing that the indicator evolution without the project will be the same as in the past, the estimated trend function constitutes therefore a comparison reference for the duration of the project impact. The function forms of the trends can be linear, logarithmic, exponential, etc. If the "with" and "without" groups are good selected, no significant difference between the trends appears before the project implementation. During the execution period, the difference between the trends gives the impact of the project (Figure 3.5).

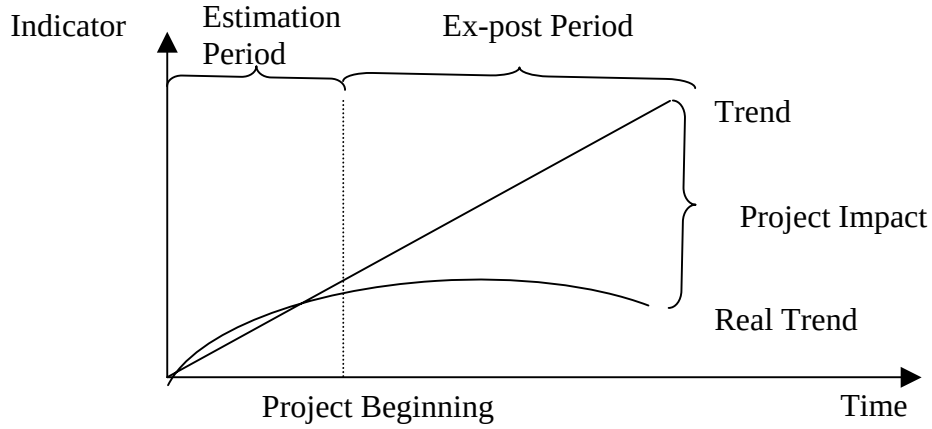



**Figure 3.5: Principle of an Oriented Trend Determination of without Reference Situation**
Source: Bauer 2000

BAUER (2000) stressed however that the method is more appropriate to aggregate indicators (regional level), which are relatively stable in their variation over time. For small regions, small-scale households or fields, related indicator change strongly in the development process due to influence of another factors. In the case, the difference between the „with“ and „without“ trends becomes more complex to appreciate and the method less suitable.

### 3.4.1.3 Econometric Models

Econometric Models allow also estimating impact of project. They give variation explanation of a development indicator considered as dependent variable. In the case, explanatory factors include as well those related to the project implementation. The general mathematical forms of the models can be expressed as:

$$Y= f(X_1, \ldots X_n, P_1, \ldots P_k, e) \quad (3.6)$$

where, e is the error terms supposed to be a $N(0,\sigma^2)$.

Y is a development indicator. In case of farming households, Y can represent farm income (€ or fcfa), productivity of land (kg/ha), food consumption quantity (kg/capita), land degradation or nutriment loss (kg/ha), etc. $X_1$, …, $X_n$ are explanatory variables. For example production inputs, economic, social or human capital variables, etc.

$P_1$, …, $P_k$ are variables of factors concerning the project implementation. They can be quantified in various ways. For example, it is possible to define a dummy variable D of indicator of participation in the project. Thus, D=0 for the “without”

group and D=1 for the "with" group. The impact of the project is directly estimated through the regression coefficient of these variables. However, attention must be paid on theoretical aspects of econometric models, as it will be developed later.

#### 3.4.1.4 Complex System Modeling

The participation of producers in agricultural projects will have a range of effects on farm profits, employment incomes, food consumption, soil degradation, socio-cultural and institutional environment of local population. Some of these effects are direct and immediate while others are indirect and take time to be realized through feedback effects from one part of the system to another.

The literature provides a variety of more complex modeling approaches useful for analyzing the effects of projects and technical change on stakeholders' development. The models are based on microeconomic theories and take into account the interactions between sectors of the economic system. Besides, they are applied for the "*without*" and "*with*" groups and the interpretation of the empirical results leads to assess the impacts of agricultural projects. This section discusses a variety of more complex modeling approaches useful for analyzing the effects of agricultural projects. It draws heavily on SINGH, SQUIRE and STRAUSS (1986), SADOULET and DE JANVRY (1995), and ABIASSI (2002) where more details can be found.

- *Household Models*

In standard economic theory, decisions regarding agricultural production, food consumption and labor allocation are analyzed separately. The basic micro-economic models for each of these activities are characterized as follows: (1) Utility maximization instead of profit maximization, and (2) Optimal allocation of labor to farm production, off-farm activities, household activities and leisure. The household model combines these two processes into a model in which the household maximizes utility subject to the joint constraints of production functions, the budget and the available resources. The key assumptions of the model are that there is a trade-off between home time and the consumption of goods, which require income and labor time to produce.

The specification of the household unit varies by culture; it can range from single-family unit to an extended family network of the common type in Sub-Saharan Africa. In addition, according to ABIASSI (2002), standard household models assume there is only one decision-maker, or that everyone in the household shares

the same objectives and interests (unitary household models). However, other various authors developed the so-called collective models of household decision-making. Known moreover as pluralistic decision-making models, they are distinguished from unitary models in that they try to capture the different preferences, conflicts and inequalities evolving among household's members.

By modeling household, many assumptions are based on input and output markets. Thus, the use of household modeling can be divided into two distinct situations: (1) when all markets operate efficiently, and (2) when at least one important market fails.

When all markets work efficiently, production and consumption decisions are linked only through the level of farm income achieved through production. Decisions regarding each can be seen as separate and sequential: the household produces as much as possible and then makes consumption decisions based on the resulting net income. Solving the household model yields different elasticities with respect to different prices (food price, wage rate, etc.).

The situation becomes more complex when markets fail. With credit market constraints, risk and risk aversion, high transaction costs and shallow local market, prices bands widen between what the household would pay to buy a commodity or service and what it would receive by selling it. After a point, the commodities effectively become non-tradable and the household becomes self-sufficient. The household's production and consumption decisions are no longer made separately. Rather, the household behaves as if there was a market for the good within the household. Factors conditioning the household's demand (as its consumers) and supply (as its producers) determine the commodity's opportunity cost or shadow price.

Under assumptions and market conditions described above, household models exist and are essential in theory. In practice, however markets do not exist or market fails and the price bands mentioned above are large for some agricultural inputs. That is the case of labor in Sub-Saharan Africa where mutual labor helps reducing hired labor. Similar case is for land because in rural areas it is considered as non-tradable good. It is therefore evident that using household modeling would be complicated and would give results remote from household realities.

- *Social Accounting Matrices (SAMs)*

While the agricultural sector is closely linked to other economic sectors, economy-wide or multiple-market analyses are needed to trace both direct and

indirect feedback links across sectors. A Social Accounting Matrix (SAM) is an economy-wide model that tracks all kinds of transactions among sectors and institutions. According to SADOULET and DE JANVRY (1995), it is consistent, meaning that for every income in one part of the economy, there is a corresponding outlay or expenditure in another, and it is complete, meaning that the two parties in every transaction are identified. Through this simple approach, the SAM captures linkage between sectors and calculates multipliers related to both production and consumption. Applications of the SAM include examining income distribution effects of policies or economic shocks, and predicting how growth in one sector will affect another, etc. SAMs are usually built to represent entire country economies, but they can be done for a region within a country, or even a village. They can therefore help to assess impact at country, region or village level.

Traditional SAM models are based on the assumption that production activities are endogenous and demand-driven. This assumes the existence of excess capacity throughout the economy. However, this assumption is not realistic for agriculture, in which production is constrained by available land, seasonal labor shortages and weather. Elasticity of supply is infinite in some models, so there is no or only limited price response to increasing demand for factors.

- *Multi-market Models*

Multi-market models incorporate elasticities based on production and consumption functions (technical and economic relationships). This means that they can be used to relate the percentage change in a set of endogenous variables (such as prices and quantities) to a percentage change in a set of exogenous variables, given a set of underlying parameters (such as elasticities and shares). Analysts can use such models to simulate the effects of change in economic policies or in agricultural technologies through participation in projects on economic outcomes such as commodity supply and price or employment and wages. In order to trace the effects on income distribution, consumers and producers can be disaggregated into different categories such as large farms, small farms and laborers, or poor and wealthy urban consumers.

The use of elasticities and market specifics in Multi-market models is an advantage over SAMs, but one limitation is that they focus only on one activity sector. Unlike economy-wide SAMs, they cannot estimate multipliers and do not guarantee macro-economic consistancy.

- *Computable General Equilibrium Models (CGEs)*

Computable General Equilibrium models (CGEs) attempt to contrast outcomes of projects in "with" and "without" groups through simulations. These models that combine different aspects of SAM and Multi-market models, seek to trace the operation of the real economy and are generally based on data collected from national accounts, household expenditure surveys, and other survey. CGE models do produce outcomes for the counterfactual, though the strength of the model is entirely dependent on the validity of the assumptions. This can be problematic as databases are often incomplete and many of the parameters have not been estimated by formal econometric methods. CGE models are also very time consuming, cumbersome and expensive to generate.

### 3.4.2 Methods for Estimating Factors of Participation or Adoption

Throughout the history of agricultural development, projects and innovations they diffused have always had a profound effect upon farming systems. Participation in projects and adoption of agricultural technology by producers revolved around the basic needs of improving their conditions of production. Futhermore, modern technologies are expected to raise productivity and farm income. Based on this premise, it is often assumed that farmers would always participate in projects and adopt new technologies that lead to increased productivity and higher income levels. However, various other factors are proved to influence adoption of modern technology and hence participation in agricultural projects which ensure their diffusion. The literature furnishes various methods that can be used to estimate factors determining participation and adoption of modern technology.

Earlier analyses consisted of suspecting some factors supposed to have influence on participation or adoption. According to the statistical context, simple descriptive tools were used to estimate the relationship between those factors and participation or adoption: Chi-square test of independence, rank correlation or Pearson correlation Coefficient (MORRIS, TRIPP and DANKYI, 1999; WIEN and SOBRADO, 1998). The completed results allowed to identify factors with significant correlation and as well the relationship sign (positive or negative). However, the analysis ended only to identify the factors. It provided no knowledge concerning the degree of influence or how much varies the participation or adoption when the factors increase or decrease.

Recent studies introduced econometric regressions to overcome weaknesses enumerated above. The models related participation or adoption variable to variables of affecting factors. Mathematically, the models are expressed as:

$$Z = g(X_1, ..., X_n, e) \quad (3.7)$$

Where, Z is participation or adoption variable. Usually, Z is defined as a dummy variable with Z=0 if no participation or adoption and Z=1 if participation or adoption. Likewise, Z can be expressed as the participation or adoption probability. X1, …, $X_n$ are variables related to participation or adoption factors (farm income or education level). In the case, those factors are supposed to be exogenous. The error terms *e* are supposed to be a $N(0,\sigma^2)$.

The model form can be linear or non-linear. The common use of non-linear forms is linear probability, probit and logit models (HONLONKOU, 1999; ROBERTS, ENGLISH and LARSON, 2002). The running of the models provides regression coefficients whose analysis allows to conclude if the factors influence or not significantly participation or adoption and to estimate the influence degree. Regrettably, the use of econometric model to estimate factors is subject to two main problems. First, the supposition that the factors explain participation or adoption so that the influence is done in a single way, exist only in theory. In practice, the relationship between the factors and participation or adoption can be established in the two senses. For instance, income of a farmer is supposed to influence positively participation or adoption, but this latter may have also effects on income. Second, there are as well interactions (correlations) between the factors and some are endogenous while depending on another factors. Actually, participation or adoption is done in a complex system where direct and indirect causality effects play key roles. A single regression model fails in the way that it cannot take into account the overall direct or indirect causality effects.

The Structural Equation Modeling (SEM), which provides estimates of the strength of all the hypothesized relationships between variables, comes out as the appropriate method of estimation of direct and indirect causality effects involved in participation and adoption issues. The roots of the SEM go back to the 1920s, when SEWELL WRIGHT, a geneticist, attempted to solve simultaneous equations to disentangle genetic influences across generation. The use of the model became thus common in social sciences (MARUYAMA, 1997) and was as well extended to other sciences. Subsequently, the SEM represented one of the most important frameworks of the methodological approach used in the study. In a SEM, there is a need of constructing theoretically variables that are not measured. For this, instead of estimating formally participation and adoption factors, the study proposed to construct theoretically the variables "*participation decision*" and "*adoption decision*" and to estimate hence factors affecting them.

### 3.4.3 Methodological Approach Used in the Study

While appraising sustainability of agricultural projects, care is needed to develop a methodology, which may take into account simultaneously the two important interrelated aspects of sustainability outlined in the conceptual framework. First, efficient management and goal achievement of the projects as well as their impacts on production and rural development sustainability should be evaluated. Second, factors affecting participation and adoption decisions of beneficiaries should be identified and estimated for long-term durability of the impacts. In the case, the methodological framework have to combine *etic* (researcher point of view) and *emic* (beneficiaries point of view) approaches as suggested DE GROOT (1997), MAXWELL (1998), and DUNN and ARBUCKLE (1999).

Using more complex system modeling to evaluate sustainability of agricultural projects may give two ranges of weaknesses. First, the models are applied with many assumptions related to modern economy theories that are not actually relevant to local rural people, rather remote from them. Consequently, impacts assessed are not really that stakeholders may observe regarding their socio-economic realities and development problems. Second, the underlying models are mostly of *etic* and rarely of *emic* approach because it seems difficult to incorporate in the models point of view of local people.

Following the foregoing discussions, the methodology approach developed for the study combines both *etic* and *emic* approaches, as well as at the same time both quantitative and qualitative analyses (Figure 3.5).

The first part includes descriptive statistics such as frequencies, histograms, means, standard deviation computed to determine the distribution of variables. Likewise, chi-square coefficients and correlation coefficients are estimated to appreciate relationship between variables, and Analysis of Variance (ANOVA) to compare means of groups of participation in projects. This part helps also to analyze and evaluate goal achievement of the projects, as well as related factors (Objective 1 and Hypothesis 1).

In the second part, econometric models are used to estimate impacts of projects on productivity, technical efficiency, food consumption, and soil degradation. (Objective 2 and Hypothesis 2). By using in the models contact and goal achievement indexes evaluated in the first part, the study expected to explore how improvement on design, management, monitoring and goal achievement of the projects could induce change in impacts at beneficiary level.

In the third part, the Structural Equation Modeling (SEM) is developed to estimate decisions' factors of participation and adoption as feedback opinions of

satisfaction with design, management, monitoring, goal achievement and impacts assessed in the first and second parts (Objective 3 and Hypothesis 3). From these, key factors for sustainability of the impacts are identified. Moreover, linkage with the previous parts is done by analyzing effects that various scenarios with respect to improvement on design, management, monitoring, goal achievement and impacts may have on participation and adoption decisions.

Finally, qualitative analysis helps to strengthen the quantitative study findings. In particular, it estimates effects of the projects on capacity building of beneficiaries. Besides, it provides opinions of local people about activities of the projects, their impacts and usefulness.

Nonetheless, the methodological approach presented above does not describe very deeply the different models and qualitative tools used. The basic assumptions, the structures and mathematical formulations as well as the estimation procedures related to their use are discussed later in associated chapters.

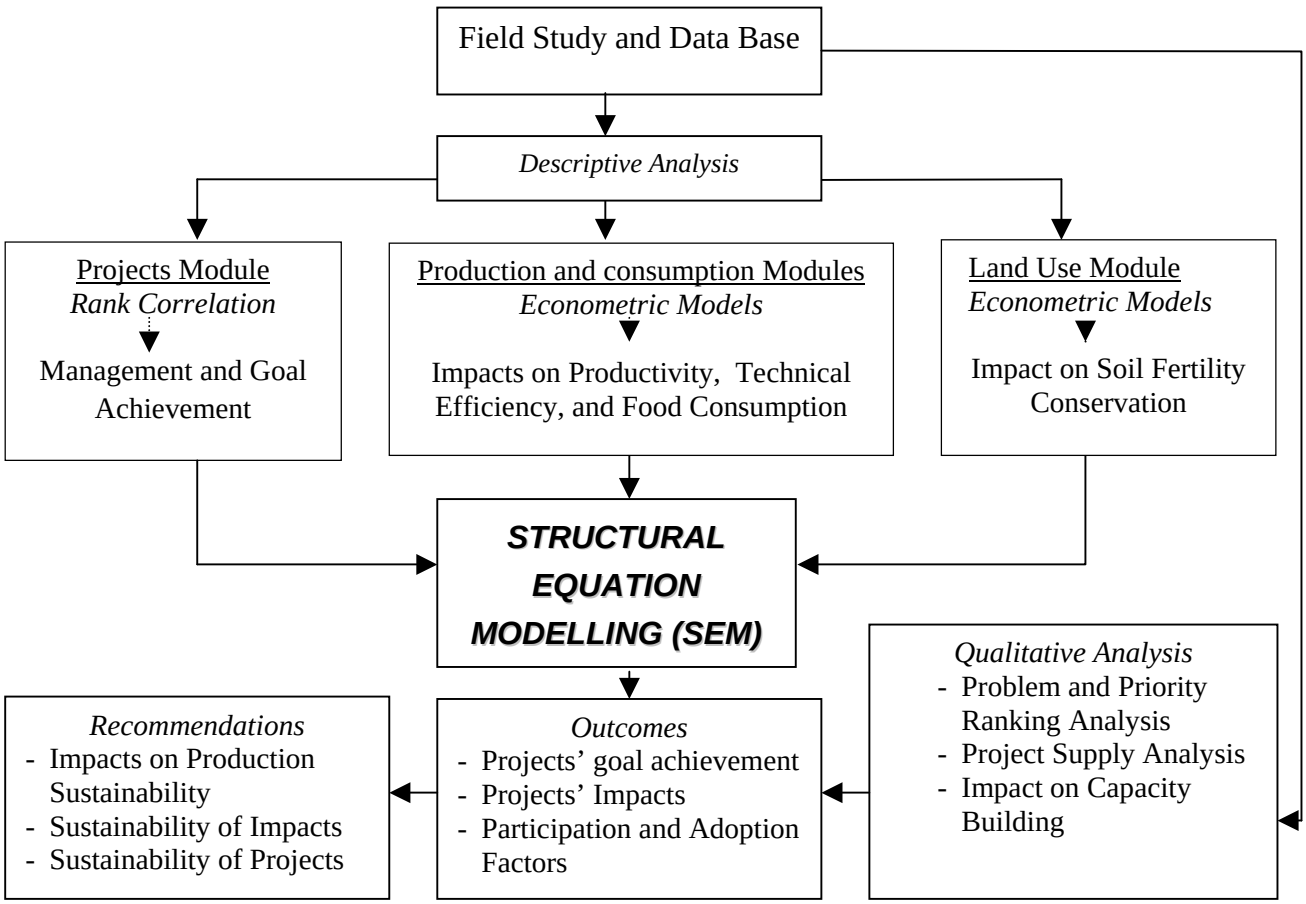



**Figure 3.6: Illustration of the Methodological Approach Used in the Study**

## 3.5 Concluding Remarks

The discussion above leads to better appreciate what concerns to take into account when studying agricultural projects and assessing their sustainability. It is possible to recognize that the exercise is not easy and needs care to develop appropriate methodology. While sustainability of agricultural projects means simultaneously good design, management and monitoring for better goal achievement, positive impacts on production and rural development sustainability and long-term durability of the impacts, the methodological approach developed for this study takes into account both goal achievement and impacts evaluation, as well as estimation of adoption and participation decisions' factors for sustainability of the impacts.

# 4 FIELD STUDY AND DATA BASE

As explained in the previous chapter, measuring the impacts of agricultural projects and assessing their sustainability is a complex assignment. The study approaches have to sort out the indirect, complex relationships and attribute causality among numerous factors. This chapter outlines the field study and building of data base. It includes the choice criteria of agricultural projects, the description of the selected projects and the study zones as well as the sampling of research items. In addition, some approaches used for data collection are presented, the focus being on minimizing errors due to collection techniques.

## 4.1 Choice of the Agricultural Projects

### 4.1.1 Choice Criteria and Process

The choice of the agricultural projects has been done after a preliminary exploratory phase through many regions of Benin. Thirty (30) projects were identified, but some are at the beginning. Likewise, not all were willing to open up to give relevant and precise information about the impacts of their activities on sustainable development. Therefore, the following main criteria have been used for rational choice: (1) the type of projects (main activities, financial sources, approaches and strategies); (2) the number of areas socio-culturally homogeneous concerned by the project; (3) the execution duration to better identify impacts and factors of sustainability, (4) the availability degree of information regarding the project's activities. These defined criteria led to select twenty (20) agricultural projects whose main characteristics are described in the following section.

### 4.1.2 Description of the Selected Projects

This section describes the selected projects to help readers appreciate the types of projects this study deals with. Emphasis was put on types of activities, organizational structures, funds amount, participatory approach and institutions financing the projects (see also Appendix 1 for complete description of each project).

#### 4.1.2.1 Types of Activities

The selected projects completed various types of activities. The typology presented in Table 4.1 shows, on one side, that high proportion of the projects (75%) targeted a single activity. Among single activity projects, 53.33% were in agricultural production and natural resources management, 20% in food security, 13.33% in education and training of beneficiaries and 6.67% in credit and health. Projects involved directly in agricultural production and natural resources

management dealt mainly with diffusion of modern technology to protect soil against erosion and degradation in order to improve agricultural productivity. They also organized commercialization and distribution of production inputs, as well as transportation and commercialization of outputs. Nevertheless, projects of single activity combined the single activity with various secondary activities to better achieve their objectives. For instance, projects in agricultural production and natural resources management provided also credit, education and training for beneficiaries. Likewise, food security projects ensured distribution of production inputs to improve productivity of crops they emphasized for food security. They also built infrastructures such as rural roads to facilitate transportation, availability and access to food crops. However, these secondary activities are given less importance in terms of time and funds, as compared to the focused activity.

On the other hand, integrated projects, which were implemented at the same time with many activities represented 25% of those that were selected. The activities included diffusion of modern technology, soil and forest protection, distribution of pesticides and fertilizer, food security, education and training, infrastructures building, etc. In these projects, all activities accounted for equal importance in terms of time and funds, and were viewed complementary to each other. For this reason, integrated projects may have higher impacts than single activity projects.

**Table 4.1: Distribution of the Selected Projects according to Types of Activities**

| Types of Projects | Number | % of Group | % of Total |
|---|---|---|---|
| Single Activity Projects (Non Integrated) | | | |
| - Agricultural Production and Natural Resources Management | 8 | 53.33 | 40 |
| - Food Security | 3 | 20 | 15 |
| - Education and Training | 2 | 13.33 | 10 |
| - Agricultural Credit | 1 | 6.67 | 5 |
| - Health | 1 | 6.67 | 5 |
| - Total of Group | 15 | 100 | 75 |
| Many Activities Projects (Integrated) | 5 | 100 | 25 |
| Total of Selected Projects | 20 | 100 | 100 |

### 4.1.2.2 Organizational Structure

The organizational structure shows that most of the projects had coordination staffs at country level. Generally put under the related ministry (national projects) or institution officer (international institutions or NGOs projects), these staffs were constituted of national coordinators, different advisers, control committees and external collaborators (national NGOs, research centers, university, etc.). At regional or zonal level, different heads coordinated the activities according to

decisions coming from coordination staffs. At village level, projects' teams composed of heads and extension agents ensured decisions implementation by working directly with beneficiaries groups (Figure 4.1). Generally, several projects were implemented at the same time in a single area. This gave opportunity to farmers to participate at the same time in many projects hoping they may maximize benefits. However, the study extended the analysis to verify efficiency of such beneficiaries' behavior.

In general, the selected projects worked with the beneficiaries by using participatory approach. Before the implementation of the projects, target groups were identified and their associations built up. During implementation, the projects' teams had frequent contacts with the target groups for visit and training. Likewise, some public meetings were organized to explain to the target groups goals, objectives and activities of the projects. It is therefore expected that the target groups will spread the activities of the projects in the midst of non target groups level so that the impacts can be distributed in large extend. Associations of the target groups represented institutional basis of the projects. The various associations or cooperatives identified during the field study were constituted of groups of cotton producers, groups of women, credit associations, etc. Particularly, groups of cotton producers participated in the projects by paying their financial contribution from returns of cotton commercialization. According to the projects' teams, the participatory approach expresses the fact that the beneficiaries are trained and helped to find by themselves solutions for their problems. To succeed, the way how to apply the modern technologies were publicly demonstrated. Likewise, the beneficiaries exposed their problems with regard to adoption of the technologies, and the projects' teams tried to understand and helped them find some solution approaches instead of giving them directly the solutions. Therefore the solutions found seem more relevant to the beneficiaries socio-economic realities. From these, the participatory approach allowed the enhancement of participation of beneficiaries and adoption of modern technologies.

Nevertheless, the organizational structure described previously may appear complex and decision taken mostly top-down. In this case, use of funds, internal organization, collaboration between different parts of the structure, and overall management effectiveness of the projects may be negatively affected. Therefore, the study is expected to help improve the management quality by exploring weaknesses of organizational structure of the projects and providing appropriate recommendations with regard to improvement on management and goal achievement.

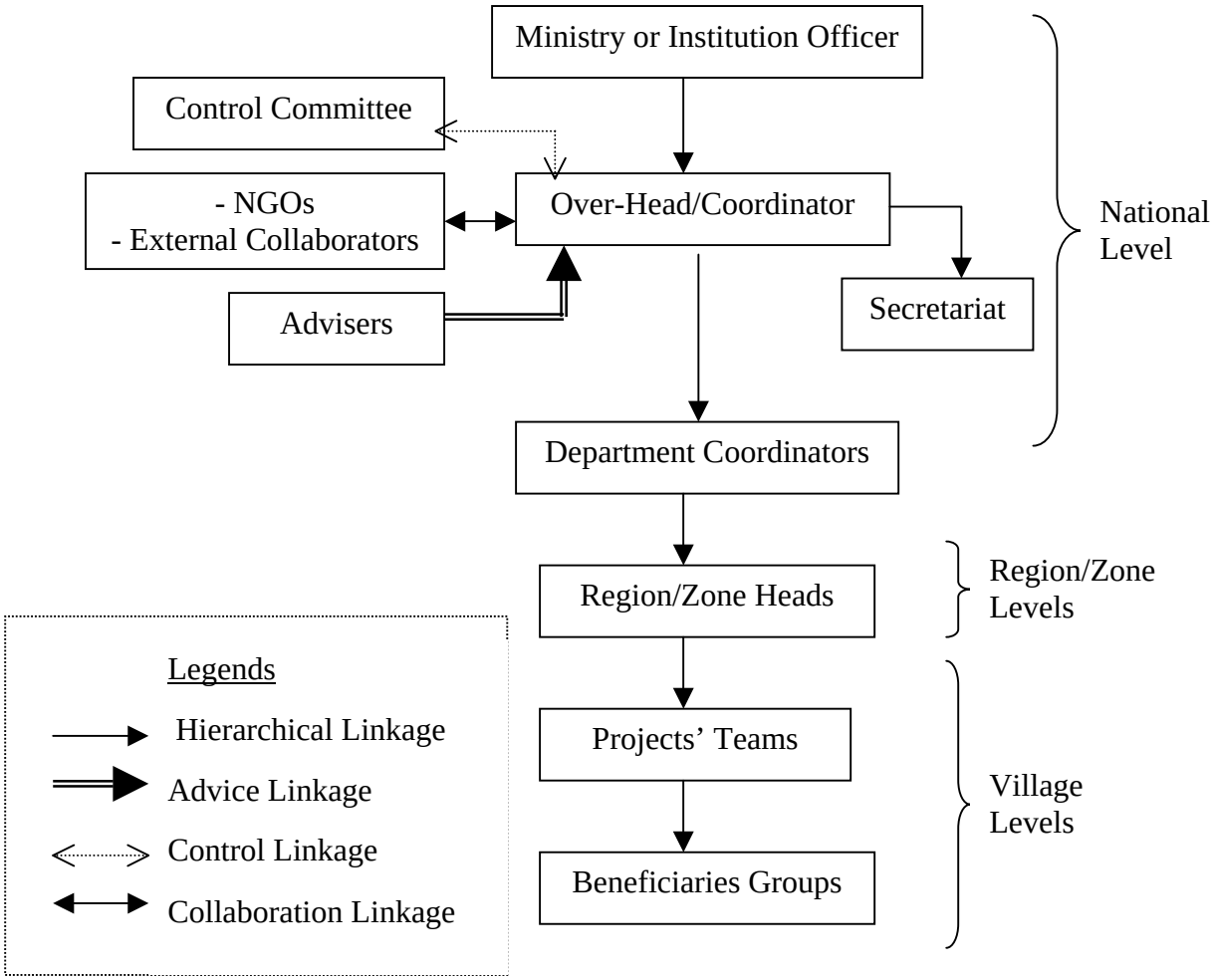



**Figure 4.1: Organizational Structure of the Projects**

### 4.1.2.3 Funding Level and Institutions

- *Funding Level*

An analysis of total funds given the 20 selected projects reveals they were of a substantial amount. Of a total sum of 75.765 billions fcfa (115.5millions Euros), they represented 4.57% of the GDP of 1999. The funds of integrated projects accounted for 68.7% and those of single activity projects for 31.3% of the total amount (Table 4.2). These explained the fact that integrated projects were given more financial importance as compared to single activity projects because of several activities they targeted at the same time. However, the task to deal with is to verify whether they succeeded better than single activity projects. Therefore, the study will explore the possible correlation between funds amount and goal achievement of the projects. This may help to evaluate how efficient or otherwise these projects have been in terms of usage of allocated funds.

**Table 4.2: Funding Level (Billions of fcfa) of the Selected Projects (N=20) according to their Types**

| Types of Projects | Funding Level (Billions of fcfa) | | | | |
|---|---|---|---|---|---|
| | Sum | Minimum | Maximum | Mean | Variation Coefficient (%) |
| Single Activity Projects | 23.703 | 0.05 | 7.341 | 1.975 | 116.46 |
| Many Activities Projects | 52.062 | 1.434 | 13.770 | 6.508 | 65.15 |
| Total | 75.765 | 0.05 | 13.770 | 3.788 | 101.82 |

- *Funding Institutions*

An analysis of institutions financing the projects reveals, regarding the cooperation with development partners, that they were more financial (80%) than technical support (20%), and bilateral (70%) than multilateral support (30%). However, most financial supports were combined with technical assistance through qualified advisers provided by the funding institutions.

According to the origin of funds and institutions involved in implementing the selected projects, they were categorized into: (1) government (national), (2) French and related, (3) international funds, and (4) English and related. National projects were those financed by public or foreign funds but entirely implemented by public development offices. French and related projects included those of French government and countries that shared French as official language. Finally, international funds projects concerned WORLD BANK, UNDP, FAO, international NGOs projects while English and related projects were those of England, USA, the Netherlands, Germany, etc. The frequency of distribution of the selected projects according to the types of funding institutions confirms the domination of national ones (35%) followed closely by international funded ones (30%), while English and French funded projects represented 20% and 15%, respectively (Figure 4.2). The Structural Adjustment Program (SAP) that aimed at increasing international funds for development and ensuring competence in the local government allowed the relative high proportions of government and international funds projects. Somehow, developed countries reoriented their development aids by lowering direct cooperation and increasing contribution through international development institutions.

Project implementation and goal achievement may closely be related to the type of institutions financing them. It may be argued, for instance, that the manner of French projects design and implementation differs from the English way. Indeed, different historical contexts and evolutions, socio-economic and politico-

institutional systems in developed countries lead to various types of management and organization named “cultures of management and organization”. Consequently, the study explored whether indicators of design, management, monitoring and goal achievement of agricultural development projects were related to the type of funding institutions.

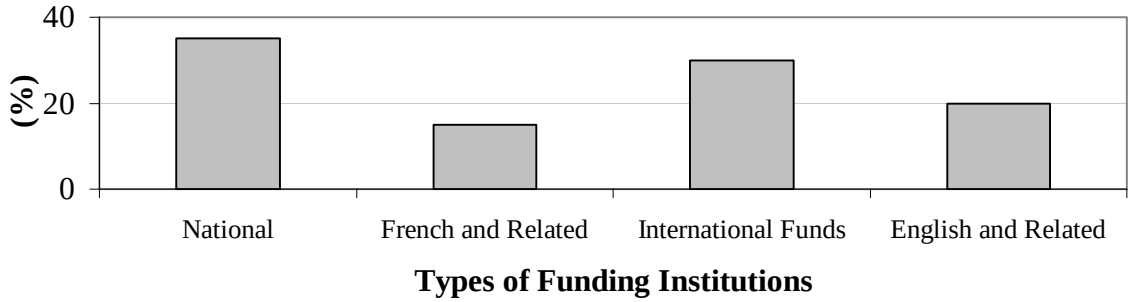



**Figure 4.2: Distribution (%) of the Selected Projects (N=20) according to the Types of their Funding Institutions**

The distribution of funds according to types of funding institutions shows international institutions represented the first projects financers (42.2%) and confirms arguments developed above. They were followed by the Government (24.6%), English and related countries (22.1%), and French and related countries (11.1%). Another side of analysis reveals more interesting aspect. In fact, the biggest funds amount were provided by external sources (75.4%) while only 24.6% came from Government (Table 4.3). Accordingly, financing agricultural development projects represented external debts the Government has to pay in future. From this, using efficiently these debts to effectively provide development for poor rural people should be a challenge for projects actors. Therefore, the study attempts to share this challenge by identifying factors of inefficiency in management and providing recommendations to improve on sustainability of the projects.

**Table 4.3: Funds Amounts (Billions of fcfa) of the Selected Projects (N=20) according to Types of Funding Institutions**

| | | | | Funds Amounts (Billions of fcfa) | |
|---|---|---|---|---|---|
| Types of Funding Institutions | Sum | Minimum | Maximum | Mean | Variation Coefficient (%) |
| Government (National) | 16.753 | 0.5 | 7.341 | 2.393 | 105.43 |
| French and Related | 8.350 | 0.05 | 8.1 | 2.783 | 165.44 |
| International Institutions | 31.992 | 1.2 | 13.770 | 5.332 | 89.28 |
| English and Related | 18.670 | 0.5 | 10.570 | 4.667 | 91.48 |
| Total | 75.765 | 0.05 | 13.770 | 3.788 | 101.82 |

## 4.2 Description of the Study Zone

### 4.2.1 Rationality of the Choice

As earlier developed, the environmental conditions of local rural population play a crucial role in project sustainability. The study zone should therefore correspond to social, and cultural homogeneity, local knowledge and organization homogeneity for production systems and management of natural resources. Benin is divided into more than ten (10) socio-cultural areas. However, two of them were representative of project types selected for the study and represented therefore the study zone: the *Adja* socio-cultural area in the south east of Benin and that of *Nagot* in the center. Administratively the *Adja* area belongs to the province of *Mono-Kouffo* and that of *Nagot* to *Zou-Collines*. As administrative and official demarcation did not take into account socio-cultural aspects of zones, data of provinces to which they belong are considered to characterize socio-cultural areas of the study zone.

### 4.2.2 Population and Agro-ecological Features

In a way described above, the study zone is divided into two socio-cultural areas: *Adja* and *Nagot*. The ethnic group *Adja* populates for the greater part *Adja* area and the *Nagot* ethnic group *Nagot* region. With a surface area representing only 2.8% of the national territory and a population 13.75% of the country in 2000, *Adja* area has one of the highest population density in Benin (224 people/km$^2$). In contrast, *Nagot* area has a less strong density (55 people/km$^2$). Its population, representing about 16.7% of the country, is distributed among a bigger surface area of 18,700 km$^2$. This is about 16.6% of the total surface area of Benin (Table 4.4). The differential distribution of population density between the two areas is characterized by a stronger pressure on agricultural land in *Adja* area than in *Nagot*, and has as consequence differentiation in land management and farming system.

Regarding agro-ecological features, WEZEL and BÖCKER (2000) distinguished six agro-ecological zones in Benin: (1) the coastal, the guinea-congolian and the southern guinea zones in the southern Benin, (2) the northern guinea zone, in the center of Benin, and (3) the northern and southern sudanian zones in the northern Benin. Taking into account localization of each zone, *Adja* area belongs to the guinea-congolian zone and the *Nagot* area to northern guinea zone. Accordingly, *Adja* region is an area of sandy or sandstone plateau (*Adja* plateau) still subdivided by major valleys. The main soil units are *ferrali-humic* or *ferric*, *lixisols*, and moister types of woodland and savannas with abundant *Daniella oliveri*, which composes the vegetation.

**Table 4.4: Surface Area, Population and Density of Population by Province in Benin**

| *Province* | Surface Area ($km^2$) | Population in 1979 | Population in 1992 | Population in 2000[a] | Population Density (per $km^2$) in 2000[b] |
|---|---|---|---|---|---|
| Atacora-Donga | 31,200 | 479,604 | 649,000 | 817,740 | 26 |
| Atlantique-Lama | 3,200 | 686,258 | 1,066,000 | 1,343,160 | 419 |
| Borgou-Alibori | 51,000 | 490,669 | 828,000 | 1,043,280 | 20 |
| Oueme-Plateau | 4,700 | 628,868 | 877,000 | 1,105,020 | 235 |
| Mono-Couffo (*Adja Area*) | 3,800 | 477,378 | 676,000 | 851,760 | 224 |
| Zou-Collines (*Nagot Area*) | 18,700 | 470,433 | 819,000 | 1,031,940 | 55 |
| Total Benin | 112,600 | 3,333,210 | 4,915,000 | 6,192,900 | 55 |

a and b: Estimation based on 3% population annual average growth rate
Source: "Institut National de la Statistique et de l'Analyse Economique" (INSAE)

Conversely, *Nagot* region is characterized by a crystalline basement and peneplain with hills about an average altitude of 200m above sea level. The soil units are *calcic vertisol*, *haplic lixisols* and *ferric lixisols*, while a mosaic of forests and savannas is the typical vegetation with common species such as *Afzelia africana*, *Ceiba pentrada*, *Imperata cylindrical*, *Panicum maximum* (STAHR, 2000; GAISER et al, 2002). The difference between the two areas about agro-ecological characteristics leads to difference in soil fertility and could hence involve differentiation in project adoption.

### 4.2.3 Climate and Rainfall Pattern

Two rainy and two dry seasons, which are alternate characterize the study zone (Figure 4.3). The average rainfall during the two rainy seasons in *Adja* area is about 1,100 mm and in *Nagot* 1,000 mm. However, a more striking feature is the variation in total amount of rainfall from year to year and the local difference within the same year (ASECNA, 1965-1993; LEIHNER et al, 1996). Therefore, the uncertainty in an isohyets diagram is very high due to the high variability and the different possibilities for interpolation (Figure 4.4). The high variability of rainfall from year to year and within the year drives to a greater risk aversion in agricultural production, as it represents a determinant factor of productivity. Consequently, considering rainfall pattern in implementation of agricultural projects appears to be very important. In fact, the local populations could be more

incentive to rise their participation in agricultural projects if modern technologies proposed help them to balance negative effects of rainfall variability and to have a good agricultural productivity.

Temperature and humidity are significantly similar in the two socio-cultural areas of the study zone. Temperature is much less irregular than rainfall with a maximum in March before the unset of the rainy season of almost 30°C, which drops to 24°C in July. A second maximum is reached in November at 28°C. This gives an annual mean temperature between 27°C-28°C throughout the study zone, with a range of about 7°C. The humidity, however, is unimodal and determined by the level of rainfall, temperature and winds with a maximum from July to September and a minimum in December and January (LEIHNER et al, 1996).

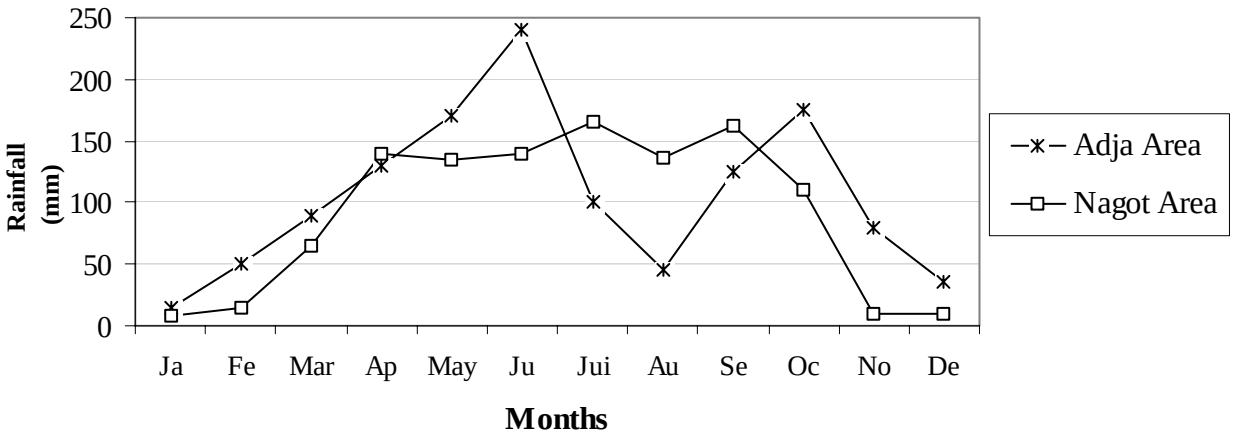



**Figure 4.3: Distribution of Average Monthly Rainfall (mm) within the Year in the Study Zone**

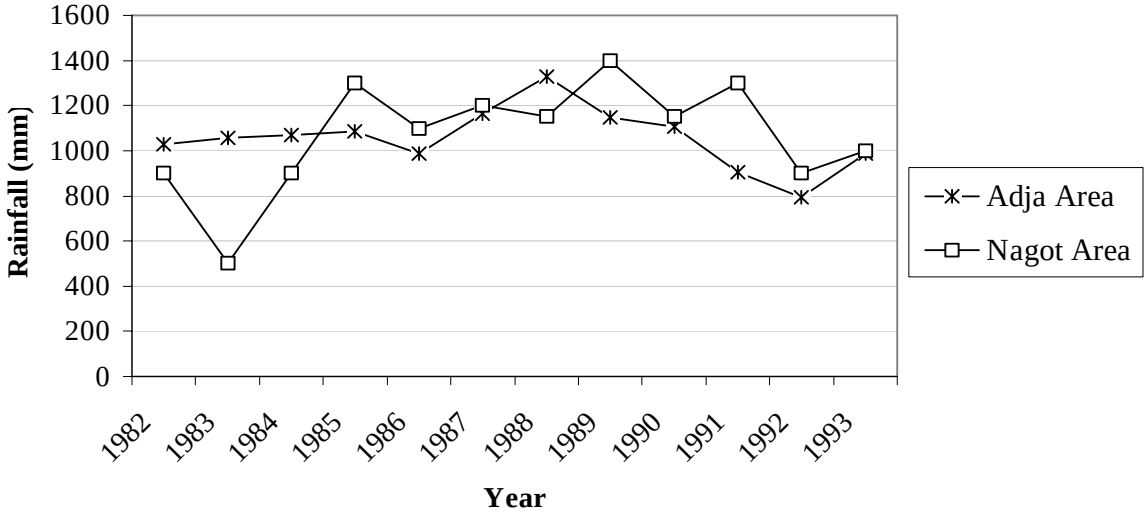



**Figure 4.4: Distribution of Annual Rainfall in the Study Zone, 1982-1993**
Source: Adapted from LEIHNER et al (1996)

### 4.2.4 Land Use and Farming Systems

Land use systems are the result of the aggregation of intensive cropping patterns. These cropping patterns depend on decision of farmers operating a farming system. In Benin, farming systems and; therefore, land use systems differ according to environmental conditions. Therefore, several farming systems can be differentiated according to agro-ecological zones.

*Adja* area has been concentrated in food crop. At the beginning of the century, yields of maize were more than 2,000kg.ha$^{-1}$. As long as population pressure remained low, the cropping phase was short compared to the fallow period. With the increase of population density, land use patterns at village level changed. In the same time, there was an expansion in the area cultivated. The last strips of forest were cleared around the villages or between the farmlands of neighboring. The spatial dynamics of such cropping system in the *Adja* plateau drives to lower disposable cultivated land per capita (0.20 ha) and to land insecurity with apparition of land tenure such as rent, leasehold, sharecropping, etc. Nowadays, the forest strips have been cleared and put under cultivation. Food crops and young oil palms, interspersed by dense monocultures of oil palms in all stage of development, intercrop many fields. It is thereby possible to notice typical forms of intensification. In the system, the oil palm trees act as a productive planted fallow. Very few remote fields are used for cotton and maize cultivation in a bush fallow system, where crops are cultivated in a relay system, beginning with maize. While more intensive land use patterns evolve, the soils get more and more exhausted and cropping systems have also to evolve. For instance, the maize-based main cropping system is turned into a maize-cassava. Mineral fertilizers are virtually unavailable and seldom used outside of cotton growing areas.

In opposite, the *Nagot* area is considered as region of food crops and cotton. The pressure on land is lower and the disposable arable land per capita around 1.5 and 2 ha is still great. The land is more secured than in *Adja* area since land tenure such as rent, leasehold and sharecropping remain scarce. However, population growth is bringing nowadays major changes in the environment and current patterns of resources use such as field clearings, deforestation for firewood and charcoal, bush fires and sometimes overgrazing are having disastrous effects on the environment. Likewise, increase in cultivated area is linked to an expansion of cotton (and cowpea as its complementary crop) and yam based on clearings. In addition, migrants coming from areas that are already intensively used take over cleared land from yam growers and settle down. In the same time, some livestock keepers are settling down and compete with farmers for land (IGUE et al, 2000). In short words, pressure on land become greater, and since available quantity cannot

increase, there is a need of intensification to keep soil fertility and productivity at satisfactory level, as well as to avoid forest destruction. This defines what could be the role of agricultural projects.

By analyzing farming systems of the two socio-cultural areas, it is possible to notice a difference in access to land, in soil fertility and in priorities that the projects are supposed to take into account. In one hand, people of *Adja* area would need to improve regeneration of their soil fertility, more land security and diversification of activities to secure revenue. On the other hand, keeping fertility and avoiding deforestation would appear as necessity for *Nagot* area.

### 4.2.5 Agricultural Production

Country-widely the case, agriculture is the main economic activity of the study zone. It occupies about 80% of the working population.

In *Adja* environment, cultivated surfaces remain weak because of low availability of arable lands. Maize stays the main crop, but its surface represents only 12% of total cultivated area in 1999/2000. Then comes cotton while yam production is very marginal because agro-ecological conditions are not convenient to its production. In *Nagot* area, cultivated surfaces are greater because of a bigger availability of fertile lands. Maize is more cultivated, followed closely by cotton. The surfaces of the other crops such as beans, groundnuts, cassava and yam are also rather important.

From the point of production view, *Nagot* area is qualified as corn loft of the country with more than 30% of cereal and other food crops produced at the country level. However, there is no significant difference between the two areas as regards quantities produced in maize and in cassava, although cultivated surfaces are greater in *Nagot* area (Table 4.5). This is explained by weaker yields obtained in this area with regard to *Adja*. Indeed, because of the uncertainty of lands in *Adja* area, agricultural production is more intensified there. This production intensification led particularly to a very high cassava yield (17,485 kg/ha). In contrast, the better availability of fertile lands in *Nagot* area does not still give intensification incentive to farmers, and the agricultural production is still characterized by a systematic clearings. Yields obtained in this region are still weak compared with those at national level.

The analysis of agricultural production shows two priorities of agricultural projects according to the socio-cultural area. With the uncertainty of lands in *Adja* area, an improvement of agricultural intensification could allow a more

sustainable production, whereas in *Nagot* area giving incentive for intensification could favor an improvement of soil fertility and avoid destruction of forests.

**Table 4.5: Surface Area, Production and Yield of Main Cultivated Crops in the Study Zone, 1999/2000**

| | Mono-Couffo Province (*Adja Area*) | | | Zou-Collines Province (*Nagot Area*) | | | Whole Benin | | |
|---|---|---|---|---|---|---|---|---|---|
| Crops | Cultivated Area (ha) | Production (metric tons) | Yield (kg/ha) | Cultivated Area (ha) | Production (metric tons) | Yield (kg/ha) | Cultivated Area (ha) | Production (metric tons) | Yield (kg/ha) |
| Maize | 80,527 | 73,732 | 916 | 88,524 | 79,056 | 893 | 653,630 | 750,442 | 1,148 |
| Groundnuts | 16,701 | 13,075 | 783 | 51,948 | 39,630 | 763 | 138,586 | 121,159 | 874 |
| Beans | 16,466 | 9,665 | 587 | 39,436 | 23,903 | 606 | 119,111 | 85,613 | 719 |
| Cassava | 27,255 | 476,542 | 17,485 | 50,945 | 401,417 | 7,879 | 219,404 | 2,350,208 | 10,712 |
| Yams | 221 | 2,458 | 11,122 | 33,061 | 282,594 | 8,548 | 156,831 | 1,742,004 | 11,108 |
| Cotton | 21,298 | 18,476 | 867 | 80,486 | 65,592 | 815 | 319,318 | 339,909 | 1,064 |

Source: "*Ministère de l'Agriculture, de l'Elevage et de la Pêche*" (MAEP)

### 4.2.6 Consumption and Food Balance

Food balance is defined as the difference between supply and demand of food. Food balance computed for main cultivated crops is presented in Table 4.6. With a positive food balance, the *Nagot* socio-cultural area appears to be more food secure than *Adja* where the food balance stays negative. In particular, there is a need of food import such as maize and yams from another areas of the country to satisfy food consumption need of *Adja* people. Conversely, food is exported from *Nagot* area to outside. The greater disposability of cultivated lands in this area allows the peasant to increase production quantity without however improving yields.

The analysis of food balance shows therefore that improving food security could be a priority in *Adja* area while an agricultural project focusing on food security could be seen as useless in *Nagot* area. Such analysis currently gives explanation for differential acceptance of agricultural projects by local people according to their main goals and to the area where they are implemented.

**Table 4.6: Balance of Staple Foods[a] (metric tons) in the Study Zone, 1993/1994-1999/2000**

| | Mono-Couffo Province (*Adja Area*) | | Zou-Collines Province (*Nagot Area*) | | Whole Benin | |
|---|---|---|---|---|---|---|
| Crop | 1993/1994 | 1999/2000[b] | 1993/1994 | 1999/2000[c] | 1993/1994 | 1999/2000[d] |
| Maize | -29,166.43 | -22,856.032 | 2,018.49 | 9,536.24 | 114,662.37 | 172,663.79 |
| Groundnuts | -1,949.7 | 1,422.4 | 5,593.03 | 8,453.57 | 2,020.51 | 17,190.68 |
| Beans | 2,214.87 | 2,502.91 | 8,777.35 | 8,469.24 | 9,252.61 | 16,540.28 |
| Cassava | 134,236.92 | 309,535.42 | 225,060.66 | 268,318.17 | 738,368.18 | 1,613,116.56 |
| Yams | -2,431.3 | -3,394.5 | 7,013.22 | 29,460.11 | 463,141.38 | 711,133.75 |

Source: "*Office National de Sécurité Alimentaire*" (ONASA)
a: (+)=Surplus and (-)=Deficit
b, c and d: Estimation based on 3% population annual average growth rate

### 4.2.7 Economic and Human Development

In economic and human development point of view, the *Adja* area is more progressed than *Nagot*. For instance, the GDP per capita in this area was estimated in 1997 at 250 $US compared to 234 $US of *Nagot* area. Likewise, the Human Development Indexes were 0.341 and 0.329 respectively for the two areas of the study zone (Table 4.7). Due to land scarcity and uncertainty, *Adja* people have developed survival strategies by diversifying generating income activities. Most of them left agricultural production to work in trade, commercialization, manufacturing, small industry and service sectors. That is not still the case for *Nagot* people, whose main activity remains agricultural production.

**Table 4.7: GDP per Capita and Human Development Index of Benin Provinces in 1997**

| *Province* | GDP per Capita ($) | Life Expectancy (Year) | Schooling Rate (%) | Informal Education Rate | Human Development Index |
|---|---|---|---|---|---|
| Atacora-Donga | 253 | 55.3 | 15.9 | 13.1 | 0.306 |
| Atlantique-Lama | 350 | 57.5 | 39.7 | 48.1 | 0.460 |
| Borgou-Alibori | 226 | 59.3 | 15.4 | 20.1 | 0.333 |
| Oueme-Plateau | 282 | 56.7 | 38.3 | 40.6 | 0.411 |
| **Mono-Couffo (*Adja Area*)** | **250** | **57.4** | **23.5** | **20.0** | **0.341** |
| **Zou-Collines (*Nagot Area*)** | **234** | **53.1** | **25.7** | **27.3** | **0.329** |
| Benin | 271 | 56.3 | 38.3 | 40.6 | 0.405 |

Source: "*Institut National de Statistique et de l'Analyse Economique*" (INSAE), 1998

## 4.3 Sampling of Research Units

In Chapter 3, the weaknesses of the various methodological approaches of project impact evaluation have been described. Then, assessing the impact of projects on population development often requires distinguishing between the impact of the project itself versus the impact of exogenous factors that have also influence on development through other avenues. The problem is not straightforward, and to overcome it, the *With-Without* approach is used. In that case, KERR and KOLAVALLI (1999), PITT and KHANDKER (1996) suggested randomizing the "with" and "without" groups selected for the study. According to them, if the sample is not drawn randomly, or if there are hidden relationships determining between relationships of interest, the findings will be biased, i.e., the statistics estimated for the sample will not represent those for the entire population. Therefore, representative samples of agricultural households were chosen by randomization according to the number of projects in which they were participating. However, three stages of scales were distinguished. In each socio-cultural area of the study zone, three villages were selected: one without project, one with single project and one with 2 or more projects. A characterized group of households was selected in each village. Consequently, there were three groups. The first concerned the "without project" group of households involved in no project. The second was the "with 1 project" group of households participating in single project. The third was the "with 2 or more projects" group of households participating at the same time in 2 or more projects. In each village retained, twenty (20) households were selected by group. In total, the sample size was 20*3*2=120. The group "without project" represented 32.01%, the group "with 1 project" 55.2% and the group "2 and more projects" 69.7% of related households in the selected villages. As far as possible with the randomization, the difference between the groups in each socio-cultural area remained the intensity of participation in agricultural projects. The distinguish of three groups of participation in projects led to see whether the impacts of different projects were complementary or offset to each other at beneficiaries level.

## 4.4 Methods of Data Collection

Data collection to assess impact of projects appears very complex. According to CASLEY and KUMAR (1988), data for impact assessment has three purposes: description, explanation and prediction, and leads to combine both qualitative and quantitative methods of collection. In fact, the two methods are highly complementary because their strengths correspond to different aspects of the research problem. For instance, successive rounds of qualitative inquiry can take a sharper focus to probe people, topics and relationships of interest, generating

knowledge that leads to more clearly articulated research questions and hypotheses. This process can help to determine further research using quantitative methods, and if so qualitative data can facilitate explanation of quantitative findings (MAXWELL, 1998). Therefore, qualitative and quantitative approaches were combined during the field study for data collection.

### 4.4.1 Qualitative Approach

A simplistic distinction between qualitative and quantitative data is that quantitative data are numeric, while qualitative data are best described in words (CASLEY and KUMMAR, 1988). However, some qualitative data can in fact be recorded in numbers. Therefore, a better characterization of qualitative data is based on the way they are collected (CHUNG, 1997) and used. More, qualitative approaches are also essential for increasing local participation in research because of their flexibility, the value they place on insiders' perspectives and knowledge, and their emphasis on iterative learning. Many qualitative methods are developed and they are growing all the time. For instance, the use of visually based Participatory Rural Appraisal (PRA) methods is especially useful because it can enhance communication between researchers and local people, and it can help stimulate people's analytic skill. However, the critical principle underlying all these methods is that the local population carries them out while the researcher only facilitates the process. Following PRETTY et al (1995) qualitative methods like loosely structured or open-ended discussions, interview, participatory mapping, matrix ranking and scoring, etc. were used in the study at two levels. At project level, the qualitative methods were applied to project heads, agents, financers or donors, local population leaders, etc., and at study zone level to village leaders, political and administrative heads, opinions leaders, extension service agents, etc.

### 4.4.2 Quantitative Approach

According to CHUNG (1997), the principal advantage of quantitative surveys is that they can be administrated to large numbers of individuals (or households) using standardized methods. Standardization across observations makes it possible to aggregate impact indicators measures and to make statistical comparisons among individuals, households, regions and periods. KERR and KOLAVALLI (1999) discussed in their working paper different quantitative methods with related advantages and disadvantages. They concluded that no standard method exists, so that the researcher should choose appropriate method by appreciating the situation. Subsequently, the structural survey with standardized questionnaire was used in the study to collect quantitative data at household level. The questionnaire

conceived to have appropriate indicators of agricultural project assessment was applied to each household of the sampling.

## 4.5 Data Base and Processing

### 4.5.1 Primary Data

The primary data included both qualitative and quantitative data collected by the combination of the two methods.

At project level, collected information concerned the design and conception, the purposes and goals, the internal organization and management, the evaluation system of the projects, and the participation of local populations as well as their opinions about the projects, etc. Likewise quantitative data concerning amount of funds, execution degree, quantity and value of realization, etc. of projects were collected.

At level of study area, qualitative data related to local organizations, endogenous knowledge on production system and natural resource management, local population perceptions and opinions about project utility, problems relative to their development, etc. were collected. Moreover, some quantitative data like prices, cultivated area, production, etc. at village level were obtained.

At household level, the target was put on quantitative data relative to impact assessment indicators such as production, cultivated area, wages and labor demand, credit demand, adoption of technology, food prices, food consumption, soil degradation, farm revenue, opinions of producers about project impact and utility, etc.

### 4.5.2 Secondary Data

The secondary data were collected through survey of existing literature and from records and documents of different public offices (Ministry of Agriculture, Ministry of Environment, Statistical and Development Planning Office, National Center for Agricultural Research, etc.), international institutions (GTZ, WORLD BANK, UNDP, FAO, international research centers and NGOs, etc.) and private offices (national NGOs and consulting centers, etc.). The various secondary data concerned the long-time series of macro-economy indicators like, GNP and GDP, inflation, export and import, revenue and employment, agricultural production, agricultural credit and interest rate, food consumption, etc. The database of earlier project evaluations obtained in most departments of selected agricultural projects had been used to verify the reliability of some primary data collected.

### 4.5.3 Data Entry, Control of Error and Processing

After data collection, the data were codified and entered with the help of *Excel* tabulation. To facilitate the analysis, some preliminary aggregations were done and to avoid entry error two individuals helped to follow the process. An additional control of data had driven to correct some errors after the data entry.

Regarding the reliability of data collected, comparison was done with existing data in the same village, and when any doubt existed, the data were classified as wrong. After the first data entry, a second round of data collection to correct and replace wrong data has been done. Finally, the second step of the entry of those data led to have a complete database for analysis.

The analysis processes were run in statistic packages *SPSS* (for descriptive statistics and assessment of impacts), *STATISTICA* (for estimation of the Structural Equation Modeling) and *FRONTIER* Version 4.1 (for estimation of impacts on technical efficiency).

# 5 FIELD STUDY RESULTS

This chapter presents the findings of field study and is subdivided into three main parts. First, the characteristics of the rural populations are described. These include their socio-demographic characteristics, farming and production systems, income generating activities and food consumption patterns. The second part explores agro-ecological conditions and the last part institutional arrangements and capacity building. The division of the study zone in two socio-cultural areas allows to identify the differences which could justify latter relative disparities in impacts, success and sustainability of agricultural projects.

## 5.1 Characteristics of the Selected Farmers

### 5.1.1 Socio-demographic Characteristics

#### 5.1.1.1 Ethnicities, Sex and Age

The ethnic groups are mainly related to the socio-cultural area. The *Adja* ethnic group was the major ethnicities in *Adja* area with 81.67% of the sampled households, while the other groups represented only 18.33%. The *Yoruba* were majority in *Nagot* area with 56.67%. However, the proportion of the other groups, majority immigrants, was relatively high (43.33%). This is due to migrations towards this zone with abundance of fertile agricultural land in disfavor of zones with high population density where pressure on land was already very high.

As regards the sex of the household heads, local cultural norms still did not allow the women to manage households and farms. In rural *Adja* where women right are little recognized, only one woman (1.67%) for every 59 men was sampled compared to 21.67% in *Nagot* area where women rights had relatively progressed.

The age of household leaders were homogenously distributed around their mean (40 years old) with no significant difference between the two areas (Table 5.1). Normally a person whose age is greater than 60 is considered inactive. Nevertheless, some peasants in the study zone aged about seventy or eighty years were still farming.

#### 5.1.1.2 Schooling and Informal Education

Schooling and informal education are expected to allow stakeholders to understand more about the projects' goal, strategies and outcomes, and hence to improve their participation. The survey results shows that half of the population were not schooled in the study zone. The situation was worse in *Adja* area (61.67%) than in *Nagot* one (43.33%). However many of schooled *Adja* people

have been able to reach the secondary level (21.67%) because of the nearness to Cotonou city compared to 13.33% in *Nagot* area which is more remote.

As in the case of formal education, more than half had no informal education (63.33 %) in *Adja* area and 56.67 % in *Nagot* (Table 5.1). Moreover, a detailed analysis of informal education situation showed that most important producers were those that had no informal education. This was because of lack of time and of willingness. The situation could reduce the expected effects as educating informally rural people could improve agricultural production.

**Table 5.1: Some Socio-demographic Characteristics of the Selected Farmers in the Study Zone, 2001-2002**

| | *Adja* (N=60) | | *Nagot* (N=60) | | Socio-cultural Area Whole Study Zone (N=120) | |
|---|---|---|---|---|---|---|
| Items | Count | % | Count | % | Count | % |
| Ethnic Groups | | | | | | |
| Adja | 49 | 81.67 | - | - | 49 | 40.83 |
| Yoruba | - | - | 34 | 56.67 | 34 | 28.34 |
| Another | 11 | 18.33 | 26 | 43.33 | 37 | 30.83 |
| Total | 60 | 100 | 60 | 100 | 120 | 100 |
| Sex | | | | | | |
| Man | 59 | 98.33 | 47 | 78.33 | 106 | 88.33 |
| Woman | 1 | 1.67 | 13 | 21.67 | 14 | 11.67 |
| Total | 60 | 100 | 60 | 100 | 120 | 100 |
| Education Level | | | | | | |
| No Level | 37 | 61.67 | 26 | 43.33 | 63 | 52.5 |
| Primary | 10 | 16.67 | 26 | 43.33 | 36 | 30 |
| Secondary | 13 | 21.67 | 8 | 13.33 | 21 | 17.5 |
| Total | 60 | 100 | 60 | 100 | 120 | 100 |
| Informal Education | | | | | | |
| No | 38 | 63.33 | 34 | 56.67 | 72 | 60 |
| Yes | 22 | 36.67 | 26 | 43.33 | 48 | 40 |
| Total | 60 | 100 | 60 | 100 | 120 | 100 |
| Age | | | | | | |
| Mean | | 39.77 | | 41.63 | | 40.70 |
| CV (%) | | 26.54 | | 33.13 | | 30.14 |
| Household Size | | | | | | |
| Mean | | 9.95 | | 6.83 | | 8.39 |
| CV (%) | | 74.19 | | 44.12 | | 69.46 |
| Active Members | | | | | | |
| Mean | | 4.38 | | 3.30 | | 3.84 |
| CV (%) | | 79.99 | | 63.44 | | 76.17 |

#### 5.1.1.3 Households' Structure

The household size is an important factor when analyzing labor input, annual revenue and food consumption or expenditure that are closely related to it. Households in the study zone define rural African characteristics with large size (8.5 capita on average in the study zone, 10 in *Adja* area and 7 in *Nagot*; Table 5.1). The decision making was officially the responsibility of the husband but the women could suggest their opinions. Hard works like manual ploughing, weeding, etc. were done by men while women have in charge of cooking, processing and commercialization of agricultural products. The children helped during agricultural activities and were considered as active members from age fifteen. On average, the surveyed households had 4 active members.

### 5.1.2 Agricultural Production

#### 5.1.2.1 Land Use and Farming System

The analysis of land use and farming system showed a significant difference between the two areas of the study zone. Because of the very high land pressure in *Adja* area, 26.67% of the farmers were without land security compared to only 6.67% in *Nagot* (Table 5.2). The *Adja* lands are largely rented or leased and under the system of sharecropping. In addition, they could not plant crops such as fruits or agro-forestry plants, etc. as they are not sure how long they could plough the field. Therefore, their willingness of adoption of modern anti-erosive and agro-forestry methods for soil fertility regeneration remained weak. The duration of farming seemed longer in *Nagot* than in *Adja* area (12.38 years against 7.46, Table 5.2) but was not reflecting the reality. In fact, the data collected gave only the duration of farming done by the surveyed peasants. Since many of them in *Adja* area had poor land security, they changed their farming fields after few years so that the real farming duration of the land they were currently using could not be identified. In reality, *Adja* lands were longer exploited than *Nagot* ones as confirmed by the use of fallow. For instance, only 10% of *Adja* farmers had fallow field as opposed to 61.62% in *Nagot* area. In addition, the farming systems evolved strictly with the land pressure. It appeared more intensive in *Adja* area with crop associations such as maize and beans or maize and nuts that led to regeneration of soil fertility. Often, cotton was grown in monoculture, but a good rotation cotton-maize-cotton or beans-cotton-maize ensured the benefits from backward effects of cotton fertilization. In *Nagot* Area where lands were still available, the farming system was still extensive. It began with the forest burning and clearing. After the ploughing, yams that are very demanding and exhaustive of soil nutrients were cultivated. Then came maize, nuts, beans, cotton and at last

cassava, which closed the rotation before the fallow. Here also associations of cultures of types of “maize and beans”, “maize and nuts” and “maize and cassava” allowed an organic breath to the soil fertility.

To characterize land management better, two own constructed indexes of adoption of production technologies were computed as:

$$MA = \frac{1}{\sum d_i} \sum A_i * d_i \qquad (5.1)$$

$$TA = \frac{1}{\sum d_j} \sum A_j * d_j \qquad (5.2)$$

Where *MA* is the index of modern technologies adoption and *TA* that of traditional technologies; $A_i$ is the proportion of parcels of the *i*th modern technology and $A_j$ that of the *j*th traditional one; $d_i$ is the adoption duration of the *i*th modern technology and $d_j$ that of the *j*th traditional technology.

*MA* is takes into account all exogenous agricultural techniques coming out of farmers’ innovations like use of chemical fertilizers, pesticides, and high yielding varieties; agro-forestry and anti-erosive methods. *TA* accounts for all indigenous agricultural techniques conceived and implemented by the farmers to overcome soil degradation and fertility decline such as appropriate crop associations and rotations, fallow and local compost use. The results presented in Table 6.2 show more intensive farming system in *Adja* area where the *MA* was greater and the *TA* was lower, and the more extensive farming system in *Nagot* area where the *MA* was lower and *TA* was greater (Table 5.2).

**Table 5.2: Some Indicators of Land Use in the Study Area, 2001-2002**

| | *Adja* Area (N=60) | | *Nagot* Area (N=60) | | Study Zone (N=120) | |
|---|---|---|---|---|---|---|
| Items | Count | % | Count | % | Count | % |
| Land Security | | | | | | |
| No | 16 | 26.67 | 4 | 6.67 | 20 | 16.67 |
| Yes | 44 | 73.33 | 56 | 93.33 | 100 | 83.33 |
| Total | 60 | 100 | 60 | 100 | 120 | 100 |
| Farming Duration (year) | | | | | | |
| Mean | | 7.46 | | 12.38 | | 9.92 |
| CV (%) | | 70.4 | | 57.50 | | 67.56 |
| *MA* | | | | | | |
| Mean | | 0.56 | | 0.46 | | 0.51 |
| CV (%) | | 39.28 | | 47.83 | | 45.1 |
| *TA* | | | | | | |
| Mean | | 0.32 | | 0.58 | | 0.45 |
| CV (%) | | 68.75 | | 37.93 | | 55.55 |

### 5.1.2.2 Use of Inputs

In normal conditions, the use of agricultural inputs is not only closely correlated to the intensification level of the farming system, but also to their availability and access. Land pressure being higher in *Adja* area, agricultural households had an average of 0.65 ha of land endowment as opposed to 2.81 ha in *Nagot* area. In order to complete the adoption of modern technologies, *Adja* farmers utilized more family labor. However, they used less mineral fertilizer, pesticide and hired labor than farmers of *Nagot* area though they produced more intensively (Table 5.3). The situation could be explained by improved availability of and access to inputs in *Nagot* area. Indeed, by producing more cotton, the existing agricultural policy that guarantee availability and access of agricultural inputs to cotton producers favored them. However, the question of how efficiently they utilize these inputs still remains.

**Table 5.3: Agricultural Inputs used according to Socio-cultural Area, 2001-2002**

| Inputs | Minimum | Maximum | Mean | CV (%) |
|---|---|---|---|---|
| Ploughed Area (ha) | | | | |
| Adja (N=60) | 0.12 | 2.5 | 0.65 | 54.00 |
| Nagot (N=60) | 0.4 | 10.5 | 2.81 | 67.45 |
| Study Zone (N=120) | 0.4 | 10.5 | 1.73 | 67.93 |
| Fertilizer and Pesticides (fcfa*ha$^{-1}$) | | | | |
| Adja (N=60) | 11,796.43 | 108,920.45 | 32,798.18 | 47.41 |
| Nagot (N=60) | 7,937.50 | 95,080.65 | 43,480.25 | 40.52 |
| Study Zone (N=120) | 7,937.50 | 108,920.45 | 38,139.22 | 45.60 |
| Family Labor (man-day*ha$^{-1}$) | | | | |
| Adja (N=60) | 28.72 | 218.50 | 86.71 | 54.56 |
| Nagot (N=60) | 8.75 | 146.25 | 63.88 | 51.68 |
| Study Zone (N=120) | 8.75 | 218.50 | 75.29 | 56.06 |
| Hired Labor (fcfa*ha$^{-1}$) | | | | |
| Adja (N=60) | 00 | 65,850.52 | 11,530.46 | 98.75 |
| Nagot (N=60) | 00 | 77,200 | 28,434.22 | 64.41 |
| Study Zone (N=120) | 00 | 77,200 | 19,982.34 | 87.06 |

### 5.1.2.3 Agricultural Outputs, Variable Costs and Gross Margins

As it was stressed in the previous subsection, field study results showed that *Nagot* farmers utilized agricultural inputs less efficiently than those of *Adja*. In fact, all the computed economic indicators presented in Table 5.4 appeared better in *Adja* area. For instance, the value of agricultural output of 178,925.29 fcfa/ha in *Adja* was higher than that of *Nagot* area. Even though *Nagot* farmers used more inputs (greater variable costs), the average gross margin of their land was lower (90,664.15 fcfa/ha) than that of *Adja* area (134,596.64 fcfa/ha). However, in the two areas, the farmers utilized efficiently their family labor. Actually, their average value added of family labor of 1,731.69 fcfa and 1,623.35 fcfa per man-

day in *Adja* and *Nagot* areas respectively were higher than the agricultural daily wages, of 1,500 fcfa and 1,000 fcfa in the two areas respectively. Moreover, the values of variation coefficients established relative distribution homogeneity of the computed economic indicators within the farmers.

**Table 5.4: Agricultural Outputs, Variable Costs and Gross Margins according to Socio-cultural Area, 2001-2002**

| Economic Indicators | Minimum | Maximum | Mean | CV (%) |
|---|---|---|---|---|
| Agricultural Outputs (fcfa*ha$^{-1}$) (A) | | | | |
| Adja (N=60) | 88,850 | 401,714.74 | 178,925.29 | 39.84 |
| Nagot (N=60) | 75,500 | 266,666.67 | 162,578.63 | 29.00 |
| Study Zone (N=120) | 75,500 | 401,714.74 | 170,751.96 | 35.57 |
| Total Variable Costs (fcfa*ha$^{-1}$) (B) | | | | |
| Adja (N=60) | 13,541.67 | 140,880.68 | 44,328.64 | 45.81 |
| Nagot (N=60) | 24,250.00 | 137,016.13 | 71,914.47 | 38.82 |
| Study Zone (N=120) | 13,541.67 | 140,880.68 | 58,121.56 | 48.14 |
| Gross Margins (fcfa*ha$^{-1}$) (A-B) | | | | |
| Adja (N=60) | 14,232.95 | 346,350.00 | 134,596.64 | 52.04 |
| Nagot (N=60) | 15,080.00 | 203,100.00 | 90,664.15 | 50.31 |
| Study Zone (N=120) | 14,232.95 | 346,350.00 | 112,630.40 | 55.80 |
| Average Added Value of Labor (fcfa*man-day$^{-1}$) | | | | |
| Adja (N=60) | 333.51 | 4,930.25 | 1,731.69 | 45.36 |
| Nagot (N=60) | 256.55 | 2,835.02 | 1,623.35 | 43.21 |
| Study Zone (N=120) | 256.55 | 4,930.25 | 1,677.52 | 44.32 |

### 5.1.3 Structure of the Annual Households' Revenue

The examination of the households' income in the study zone showed three levels of disparities. First, crop production appeared as the most important income generating activity. As a percent of total annual income, it contributed to about 60% in *Adja* area and 80% in *Nagot*. The other activities had marginal contribution. For example, livestock that was still very traditional generated only 11.1% and 4% of the total income in *Adja* and *Nagot* areas respectively. In addition, the incomes of crop processing (mainly done by women); agricultural wage or salary and off-farm activities represented about 30% and 15% of total households' income in *Adja* and *Nagot* areas respectively. Second, the values of variation coefficients showed a strong disparity in the distribution of the various incomes through households. This confirmed the unequal income distribution within households in the study zone. This disparity could be the consequence of land availability and access as main agricultural inputs, which was so unequally distributed through households. Third, there was a significant difference between the averages of the total income of the two areas of the study zone. Although *Nagot* households had higher availability and access to cultivated lands, their agricultural income remained low compared to *Adja* households as the later managed to value their land better. Additionally, because agricultural production

was declining due to land pressure and decline in soil fertility, *Adja* people developed other off-farm activities allowing them to have a total annual average income per capita largely superior to that of *Nagot* people (73,465.34 fcfa against 55,703.46 fcfa, Table 5.5). Nevertheless, the values of the total annual average income per capita in the study zone confirms former study results and shows the poorer income level in rural areas in comparison with urban areas.

**Table 5.5: Structure of the Annual Households' Revenue (fcfa) according to Socio-cultural Area, 2001-2002**

| Items | Minimum | Maximum | Mean | CV |
|---|---|---|---|---|
| Net Crop Production Revenue | | | | |
| Adja (N=60) | 25,050 | 2,232,600 | 313,046.58 | 122.59 |
| Nagot (N=60) | 17,625 | 1,472,300 | 264,217.92 | 96.10 |
| Study Zone (120) | 17,625 | 2,232,600 | 288,632.25 | 112.58 |
| Net Breeding Revenue | | | | |
| Adja (N=60) | 0 | 666000 | 61,450 | 161.50 |
| Nagot (N=60) | 0 | 150000 | 11,883.33 | 243.71 |
| Study Zone (120) | 0 | 666000 | 36,666.67 | 209.82 |
| Agricultural Wage Salary | | | | |
| Adja (N=60) | 0 | 60000 | 1,500 | 573.42 |
| Nagot (N=60) | 0 | 17500 | 541.67 | 544.72 |
| Study Zone (120) | 0 | 60000 | 1,020.83 | 628.99 |
| Net Processing Revenue | | | | |
| Adja (N=60) | 0 | 450000 | 68,800 | 114.06 |
| Nagot (N=60) | 0 | 240000 | 4,750 | 657.63 |
| Study Zone (120) | 0 | 450000 | 36,775 | 183.85 |
| Net Off-Farm Revenue | | | | |
| Adja (N=60) | 0 | 860000 | 108,533.33 | 155.96 |
| Nagot (N=60) | 0 | 780000 | 32,533.33 | 347.06 |
| Study Zone (120) | 0 | 860000 | 70,533.33 | 210.20 |
| Net Total Annual Revenue | | | | |
| Adja (N=60) | 108,275 | 2,362,600 | 553,329.92 | 89.41 |
| Nagot (N=60) | 32,625 | 1,615,600 | 313,926.25 | 98.48 |
| Study Zone (120) | 32,625 | 2,362,600 | 433,628.08 | 98.70 |
| Net Total Annual Revenue per capita | | | | |
| Adja (N=60) | 13,171.43 | 333,508.33 | 73,465.34 | 96.61 |
| Nagot (N=60) | 4,466.67 | 301,040.00 | 55,703.46 | 108.29 |
| Study Zone (120) | 4,466.67 | 333,508.33 | 64,584.40 | 102.49 |

### 5.1.4 Food Consumption Patterns

In order to study the food consumption patterns of the households in the study zone, the total food consumption was expressed by its value. Generally speaking, an indicator representing household food consumption cannot be directly established. During periods of abundance of agricultural products (from May to December) households do not buy food but provide it from their production. Nevertheless, some higher income households purchase meat and other imported

food like rice, wheat, etc. Between January and April, stored agricultural products are used up and households have to purchase food to top up any consumption deficit. To harmonize the consumption assessment during the year, all consumed food, purchased or produced, were expressed in value terms. The value of food provided from agricultural production was computed as its trading value by taking into account prices of the same period. From this, the total annual food consumption was expressed as the sum of trading value of none purchased food and payment of purchased food during the year. The results in Table 5.6 showed that the value of annual food consumption in households represented about 50% of their total annual revenue. However, the high values of variation coefficient demonstrated disparities existed as some households accessed better consumption food than others. The situation could result from unequal distribution of production factors mainly land, as well as income within households as demonstrated in the previous section.

According to the respondents, food was available during the whole year and households could access it even if they had to purchase more in dry season when stores becomes empty. However, the availability appeared better in *Nagot* area than in *Adja* since food balance was greater in the former than in the latter. Consequently, 80% of surveyed *Nagot* peasants had not experienced any food security problem compared to 65% in *Adja* area. Nevertheless, the study did not evaluate the quality of the consumed foods, which is important for children nutrition.

**Table 5.6: Annual Food Consumption (fcfa) according to Socio-cultural Area, 2001-2002**

| Total Annual Food Consumption | Minimum | Maximum | Mean | CV |
|---|---|---|---|---|
| Adja (N=60) | 30,000 | 766,424 | 217,280.40 | 79.11 |
| Nagot (N=60) | 17,000 | 700,900 | 167,369.17 | 86.62 |
| Study Zone (120) | 17,000 | 766,424 | 192,324.78 | 83.35 |
| Total Annual Consumption per capita | | | | |
| Adja (N=60) | 1,166.67 | 163,366.67 | 31,877.17 | 108.85 |
| Nagot (N=60) | 1,750 | 135,000 | 29,337.72 | 93.50 |
| Study Zone (120) | 1,166.67 | 163,366.67 | 30,607.44 | 101.84 |

## 5.2 Agro-ecological Concerns

Among the factors determining soil degradation, agro-ecological conditions are very central and decisive for technology adoption. Therefore, the present section explores the soil slope, the soil types, the vegetation cover and the degree of soil degradation of the cultivated areas in the study zone.

### 5.2.1 Slope

The slope of the land influences soil degradation because the steeper the slope is, the faster the water flows. Soil erosion is therefore higher and degradation more accelerated. The results presented in Figure 5.1 attest that about 60% of the cultivated areas were flat. However, 20.42% of them had a gradient of over 7%. The situation of steeper slope was more pronounced in *Adja* area located on plateau where 40% of cultivated parcels had gradient over 7%. On the other hand, *Nagot* lands were flatter (65.83%) with very low gradient sometimes (7.5%). Nonetheless, they contained more valleys with or without inundation (15% against 3.34% in *Adja* area). The differential in slope could explain the disparity of project impact on soil degradation in the two areas of the study.

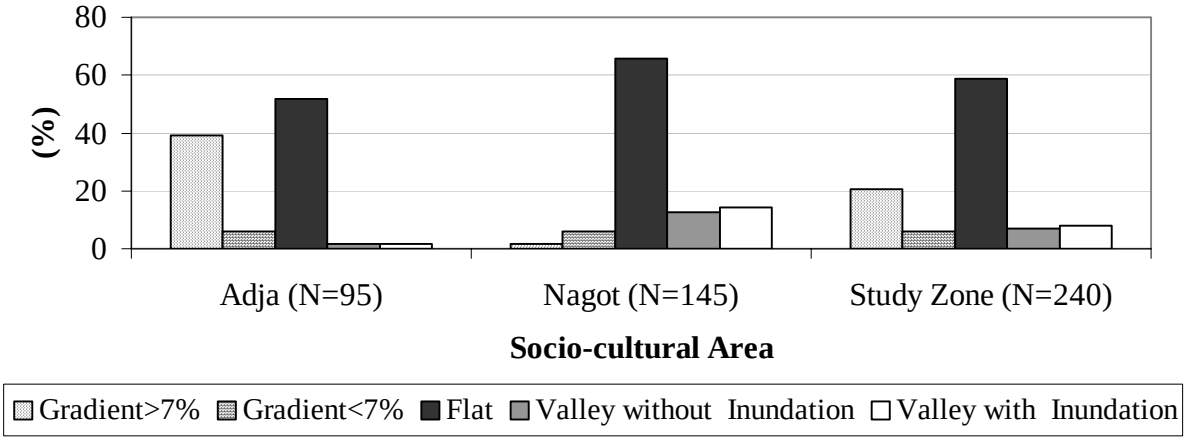



**Figure 5.1: Distribution (%) of the Ploughed Parcels according to their Slope, 2001-2002**

### 5.2.2 Soil Types

Many studies in Benin have demonstrated that soil type could determine soil degradation. In fact, the "*terre de barre*" and "*ferralitic acrisol*" types have light structure that facilitates erosion whereas the "*gleysol*" or "*vertisol*" have more compact structure, which resists to erosion better. In the study area, most of soils were "*ferralitic acrisol*" (50.08%). However they were more concentrated in *Adja* area where the slope was greater. Soils of *Nagot* area, in opposite, had more compact structure because land was flatter or situated in valley (48.34%, Figure 5.2).

### 5.2.3 Vegetation Cover

Vegetation cover on land helps to decrease the speed of water runoff and consequently to reduce the erosion. The results show that *Adja* soils were for the greater part uncovered (17.5%) or slightly covered with grasses and scattered palm trees (73.33%). There were few lands with many trees (9.16%). While recently

cultivated lands were often rare in the *Adja* farming system, they were numerous in *Nagot* area (45.32%). In this area, many parcels of land were still covered with trees or grasses (43.33%) even though 11.25% of them were uncovered notably due to expansion of cotton production (Figure 5.3). The outcomes confirmed therefore the more progressed degradation of forests and other natural resources in *Adja* area than in *Nagot*.

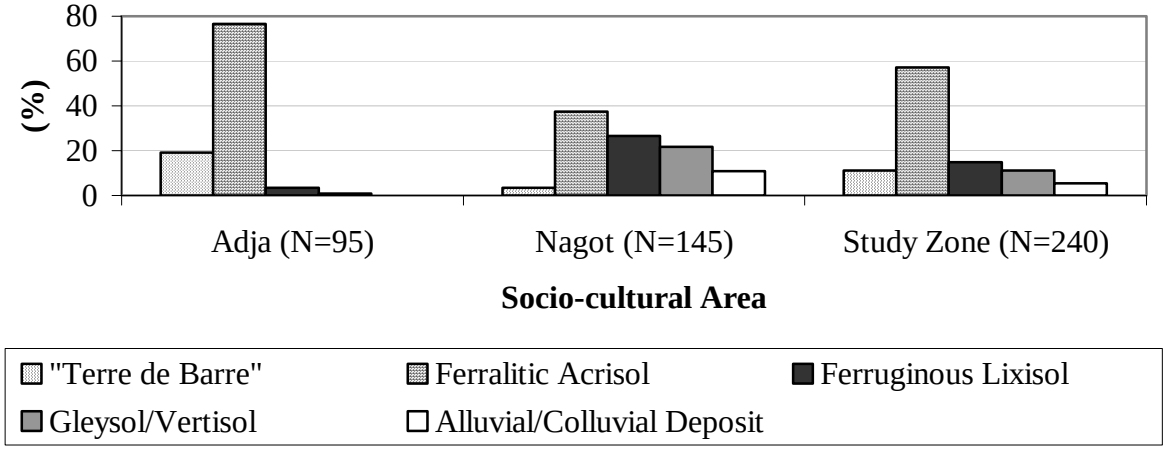



**Figure 5.2: Distribution (%) of the Ploughed Parcels according to their Soil Types, 2001-2002**

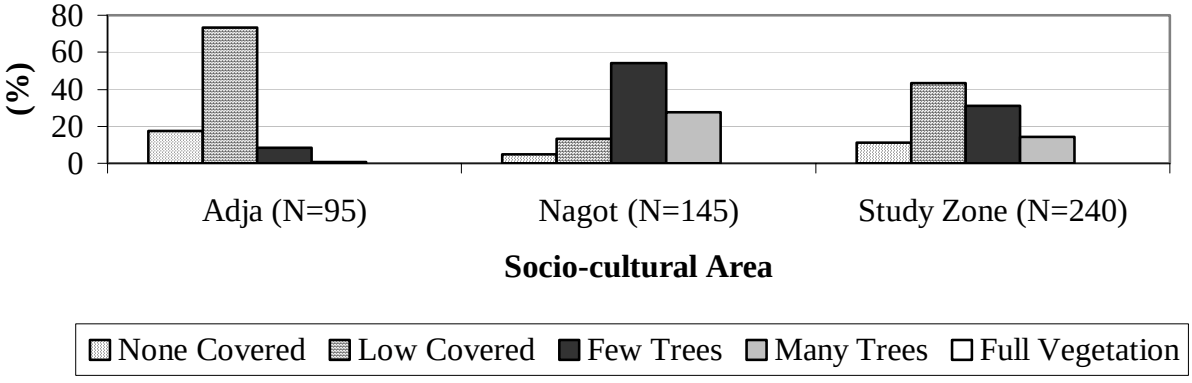



**Figure 5.3: Distribution (%) of the Ploughed Parcels according to their Vegetation Cover, 2001-2002**

### 5.2.4 Soil Degradation

The assessment of soil degradation is always a difficult process. Many studies used the quantification of soil nutrients to determine the extend of degradation. However, this methodology needs time and appropriate materials that unfortunately were not disposable for the present study. To overcome this challenge, soil degradation was quantified by physical soil erosion and the opinions of the farmers based mainly on their perception of yield decline in the

parcel. The degree of degradation was therefore ranked from 0 to 5: 0= no degradation, 1= very low, 2= low, 3= medium, 4= advanced and 5= very advanced degradation.

The analysis of the output presented in Figure 5.4 shows the higher soil degradation in *Adja* area than in *Nagot*. For instance, about 39% of *Adja* soils were highly degraded compared to 11.03% of *Nagot*. Moreover, 17.93% of *Nagot* area was not degraded compared to 8.42% of *Adja*, while 60% and 31.58% of soils had very low or low degradation in *Nagot* and *Adja* areas respectively. The results confirmed the earlier differences obtained for the two areas. Land pressure and farming system differences led to the conclusion that agricultural production in *Adja* area was more uncertain than in that of *Nagot*. According to the *Nagot* farmers, the degradation of their soil was due to mineral fertilizer overuse for cotton production. Currently they are worried about effects of over dependence of high output on such agricultural inputs. If agricultural policy does not change the situation, *Nagot* area could also regrettably attempts its soil fertility limits in very few years.

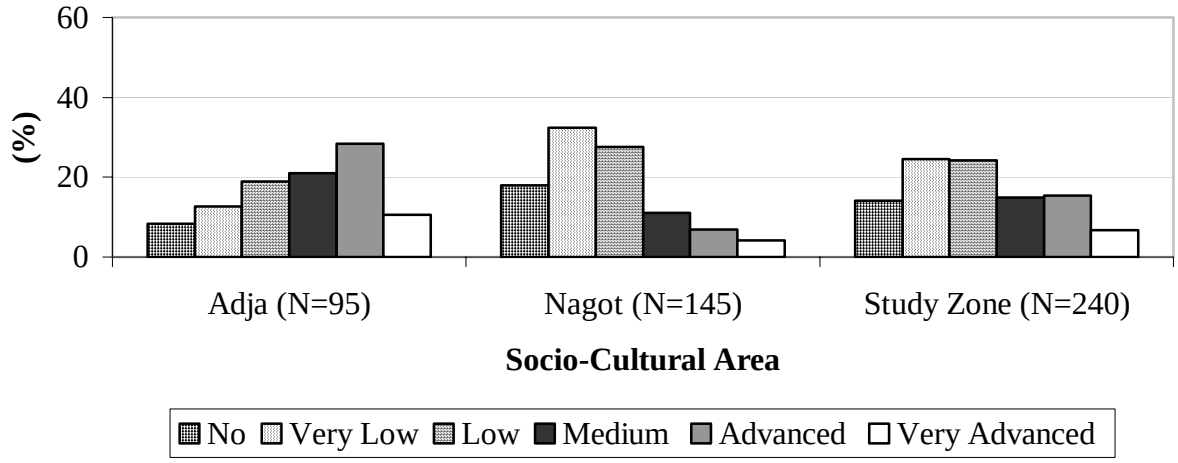



**Figure 5.4: Distribution (%) of the Ploughed Parcels according to the Degree of their Soil Degradation, 2001-2002**

## 5.3 Institutional Arrangements and Capacity of Local People

Local populations of the study zone were organized in associations or cooperatives that can be classified into three types (Table 5.7). First, the control and regulation of land and forest management are mainly in charge of the traditional institutions. Being a common feature in *Nagot* area, these institutions were considered illegal by the government but legitimate by local people. In the past, traditionally self-established laws for land and forest management by the local populations through their institutions worked harmoniously. Likewise, the institutions allowed them to reinforce the socio-cultural linkages in villages.

However, the enactment of new legal rules of the government caused a break to the working and the influences of traditional institutions.

The second type of associations included the more or less modern ones created by the people to tackle difficulties in agricultural production (e.g. credit and labor supply). Some of them are legal with status and working rules recognized by administrative authorities. Within this type of associations, the working of "*Groupement Villageois*" or *GV* can be termed successful but with some weaknesses. Constituted by cotton producers, the *GV* helped the members to defend their interests in a market system where various interests coexisted. Moreover, refunds from cotton commercialization enabled to (co)finance some public investments such as building social and sanitary infrastructure and to participate financially in agricultural projects.

The third type of associations were those established by the project teams to increase participation of local people. The members were the stakeholders of agricultural projects. During project implementation, the associations worked well but regrettably disappeared after the project termination. This shows the problems they have to sustain.

As discussed above, institutional arrangements and self-reliance capacity of local people were well established. Their reinforcement through agricultural projects could ensure the continuation of implemented activities after their termination and give hence sustainability to the projects.

**Table 5.7: Institutional Arrangements and Capacity of Local People, 2001-2002**

| Types | Roles | Frequency |
|---|---|---|
| **Type 1** | | |
| Traditional institutions for land and forest management | - Guarantee of sustainable management of land and forest<br>- Reinforcement of social and cultural linkages in villages | In many *Nagot* villages. Do not exist in *Adja* villages |
| **type 2** | | |
| "Groupements Villageois" (GV) | - Facility of access to agricultural credits<br>- Commercialization of cotton<br>- Informal training and education<br>- Infrastructure building<br>- Self-reliance capacity building<br>- Empowerment of cotton producers | In each village of the study zone |
| Mutual saving and credit associations | - Facility of access to agricultural credits<br>- Improvement of farmer's savings | In some villages |
| Mutual labor help associations | - Facility of access to labor<br>- Social linkage reinforcement | In many villages |

**Table 5.7 (Continued): Associations and Cooperatives of Local People and their Roles, 2001-2002**

| Types | Roles | Frequency |
|---|---|---|
| **Type 3** | | |
| Women associations | - Facility of access to agricultural credits<br>- Opportunity of income<br>- Training and informal education<br>- Women empowerment | In many villages |
| Associations or cooperatives created through agricultural projects | - Guarantee of institutional arrangement for project management and implementation<br>- Self-reliance capacity building | In villages where agricultural projects exist |

## 5.4 Concluding Remarks

The exploration of characteristics of local populations has allowed strengthen the differences that existed between the two socio-cultural areas of the study zone. As land pressure was greater and natural resources more degraded in *Adja* area than in *Nagot*, farming system was more intensive in the former area and the farmers adopted not only the use of fertilizers and insecticides, but also other modern agricultural technologies. Moreover, land endowment of *Adja* farmers was poorer but more efficiently used since the average added value of land was higher than that of *Nagot*. To spread the increased risk of agricultural production they developed off-farm activities that drove to higher total annual income. With regard to institutional issues and capacity building, various associations of producers were created, but they need more empowerment and reinforcement.

The present chapter has exclusively explored socio-economic characteristics of local people considered as beneficiaries of agricultural projects. In the next chapter, management of the projects is described and their goal achievement evaluated.

# 6 MANAGEMENT AND GOAL ACHIEVEMENT

Before analyzing the projects' impacts on beneficiaries, there is a need to put emphasis on their design, management, monitoring and goal achievement. In fact, quality and extent of impacts may closely depend on these aspects. In this chapter, design, conception and planning, management and monitoring of the selected projects are analyzed. These lead to evaluate goal achievement and identify its factors for its success. In the last part of the chapter, some indicators of production sustainability are computed according to groups of participation in projects.

## 6.1 Evaluation Approach of Design, Management and Monitoring

The measurement of design, management or monitoring quality may be opened to debate since the variables used were qualitative in nature. In this case, various studies use the scaling approach that TROCHIM (2000) defined as assignment of objects to numbers according to a rule. In general, the procedure is very complex and needs to follow the different steps rigorously. The literature provides three types of scaling approaches: THURSTONE or "equal appearing" scaling, LIKERT or "summative" scaling and GUTTMAN or "cumulative" scaling. They are similar in that they each measure the concept of interest on a number line. Moreover, the approaches are more relevant to attitudes or opinions of persons. But they differ considerably in how they arrive at scale values for different items.

As regards development projects, the quality of their factors does not depend on opinions or attitudes of persons, but on technical criteria. Therefore, the more the factors satisfy these criteria, the better their quality is. For this, BMZ (2000) used specific criteria to scale quality of design, management and monitoring of development projects that the German government financed in Less Developed Countries. To make the scaling succeed, criteria were stated and converted to questions. According to percentage of positive answers obtained, the variables to measure were ranked from 1=very bad to 10=very good.

The present study uses the same approach to evaluate the quality of design, management and monitoring of the selected projects. However, criteria of BMZ are combined with those suggested by MARGOLUIS and SALAFSKY (1998), as described in following sections (see also the complete criteria for each item in Appendix 2). During the field study, survey was conducted at projects' level to know whether the projects fulfilled the set criteria. The questions related to criteria were formulated as "yes or no" questions. Taking into account the percentage of positive answers ("yes"), the quality of the variables is ranked from 1=very bad to 5=very good. As explained above, the ranking was not based on

attitudes or opinions of persons, but on satisfaction of the defined criteria. Therefore, the quality measured may only reflect technical characteristics of the projects with respect to their design, management and monitoring, as experts of development projects view them through the criteria. Likewise, the scaling results obtained are based on documents provided by projects managers (monitoring reports, evaluation reports, consulting reports, etc.). Since the study was conducted during a short time, it can not cover the implementation period. Accordingly, it did not help to verify fully if the projects satisfy really the criteria during implementation. Nevertheless, the approach has helped to have ideas of design, management and monitoring quality for the selected projects.

## 6.2 Design, Conception and Planning of Activities

### 6.2.1 Design and Conceptual Model

Designing a conceptual model for project execution is the first important step of the project cycle, since a good conceptual model will help to determine why a project succeeds or fails. For instance, MARGOLUIS and SALAFSKY (1998) stressed that, (1) if the conceptual model truly shows how the project will influence the target condition, then its implementation will lead to desired results, (2) if the model is inaccurate, then initiating the proposed project will probably not lead to the desired results, i.e. theory failure, (3) if the model is accurate, but the implementation of the project is faulty, then it is likely that the desired results will not be reached, i.e. program failure, and (4) if the model is inaccurate and the project poorly implemented, then it is highly unlikely that there will be no positive results.

To reach good conceptual model of a project, it is commonly recognized nowadays that it must be based on local populations conditions by taking into account major direct and indirect threats affecting the target stakeholders. From this, to measure design and conception quality of the selected agricultural projects suitable criteria have been evaluated: (1) Have threats that affect target groups been identified and ranked with their collaboration before the design? (2) Have implementation possibilities been studied? (3) Has capacity of local people to face the project cost been explored? (4) Have local people institutions been involved in the project design? etc. According to the positive answers obtained from field study regarding the criteria above, a rank was given to the project. Rank 1 corresponded to a very bad design and conceptual model (between 0 and 20% of positive answers), 2 bad (between 20 and 40% of positive answers), 3 medium or acceptable (between 40 and 60% of positive answers), 4 good (between 60 and 80% of positive answers) and 5 very good (between 80 and 100% of positive

answers). The evaluation outcome presented in Figure 6.1 proved that the projects had a normal distribution according to the quality of their design and conceptual model. It shows neither project with a very bad model, nor with a very good one. Only 25% of the projects had good model while they were all expected to be well designed.

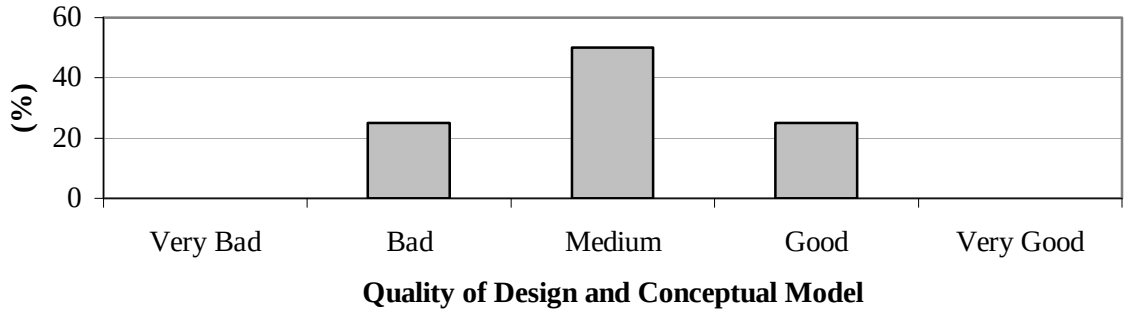



**Figure 6.1: Distribution (%) of the Selected Projects (N=20) according to the Quality of their Design and Conceptual Model**

The failure on design and conception was a setback of identification and ranking of problems affecting and hindering development of local people. Generally speaking, designers of project thought they had experience and knowledge on development problems of rural people. Therefore, they designed the project and planned its activities outside of stakeholders, and it led incontestably to a bad conceptual model. However, only the stakeholders actually know and appreciate better their challenges and a good model of design may be the one based on development priorities enumerated by local people.

Moreover, a look at Table 6.1 shows that 71.4% of national projects were badly designed, while 50% of English institutions (USA, the Netherlands, Germany, their NGOs, etc.) were good and 50% acceptable. However, the computed $\chi^2$ was significant at 5%, so the hypothesis of independence between the quality of design and the type of funds institutions cannot be rejected. The quality of design was not therefore statistically related to the type of institutions involved in the project financing and implementation.

### 6.2.2 Goal, Objectives and Activities Planning

After the design of the project, definition of goal and objectives and planning of activities are the second step of the cycle. These following criteria helped to measure the goodness of the objectives: (1) Do the beneficiaries participate in definition of the objectives? (2) Have the objectives been accepted by all the

actors involved? (3) Can the activities planned help to achieve correctly the objectives? (4) Can the implementation duration enough for objectives achievement? (5) Are the objectives achievement easily measurable?, etc.

**Table 6.1: Distribution (%) of the selected Projects (N=20) according to the Quality of their Design and Conceptual Model and Types of Funding Institutions**

| Types of Funding Institutions | Quality of Design and Conceptual Model | | | | | |
|---|---|---|---|---|---|---|
| | Very Bad | Bad | Acceptable | Good | Very Good | Total |
| National | 0 (0) | 5 (71.4) | 2 (28.6) | 0 (0) | 0 (0) | 7 (100) |
| French and Related | 0 (0) | 0 (0) | 2 (66.67) | 1 (33.33) | 0 (0) | 3 (100) |
| International Funds | 0 (0) | 0 (0) | 4 (66.67) | 2 (33.33) | 0 (0) | 6 (100) |
| English and Related | 0 (0) | 0 (0) | 2 (50) | 2 (50) | 0(0) | 4 (100) |
| Total | 0 (0) | 5 (25) | 10 (50) | 5 (25) | 0 (0) | 20 (100) |
| Pearson $\chi^2$=13.43* | | | | | | |

( ): % within Type of Funding Institutions *: Significant at 5%

The percentage of positive answers of criteria defined previously led to rank the selected projects according to the quality of their objectives into (1) very bad (0-20% of positive answers), (2) bad (20-40%), (3) medium or acceptable (40-60%), (4) good (60-80%) and (5) very good objectives (80-100%). Moreover, the frequency distribution is drawn according to the goodness of their objectives (Figure 6.2). In general, the projects' objectives were good (45%) or very good (25%). However, the results outlined here were provided from working papers of the projects. It is possible to be reserved about the real implementation of the defined objectives and the good monitoring of planned activities during the project execution.

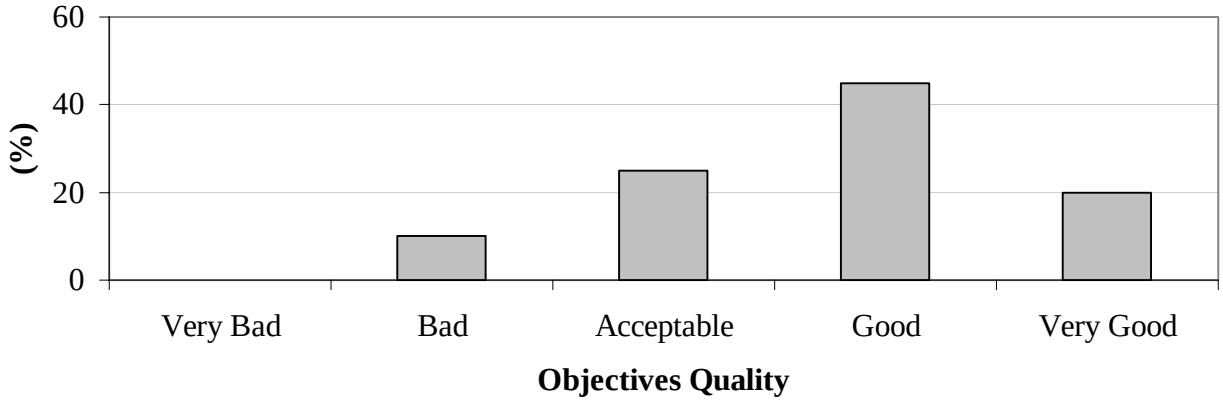



**Figure 6.2: Distribution (%) of the Selected Projects (N=20) according to the Quality of their Objectives**

## 6.3 Management of the Projects

After the project design, the definition of objectives and the schedule of activities, follows the execution stage. Implementing management plan of projects is probably the single most sensitive phase of the entire cycle because it is more practical than the previous phases, which are more theoretical. This section presents the internal organization of the projects, the transparency in their financial management and the participation of the local populations in the projects' activities. The various analyses determine the factors that affected management efficiency of the projects.

### 6.3.1 Internal Organization

The internal organization provides the relationships between the various actors (project teams, beneficiaries, government, donors and universities). These following questions helped to examine the quality of internal organization of the selected projects: (1) Are the functions defined during the implementation compatible with their objectives? (2) Can the projects' teams take some decisions or are decisions top down, coming from donors, government or project heads? (3) Is the qualification of the project agents compatible with these tasks? (4) Are rules and internal organizations established to control administrative working of the projects strictly followed?, etc. According to positive answers obtained, internal organization quality of the selected projects was ranked into (1) very bad (0-20% of positive answers), (2) bad (20-40%), (3) medium or acceptable (40-60%), (4) good (60-80%) and (5) very good (80-100%). From the results obtained, it was established that both the internal organization of projects and relationship between actors were complex. Likewise, project teams which had direct contact with local populations represented only 20-30% of the project component while the coordination of activities, the management of funds and some administrative works were in charge of the remaining 70-80%. For instance, most of government projects were implemented country widely with coordinators at every local levels. This made the project administration complex because very few extension agents had contact with beneficiaries. Besides, in most projects, political interventions and behaviors of some heads led to inconsistence in decision making and so the working of the project implementation was adversely affected. Consequently, only 15% of the selected projects had good or very good internal organization while 50% had very bad or bad internal organization (Figure 6.3).

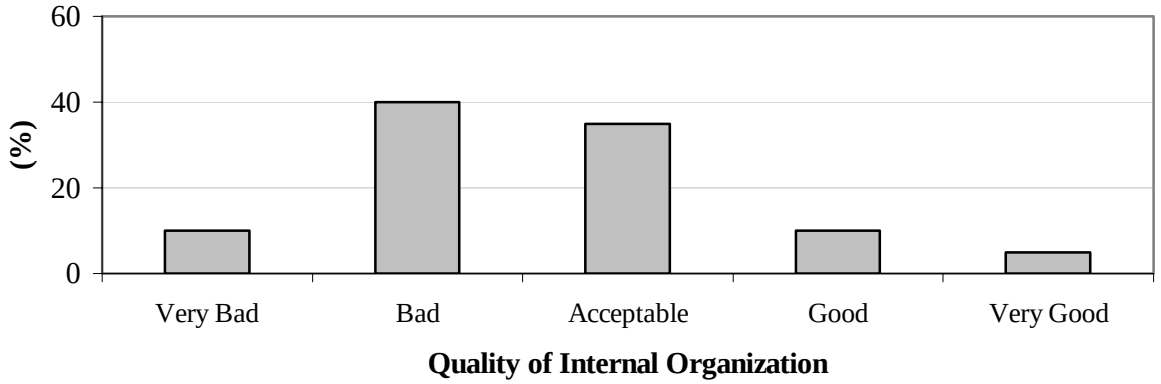



**Figure 6.3: Distribution (%) of the selected Projects (N=20) according to the Quality of their Internal Organization**

Additionally, no national project had good internal organization whereas some of the projects financed by international funds (FAO, UNDP, World Bank, etc.), English and related institutions (USA, Germany, the Netherlands, their NGOs, etc.) had good or very good internal organization (Table 6.2). The "English culture" that consists of providing in any situation good quality of organization and management would explain the situation. Conversely, political considerations and lack of transparency could not allow a good organization and management for national projects. Moreover, the operational environments were rigid, so that information and decisions come from the heads and are top-down. Therefore, the feed-back from beneficiaries and project agents working with them do not necessary reach the project heads and funds donors. As it will be later pointed out, such situation could hinder sustainability of some projects, in particular the national ones. Nonetheless, since the computed $\chi^2$ was significant and the null hypothesis of independence accepted, the quality of internal organization was not thus statistically related to the types of funds institutions.

**Table 6.2: Distribution (%) of the selected Projects (N=20) according to the Quality of their Internal Organization and Types of Funding Institutions**

| Types of Funding Institutions | Quality of Internal Organization | | | | | |
|---|---|---|---|---|---|---|
| | Very Bad | Bad | Acceptable | Good | Very Good | Total |
| National | 2 (28.6) | 5 (71.4) | 0 (0) | 0 (0) | 0 (0) | 7 (100) |
| French and Related | 0 (0) | 1 (33.3) | 2 (66.7) | 0 (0) | 0 (0) | 3 (100) |
| International Funds | 0 (0) | 2 (33.3) | 2 (33.3) | 2 (33.3) | 0 (0) | 6 (100) |
| English and Related | 0 (0) | 0 (0) | 3 (75) | 0 (0) | 1 (25) | 4 (100) |
| Total | 2 (10) | 8 (40) | 7 (35) | 2 (10) | 1 (5) | 20 (100) |
| Pearson $\chi^2$=20.95* | | | | | | |

( ): % within Type of Funding Institutions *: Significant at 5%

### 6.3.2 Funds and Transparency of Funds Management

The way the projects' funds are managed remains a difficult problem to tackle. As regards the present study, it is not possible to guarantee reliable data relative to funds management transparency of the selected projects. However, information from various internal or external sources led to the collection of data about the fund management of the selected projects. In chapter 4.1 related to description of the selected projects, funds amounts were presented. Therefore, this part of analysis focuses mainly on quality of funds management transparency. To achieve this goal, the following criteria were defined: (1) Are the percentage of the total funds exactly assigned to field activities above 50%? (2) Are the funds frequently available? (3) Have the financial management procedures been strictly respected? (4) Are funds management frequently controlled?, etc. According to results obtained with regard to these criteria, projects were classified into (1) very bad (0-20% of positive answers), (2) bad (20-40%), (3) medium or acceptable (40-60%), (4) good (60-80%) and (5) very good financing and transparency of fund management (80-100%). Results showed that half of projects had an acceptable transparency of fund management whereas about 30% had a good or very good. However, 20% showed poor quality of fund management essentially due to bad distribution of capital between the various activities of the projects, lack of regular controls of fund management and non-respect for fund management procedures (Figure 6.4).

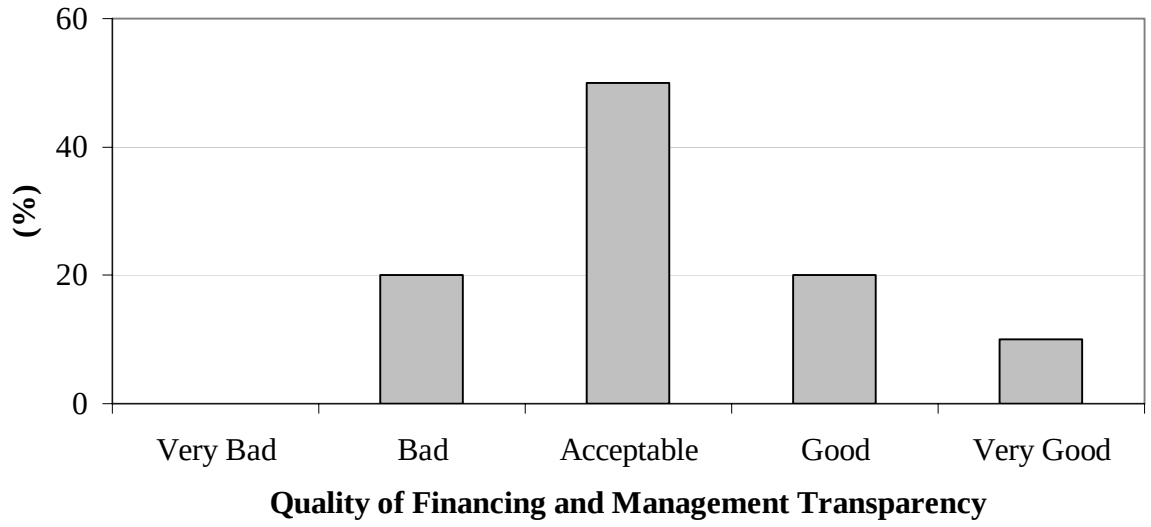



**Figure 6.4: Distribution (%) of the selected Projects (N=20) according to the Quality of their Financing and Transparency of Funds Management**

As it was the case at the internal organization level, 42.9% of national projects showed poor quality fund management whereas 50% and 25% of English and related projects had good and very good transparency of funds management (Table 6.3). In national projects, almost 60% to 70% of total project funds were allocated to seminars, conferences, salaries, cars and bus, administration working, etc., and the remaining 30%-40% to field actions for beneficiaries. From this, local populations considered the projects team as the ones that enjoyed projects. According to them, it is possible to approach agricultural projects as "*4 Wheel*" cars, funds for seminars and conferences and subsidy for project agents and heads. To increase quality and transparency of funds management there is therefore a need of easing the administration of the projects, concentrating funds on most important activities such as field actions directed at beneficiaries. Somehow, English and related projects can be considered as guide for improvement of management quality. Their administration was easier with minimum accessories such as cars, buses, seminars and conferences. Actions were more concentrated at stakeholders' level and this probably increased sustainability of their projects. However, the computed $\chi^2$ was significant and the null hypothesis of independence accepted. Actually, quality of financing and funds management transparency was not statistically related to the types of funds institutions.

**Table 6.3: Distribution (%) of the selected Projects (N=20) according to the Quality of their Financing and Transparency of Funds Management and Funding Institutions**

| Types of Funding Institutions | Quality of Financing and Transparency of Fund Management | | | | | |
|---|---|---|---|---|---|---|
| | Very Bad | Bad | Acceptable | Good | Very Good | Total |
| National | 0 (0) | 3 (42.9) | 4 (57.1) | 0 (0) | 0 (0) | 7 (100) |
| French and Related | 0 (0) | 0 (0) | 1 (33.33) | 1 (33.33) | 1 (33.33) | 3 (100) |
| International Funds | 0 (0) | 0 (0) | 5 (83.3) | 1 (16.7) | 0 (0) | 6 (100) |
| English and Related | 0 (0) | 1 (25) | 0 (0) | 2 (50) | 1 (25) | 4 (100) |
| Total | 0 (0) | 4 (20) | 10 (50) | 4 (20) | 2 (10) | 20 (100) |
| Pearson $\chi^2$=14.58* | | | | | | |

( ): % within Type of Funding Institutions *: Significant at 5%

### 6.3.3 Participation of Local People

In the selected projects, participation of beneficiaries was done through local associations and NGOs. Their participation consisted, in general, of financial contribution to project funds (15-20%) and of participation in some decision making. Following the works of OAKLEY (1988; 1991), CERNEA (1991), HINCHCLIFFE et al (1995), MARGOLUIS and SALAFSKY (1998) and BMZ (2000)

following criteria were defined to measure intensity of local people participation in projects: (1) Do local populations and their associations participate in decision taking during the project implementation? (2) Do they contribute financially to the projects? (3) Do stakeholders have clear idea of their roles in the project activities?, etc. Results of survey allowed to rank the selected projects into (1) very low (0-20% of positive answers), (2) low (20-40%), (3) medium or acceptable (40-60%), (4) high (60-80%) and (5) very high participation of local people (80-100%). In general, 35% of them had low participation of local people, 30% high and 30% acceptable (Figure 6.5). The situation of local people participation was on overall acceptable since the involvement of local NGOs and peasant associations in different projects ensured financial participation of stakeholders. Nevertheless, during the project implementation, it was difficult to take into account opinions of local people. In fact, most of the projects appeared rigid, and changing their orientation as conceived during design would be difficult.

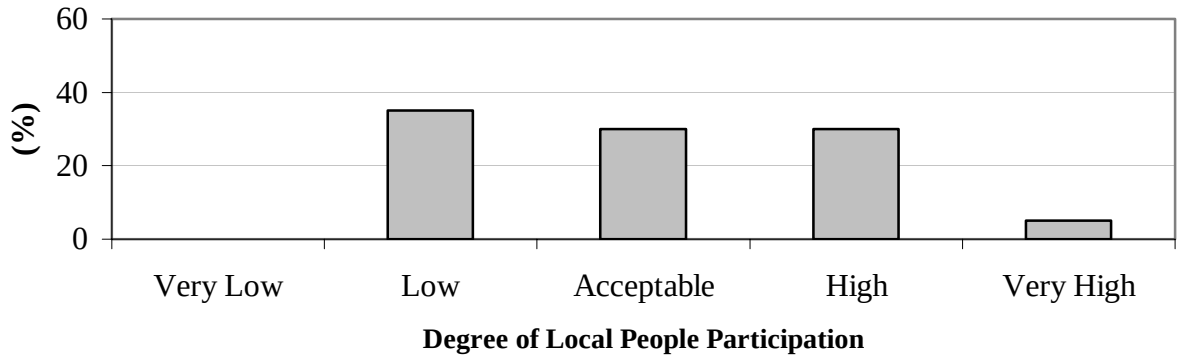



**Figure 6.5: Distribution (%) of the selected Projects (N=20) according to the Degree of Local People Participation**

As described in Table 6.4, no national project had a high or a very high level of participation. Worse, still 71.4% of them had a low level of participation. According to local people, national projects' heads would not discuss enough with them regarding natural resources management. On the other hand, the project heads stressed that local stakeholders did not follow legal laws that conditioned management of natural resources. The interpretation of the situation brought up a duality of perception between the legitimacy of natural resources use that local people supposed they have, and the legality of use that project agents control. At the same time, the other projects financed by another institutions involved more local people by increasing and improving their participation. Particularly, one American project had a very good participation of local people. In the project, all the decision making were transferred to target groups. The American technical

assistant helped them no more than to improve the management of the project and did not officially take alone any decision. Besides, the project team encouraged the local people to work legally. From this, the government can learn to increase local people participation in its projects since the control of rules should not hinder the transfer of competences and democratization for sustainable development. Nevertheless, the hypothesis of dependence between the types of funds institutions and intensity of local populations participation was not proved as the computed $\chi^2$ was significant and the null hypothesis of independence accepted.

**Table 6.4: Distribution (%) of the selected Projects (N=20) according to the Degree of Local People Participation and Funding Institutions**

| Types of Funding Institutions | Degree of local Population Participation | | | | | |
|---|---|---|---|---|---|---|
| | Very Low | Low | Acceptable | High | Very High | Total |
| National | 0 (0) | 5 (71.4) | 2 (28.6) | 0 (0) | 0 (0) | 7 (100) |
| French and Related | 0 (0) | 0 (0) | 1 (33.33) | 2 (66.66) | 0 (0) | 3 (100) |
| International Funds | 0 (0) | 2 (33.33) | 2 (33.33) | 2 (33.33) | 0 (0) | 6 (100) |
| English and Related | 0 (0) | 0 (0) | 1 (25) | 2 (50) | 1 (25) | 4 (100) |
| Total<br>Pearson $\chi^2$=13.18* | 0 (0) | 7 (35) | 6 (30) | 6 (30) | 1 (5) | 20 (100) |

( ): % within Type of Funding Institutions *: Significant at 5%

## 6.4 Monitoring and Evaluating the Projects

Monitoring and evaluation of projects enable the assessment of the degree of achievement of goals and objectives. When implementing the management plan, the monitoring must also be executed to have reliable success indicators' data. Monitoring also helps to discover failures in management implementation and allows adjusting project execution to improve on goals and objectives achievement. Indeed, the most important outcomes of monitoring and evaluating a project remain the lessons learnt at its termination that could be used to improve future ones. Hence, this section highlights the quality of evaluation systems of the selected projects, their weaknesses and lessons learnt to improve futures projects.

### 6.4.1 Quality of Monitoring and Evaluation Systems

According to MARGOLUIS and SALAFSKY (1998) and BMZ (2000), the following criteria in question form can be used to evaluate the quality of monitoring and evaluation systems of the selected projects: (1) Does a monitoring plan exist? (2)

Are the indicators to measure the project success clearly defined? (3) Are they measurable? (4) Do databases exist? (5) Are the beneficiaries involved in the monitoring system?, etc. The information collected from various sources led to rank the selected projects into (1) very bad (0-20% of positive answers), (2) bad (20-40%), (3) medium or acceptable (40-60%), (4) good (60-80%) and (5) very good monitoring and evaluation system (80-100%). The results show most of the projects had acceptable (55%) and good (35%) monitoring and evaluation systems while 10% had bad ones (Figure 6.6). However, databases did not sometimes exist or were not easily accessible, hence highlighting the secret surrounding most of them. Moreover, the local people stressed that their participation in project evaluation consisted only on answering researchers questions, and rarely were their opinions taken into account for implementation improvement. From this, data presented here would be different from what was done in reality.

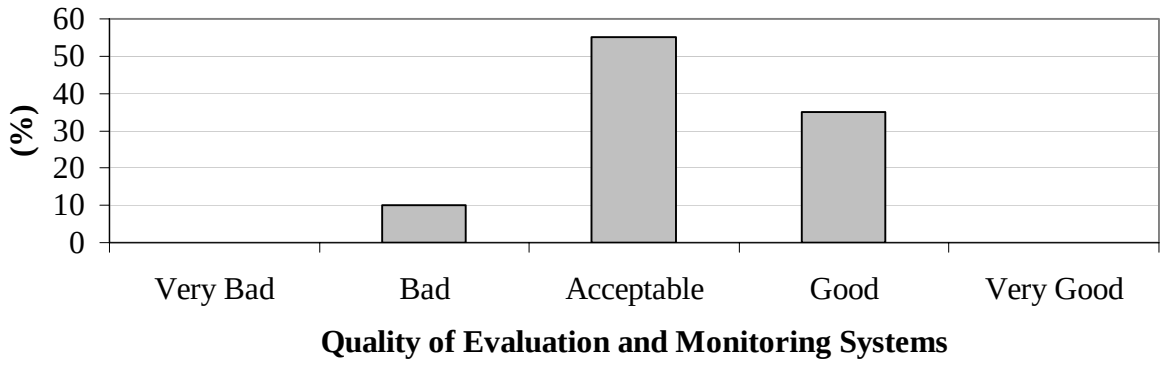



**Figure 6.6: Distribution (%) of the selected Projects (N=20) according to the Quality of their Monitoring and Evaluation Systems**

The frequency distribution of the projects according to the quality of their monitoring and evaluation systems and the types of funding institutions are presented in Table 6.5. It shows that international funds as well as English and related projects conceived and implemented relative good systems of monitoring and evaluation while those of the national projects were bad or of acceptable quality. Weaknesses of monitoring and evaluation concerning most of the projects, in particular the national ones, described below conducted somehow to very bad systems. However, the computed $\chi^2$, which was significant proved no statistical relationship between the two variables.

**Table 6.5: Distribution (%) of the selected Projects (N=20) according to the Quality of their Monitoring and Evaluation Systems and Funding Institutions**

| Types of Funding Institutions | Quality of the Evaluation System | | | | | |
|---|---|---|---|---|---|---|
| | Very Bad | Bad | Acceptable | Good | Very Good | Total |
| National | 0 (0) | 2 (28.6) | 5 (71.4) | 0 (0) | 0 (0) | 7 (100) |
| French and Related | 0 (0) | 0 (0) | 1 (33.3) | 2 (66.7) | 0 (0) | 3 (100) |
| International Funds | 0 (0) | 0 (0) | 3 (50) | 2 (50) | 0 (0) | 6 (100) |
| English and Related | 0 (0) | 0 (0) | 2 (50) | 2 (50) | 0 (0) | 4 (100) |
| Total | 0 (0) | 2 (10) | 11 (55) | 7 (35) | 0 (0) | 20 (100) |
| Pearson $\chi^2$=8.31* | | | | | | |

( ): % within Type of Funding Institutions *: Significant at 5%

### 6.4.2 Weaknesses and Lessons Learnt

Weaknesses that occur from the monitoring and evaluation systems can be summarized into three types. First, the secrecy surrounding the monitoring database until the project termination and sometimes after could be a handicap for the project success. Even if it helps to avoid bad criticisms in order to conduct the project at the end, it could also hinder the project teams and heads to improve the implementation due to low criticisms. Indeed, the evaluation results usually published at the project termination demonstrate the project failure. By publishing periodical monitoring results, criticisms of different experts could give suggestions for progress regarding the project success. Second, most of the projects are rigid and adjustment from monitoring results during implementation would be difficult. Monitoring and evaluation outcomes are always seen as tools to improve future projects and not the current ones. Third, according to opinions of local people and target groups, they have no idea on how the projects are monitored and evaluated. Here also the secret works. The opinions of local population are rarely weight to determine if they accept or reject the project impacts.

From weaknesses described above, it would be better for the project implementation and success improvement: (1) to periodically publish some results of monitoring and to submit them to criticisms while some sensitive data could be kept in secret; (2) to use monitoring results to improve on currently implemented project; (3) to involve local people in project monitoring and implementation as well as to give weight to their opinions during project monitoring and evaluation.

## 6.5 Goal Achievement of the Projects

A goal achievement of a project allows to appreciate how design, management, monitoring and evaluation issues help the success in objectives achievement. Therefore, this section presents the methodology of goal achievement measurement and explores the correlation between the quality of issues evaluated in previous section and the goal achievement. This helps to identify factors of success in achievement of objectives and activities of the projects.

### 6.5.1 Methodology of Measurement and Empirical Results

The appraisal of agricultural development projects is often constrained by time limitation. According to DILLON and PERRY (1977) when time limitation is real, the utility value (UA) permits an acceptable appraisal. The analysis allows the combination of the results of different methods by weighting the degree of goal achievement with a goal-specific factor and summing up all weighted goal achievements (utility value) of different project concepts and alternatives. Thus, the utility value (UA) is computed as:

$$UA = \frac{1}{\sum g_i} \sum g_i * GA_i \qquad (6.1)$$

where $UA$ is utility value with $0<UA<1$, $g_i$ the grading or weight and $GA_i$ the achievement of goal $i$.

Using this approach, empirical results were obtained from selected projects based on monitoring and evaluation reports that were available. Likewise, an example of calculation process is highlighted for the Farming Management Support Project, one among the twenty selected. The Utility Value of 0.43 showed the low goal achievement of the project, and was also quite close to the sample average (0.46). The Utility Values were distributed homogenously around the average with a variation coefficient of 39%. The majority of the projects had Utility Values below 0.5 while those of 20% of them were above 0.6. The range was between 0.24 (minimum) and 0.82 (maximum, Table 6.6). Generally, the results showed that goal achievement was poorer than expected widely due to low quality of design, management and monitoring previously discussed.

### 6.5.2 Factors of Success in Goal Achievement

Utility Analysis done above focuses more on goal achievement and fails in showing the factors explaining it, as well as their degree. In an attempt of carrying out these factors, the study draws a correlation matrix between the goal

achievement (Utility Value) of the projects and the described quality variables related to design and conception, management and monitoring.

**Table 6.6: Example of Utility Value Computation for the Farming Management Support Project and Empirical Results for the selected Projects (N=20)**

| Example of Utility Value Computation | Grading (Weight) | Achievement | Weighted Utility | Utility Value |
|---|---|---|---|---|
| Project Objectives | | | | |
| (1) To improve farming management to 50% | 5 | 0.52 | 2.6 | |
| (2) To make all the stake-holders self-reliant regar-ding farming management | 3 | 0.4 | 1.2 | 4.3/10=0.43 |
| (3) To reduce poverty to 50% | 2 | 0.25 | 0.5 | |
| Total | 10 | - | 4.3 | |
| | | | | |
| Empirical Results for Selected Projects (N=20) | | Mean | CV (%) | Minimum | Maximum |
| Utility Value | | 0.46 | 39 | 0.24 | 0.82 |

The results obtained in Table 6.7 showed, on one hand, that the projects' success in goal achievement was significantly and positively correlated to the type (integrated or single activity project), the funding institutions, the quality of internal organization, the degree of funds management transparency and the degree of local people participation. The Hypothesis 1 is hence verified. The better the internal management and local people participation, the better the utility value of agricultural projects, and hence the higher the success in goal achievement. Moreover, project and types of funding institutions, internal organi-zation and funds management transparency, as well as local people participation were identified as goal achievement factors. However, correlation coefficient of funding level was lower as compared to that of funds management transparency (0.27 against 0.67). This gave hence evidence that funds are necessary, but not sufficient for success in goal achievement, which needs additionally good transparency in management.

On the other hand, there was no significant positive relationship between the utility value and the quality of design and conception, the goodness of objectives and planning activities and the quality of monitoring and evaluation systems. Indeed, even when the design, the objectives and the monitoring and evaluation planning were well conceived, the good practices did not necessary follow. This shows a wide difference may exist between intention written during project conception and their implementation during project execution. For instance, some evaluations were done closely on visit of donors to prove the use of their funds. From this, no relationship would be identified with goal achievement since it

represented the result of what was really done during implementation. Accordingly, good design, objectives and monitoring as well as evaluation planning did not necessary lead to better goal achievement. International donors and governments, local government and other development actors should put therefore emphases on good practices and implementation of planning actions.

**Table 6.7: Rank Correlation Matrix of Variables of Agricultural Projects' Factors (N=20)**

| Variables | TYPRO | FININS | QUPDC | LOBJ | INTOR | TRAFIN | DEPOP | EFEVA | UA |
|---|---|---|---|---|---|---|---|---|---|
| TYPRO | 1 | | | | | | | | |
| FININS | 0.638** | 1 | | | | | | | |
| QUPDC | 0.289 | 0.675 | 1 | | | | | | |
| LOBJ | 0.000 | 0.134 | 0.080 | 1 | | | | | |
| INTOR | 0.653** | 0.707** | 0.583** | 0.174 | 1 | | | | |
| TRAFIN | 0.398 | 0.428* | 0.649** | 0.323 | 0.568** | 1 | | | |
| DEPOP | 0.510* | 0.596** | 0.461* | 0.077 | 0.807** | 0.611** | 1 | | |
| EFEVA | 0.492* | 0.505* | 0.227 | 0.204 | 0.497* | 0.369 | 0.676** | 1 | |
| UA | 0.726** | 0.674** | 0.534 | 0.061 | 0.912** | 0.668** | 0.890** | 0.606 | 1 |

** : Significant at the 0.01 level (2-tailed) *: Significant at the 0.05 level (2-tailed)
TYPRO=Project Type (integrated or not); FININS=Type of Funding Institutions; QUPDC=Quality of design and conception; LOBJ=Goodness of objectives; INTOR=Quality of internal organization; TRAFIN=Transparency degree of funds management; DEPOP=Degree of local people participation; EFEVA=Quality of monitoring and evaluation systems; UA=Utility Value

## 6.6 Agricultural Projects and Local Rural People

After the analysis and evaluation of the projects' management and goal achievement in the previous section, this current section describes relationships between local rural people and agricultural projects. It targets mainly agricultural projects indicators at beneficiaries level, the linkage with some sustainability indicators and adoption of modern technologies. Likewise, collaboration of stakeholders with the projects' teams and their opinions about the projects' activities are explored.

### 6.6.1 Projects Indicators at Beneficiary Level

The way the projects were implemented in the study areas allowed local people to get involved in several projects at the same time. In order to appreciate the presence of the projects at beneficiaries level, two indicators, relative to the projects in which each stakeholder was involved, were computed for him: (1) contact index and (2) goal achievement index. The contact index (*IC*) is expressed as the sum of contact frequency at stakeholder level and mathematically defined as:

$$IC_i = \begin{cases} 0 & \text{if the farmer } i \text{ was involved in no project} \\ \sum_{k=1}^{n} f_{ki} & \text{if he was involved in } n \text{ projects; } n = 1, 2, \ldots, p \end{cases} \quad (6.2)$$

Where, $IC_i$ represents the contact index of stakeholder $i$, $f_{ki}$ the frequency of contact this stakeholder $i$ did per week with the team of the $k$th project, $n$ the number of projects in which he participated.

As defined, the contact index considers only the frequency of contact with the beneficiaries. It fails to take into account success in achievement of activities that the projects completed. Conversely, the goal achievement includes the overall success in achivement of objectives and activities of the projects, and computing its index could help appreciating these aspects at beneficiary level. Therefore, by introducing in equation (6.2) the utility value of the projects as computed in equation (6.1), it is possible to define goal achievement index (*IS*) as:

$$IS_i = \begin{cases} 0 & \text{if the farmer } i \text{ was involved in no project} \\ \sum_{k=1}^{n} UA_k . f_{ki} & \text{if he was involved in } n \text{ projects; } n = 1, 2, \ldots, p \end{cases} \quad (6.3)$$

Where, $IS_i$ represents the goal achievement index of stakeholder $i$, $UA_k$ the utility value of the $k$th project in which he was involved as defined in equations (6.1). The $f_{ki}$ and $n$ are defined as in equation (6.2).

The results of descriptive statistics (mean and standard deviation) of the indexes (*IC*) and (*IS*) are presented in Table 6.8. Here, interpretation of the findings is not of big importance. However, the use of these indexes in following chapter will help estimate impacts of the projects on beneficiaries.

**Table 6.8: Mean and Standard Deviation of Indexes *IC and IS* of Farmers Participating in Projects, 2001-2002**

| Indicators of Projects | *Adja* Area Mean | *Adja* Area Standard Deviation | *Nagot* Area Mean | *Nagot* Area Standard Deviation | Study Zone Mean | Study Zone Standard Deviation |
|---|---|---|---|---|---|---|
| Contact Index (*IC*) | 1.6 | 0.14 | 1.6 | 0.09 | 1.6 | 0.12 |
| Goal Achievement Index (*IS*) | 0.54 | 0.11 | 0.49 | 0.10 | 0.5 | 0.11 |

### 6.6.2 Participation in Projects and Agricultural Production

The analysis of economic indicators of agricultural production showed no significant difference between their averages according to the groups of participation in projects in the two socio-cultural areas (F statistics are not significant at 5%, Table 6.9). Nevertheless, the farmers involved in projects had agricultural outputs higher than those of without project. Even though the variable costs of production were higher for the former, their gross margins were also better in comparison with farmers without project. However, the study scope did not cover the analysis of positive impact of projects on agricultural productivity. Additionally, the results demonstrated that the farmers with a single project had higher gross margins than those with 2 or more projects. This could be because those with a single project were more efficiently involved in the project than those with 2 or more projects. In addition, the effects of projects would be counterproductive to each other instead of being complementary. These results challenge the implementation of several agricultural projects at the same time and place, and as well the necessity for the farmers to get involved in several projects the same time.

**Table 6.9: Outputs, Variable Costs and Gross Margins (in fcfa/ha) of Agricultural Production according to Socio-cultural Areas and Groups of Participation in Projects, 2001-2002**

| Indicators | Groups of Participation | *Adja* Area Mean | *Adja* Area Standard Deviation | *Nagot* Area Mean | *Nagot* Area Standard Deviation |
|---|---|---|---|---|---|
| Outputs (A) | Without Project (N=20) | 165,604.39 | 66,733.14 | 149,518.75 | 33,056.27 |
| | With 1 Project (N=20) | 185,568.20 | 73,150.41 | 165,040.81 | 56,639.13 |
| | With 2 or more Projects (N=20) | 185,603.27 | 75,466.63 | 173,176.32 | 47,956.87 |
| | Total (N=60) | 178,925.29 | 71,285.30 | 162,578.63 | 47,154.54 |
| | F Statistic | F=0.515 (p=0.600) | | F=2.546 (p=0.087) | |
| Variable Costs (B) | Without Project (N=20) | 38,889.87 | 18,527.07 | 75,530.63 | 38,993.54 |
| | With 1 Project (N=20) | 46,248.09 | 18,858.39 | 59,469.37 | 32,326.24 |
| | With 2 or more Projects (N=20) | 47,847.97 | 18,977.79 | 80,743.43 | 47,546.82 |
| | Total (N=60) | 44,328.64 | 18,232.59 | 71,914.47 | 14,6251.10 |
| | F Statistic | F=1.111 (p=0.33) | | F=1.313 (p=0.277) | |
| Gross Margins (A-B) | Without Project (N=20) | 126,714.53 | 64,228.02 | 73,988.13 | 36,423.30 |
| | With 1 Project (N=20) | 139,320.11 | 76,215.20 | 105,571.44 | 48,445.88 |
| | With 2 or more Projects (N=20) | 137,755.29 | 72,111.86 | 92,432.89 | 47,514.77 |
| | Total (N=60) | 134,596.64 | 70,040.73 | 90,664.15 | 45,615.17 |
| | F Statistic | F=0.187 (p=0.82) | | F=0.722 (p=0.49) | |

### 6.6.3 Participation in Projects and Food Consumption

The analysis of food consumption showed no significant difference between its averages according to the groups of participation in projects in *Adja* area (F statistic is not significant at 5%, Table 6.10). Therefore, food consumption in *Adja* households involved in projects did not differ from those without project. Conversely, the F statistic is significant in *Nagot* area and food consumption in households of this area is different according to groups of participation in projects. However, the study scope could not allow for the analyses of projects impact on food consumption. Care is therefore needed to develop appropriate analysis tools to explore the impacts.

**Table 6.10: Annual Total Food Consumption (fcfa per capita) according to Socio-Cultural Areas and Groups of Participation in Project, 2001-2002**

| | *Adja* Area | | *Nagot* Area | |
|---|---|---|---|---|
| Groups of Participation | Mean | Standard Deviation | Mean | Standard Deviation |
| Without Project (N=20) | 28,770.8 | 34,524.30 | 28,196.6 | 25,596.09 |
| With 1 Project (N=20) | 32,925.1 | 34,573.68 | 30,279.5 | 20,773.98 |
| With 2 or more Projects (N=20) | 33,935.6 | 36,542.57 | 29,537.1 | 24,487.28 |
| Group Total (N=60) | 31,877.1 | 34,697.14 | 29,337.7 | 27,429.77 |
| F Statistic | | 0.12 (p=0.886) | | 5.08 (p=0.009) |

### 6.6.4 Participation in Projects and Soil Degradation

The relationship between agricultural projects and soil degradation varied according to socio-cultural area (Table 6.11). In *Adja* area, the $\chi^2$ was not significant and one can conclude that soil degradation was related to participation in projects. In other words, the results showed that proportions of degraded soil for farmer involved in projects were lower than those of without project. However, farmers with single project had lower proportion of soil degradation than that of farmers with 2 or more projects. As in the case of agricultural productivity, farmers with single project benefited more from projects than those with 2 or more projects. The reasons for this situation were discussed earlier. In *Nagot* area, the $\chi^2$ was significant and it is possible to draw a conclusion of independence between soil degradation and participation in projects. Since land was still relatively available and fertile in this area, soil degradation was not related to intensity of participation in projects.

The analysis done above however, explores only the relationship between soil degradation and participation in projects. The study cannot, therefore, conclude on the impact of projects on soil degradation.

**Table 6.11: Distribution of the Plots according to their Degradation and Groups of Participation in Projects, 2001-2002**

| | | Group of Participation in Projects | | |
|---|---|---|---|---|
| Soil Degradation | Without Project | With 1 Project | With 2 or more Projects | Total |
| Adja Area | | | | |
| No Degradation | 3 (09.68)[a] | 6 (17.65) | 5 (16.67) | 14 (14.74) |
| Degradation | 28 (90.32) | 28 (82.35) | 25 (83.33) | 81 (85.26) |
| Total | 31 (100) | 34 (100) | 30 (100) | 95 (100) |
| $\chi^2$=7.02 (p=0.24) | | | | |
| Nagot Area | | | | |
| No Degradation | 22 (44) | 11 (18.33) | 8 (22.86) | 41 (28.28) |
| Degradation | 28 (56) | 49 (81.67) | 27 (77.14) | 104 (71.72) |
| Total | 50 (100) | 60 (100) | 35 (100) | 145 (100) |
| $\chi^2$= 2.74 (p=0.04) | | | | |

a: The Figures in bracket are frequencies within Group of Involvement in Projects

### 6.6.5 Participation in Projects and Adoption of Modern Technology

One of main purposes of the projects' teams is to popularize and to diffuse the modern agricultural technologies that the stakeholders can adopt. From this, the better the farmer is involved in projects, the more he will adopt modern innovations. This was confirmed by data presented in Table 6.12. Indeed, the index of modern technology adoption was greater for the "with 2 or more projects" group than that of "with 1 project" one. However, there is evidence that the farmers who did not get involved in any project had an index of modern technology adoption greater than zero. In fact, these farmers went on adopting innovations that they learnt from previous projects in which they were involved or from another information sources. One can notably remark the use of mineral fertilizers and insecticides on which they depended for better productivity. The difference in modern technology adoption between farmers with no project and those involved in projects came from the fact that the latter, besides the use of mineral fertilizers and insecticides, practiced certain anti-erosive and agro-forestry techniques and adopted high yielding varieties. Nevertheless, it is not possible to conclude at this analysis level that participating in projects may cause adoption. There is a need of appropriate farmers' decisions modeling to explore later such causality.

**Table 6.12: Index of Modern Technologies Adoption (*MA*) according to Socio-cultural Area and Groups of Participation in Projects, 2001-2002**

| Socio-cultural Area | Groups of Participation | | | |
|---|---|---|---|---|
| | Without Project | With 1 Project | With 2 or more Projects | Whole Sample |
| Adja (N=60) | 0.39 (0.14)[a] | 0.62 (0.19) | 0.69 (0.21) | 0.56 (0.22) |
| Nagot (N=60) | 0.24 (0.20) | 0.53 (0.09) | 0.62 (0.16) | 0.46 (0.22) |
| Study Area (N=120) | 0.31 (0.19) | 0.57 (0.15) | 0.65 (0.19) | 0.51 (0.23) |

a: Figures in bracket are standard deviation

### 6.6.6 Opinions of Stakeholders about the Projects

The opinions that the local populations in general and the beneficiaries in particular had about agricultural projects were erroneous and could be harmful to the projects' sustainability. Indeed, projects were seen as funds institutions conceived to develop local people through money disbursement. According to them, projects should lead undoubtedly to their development if they are well implemented. For instance, 97.5% of the interviewed farmers thought that activities of projects are useful as opposed to 2.5% who reported them useless.

In order to achieve development through agricultural projects, local people maintained excellent relations with the projects' teams. Indeed more than 90% reported to have very good relations with the agents of projects in which they participated. The situation would be clearly justified by the experience that they had from projects. According to them, projects have many funds in the sense that they have many "*4 Wheel*" cars and motorcycles. Besides, the living standards of agents increased often quickly because of mission payments, seminar primes and other financial advantages. Subsequently, projects should also be capable to positively change their living conditions.

In reality, the point of view of local rural people was the corollary of project management that was presented in the previous chapter. It would favor mainly the projects' teams and not the beneficiaries. Therefore, the hopefully opinions become illusions because the expected impacts do not necessary follow when the farmers get involved in the projects and start on working with their teams. To remedy the situation that would regrettably compromise the projects' sustainability, agricultural policies should demonstrate to the local people that projects are conceived not to disburse money, but to accompany their own development efforts and to allow them to successfully improve their welfare. This change can be achieved through efficient way of managing and implementing agricultural projects that allows targeting effectively the sustainable development of local

people. In order to succeed, the projects' teams have to be aware that agricultural projects are designed and implemented largely for the development of local people and not for their own development. The use of a great part of the projects' funds for purchase cars and motorcycles as well as for organization of seminars and mission primes has proved inefficiency and cannot achieve the sustainable development for the beneficiaries.

## 6.7 Concluding Remarks

Analysis of management effectiveness and goal achievement of the selected projects showed poorer design, conception, implementation, monitoring and evaluation than expected. While international funds, English and related projects were better designed, implemented and evaluated, and had therefore relative high management effectiveness, national ones were worse due to their rigidity, complexity, low transparency and control, meaning they had relative low management effectiveness. From these results, rigidity, complexity, low transparency and control associated with high corruption, as well as low participation of beneficiaries could be considered as inefficiency factors of goal achievement.

Factors of success in goal achievement were identified as quality of internal organization, and funds amount and management transparency, as well as intensity of local population participation. However, correlation of funding level was very low, meaning it should be associated to high management transparency for success in goal achievement. Conversely, good design and conception, definition of excellent objectives and activities planning as well as efficient monitoring and evaluation systems planning did not lead to better goal achievement, probably because of poor implementation and control. Therefore, recommendations for improvement on management and success in goal achievement should be more focused on these weaknesses.

As living conditions were made more difficult in rural areas, the population willingness to get involved in agricultural projects and go in working with their teams for welfare improvement was higher. In reality, local people in either *Adja* or *Nagot* had built opinions that agricultural projects are useful and have capacities to enhance their welfare. However, the task remains to show whether the projects have positive impacts on their environment. Regrettably, the level of analysis developed in this chapter explores only differences between groups of participation in projects, and as well relationships between participation and some indicators of sustainability. Likewise, the utility value computed shows only the projects succeed in achievement of their objectives. It does not allow assessing explicitly the impacts on beneficiaries and sustainability of the projects. In next

chapter, the two indexes of the projects defined at beneficiary level will help to assess the impacts and estimate how much improvement on design, management and monitoring, as well as on goal achievement of the projects affected the beneficiaries' living conditions.

# 7 IMPACTS OF THE PROJECTS

After analyzing design, management and monitoring of the projects, and evaluating their goal achievement in chapter 6, this chapter, related to Objective 2 and Hypothesis 2 of the study, presents in a deeper way the impacts of the projects on stakeholders and rural areas. In the first part, using the "*with-without*" approach, literature review of econometric models leads to specify the empirical models and to derive results that allow estimating the impacts. Impact assessment is done in two dimensions by considering the projects' indicators contact and goal achievement indexes. The second part of the chapter uses the "*before-after*" approach to evaluate impact of the projects on capacity building of beneficiaries. In the final section, opinions of local people about the impacts and usefulness of the projects are explored.

## 7.1 Econometric Models

### 7.1.1 Theoretical Bases

In development research, the interest is to investigate relationships between two or more variables. Typically, the problem is to come to grips with relations between variables in non-deterministic situations in which regularity of data goes hand in hand with considerable random error fluctuations. A statistical model on which we rely to analyze such relations between variables is an abstraction we use to characterize and explain the variability in real data. As well, it is a pure theoretical construction in a double sense. First, to model the data we draw upon substantive theory, and second, one relies on probability and statistical theory to model stochastic nature of the relations between variables (MUKHERJEE, WHITE and WUYTS, 1998; RAMANATHAN, 1992).

MUKHERJEE, WHITE and WUYTS (1998) modeled the mean and produced the simplest statistical model. In fact, its systematic component merely stated that the variable fluctuates around a constant population mean, μ. Therefore:

$$Y_i = \mu + \varepsilon_i \quad i=1, 2, \ldots, n \tag{7.1}$$

where $\varepsilon_i$ is a random variable which depicts the random fluctuations of the data around its constant mean and is supposed $N(0,\sigma^2)$. In statistical language, this random variable is referred to as the error term or disturbance term of the model. However, the first task they had to confront was to check whether the assumption of a constant mean is reasonable, for example in case of time variation.

The study of relationships between variables extends the idea of an average as the systematic component of a statistical model by making the average of the

dependent variable conditional upon the values of explanatory variables. Hence, it is not only one average, but a line or curve of averages of the dependent variable for different values of the explanatory variables. This line or curve of average is called the regression of the dependent variable on the explanatory variables. Mathematically, the regression can be expressed as:

$$Y_i=f(X_{1i}, X_{2i}, \ldots, X_{ni}, e_i) \quad (7.2)$$

where $Y_i$ is the dependent variable, the $X_{1i}, X_{2i}, \ldots, X_{ni}$ the explanatory variables and the $e_i$ the terms of error supposed $N(0,\sigma^2)$.

Various estimators allow to compute the regression coefficients and to estimate the degree of explanation. The Ordinary Least Square (OLS) is the common used since it gives attractive statistical properties as well as providing the foundations for statistical inference based on the least squares regression line or curve. However, the use of the OLS as estimator required the condition that all explanatory variables are exogenous. When it is not the case, i.e. existence of endogenous explanatory variables, the bias is corrected by using for example simultaneous equations and the Two Stage Least Square as estimator. Moreover, when the dependent variable is categorical in nature, there is a need of transformation to probabilities and of utilization of Maximum Likelihood as estimator (RAMANATHAN, 1992). To sum up, the choice of estimator is closely related to the situation the study deals with. As regard the current study, the choice of estimator will be explained in related sections.

Nevertheless, regression analysis allows theoretically only to investigate the statistical association, but not the causality between two or more variables. Even if the use of terminology such as dependent or independent variable often suggests to contrary, one should never forget that a regression model only depicts statistical association between variables, but in itself cannot establish the direction of causality between them (for more details, see MUKHERJEE, WHITE and WUYTS; 1998).

### 7.1.2 Model Specification and Mathematical Formulations

The selection of model and mathematical formulation remain complex tasks in regression. Care is needed to avoid misspecification by omitting relevant explanatory variables or adding irrelevant ones. As well, the form of the relation between the dependent and independent variables should be fit.

The simplest forms of model developed through empirical researches were linear regressions. They established linear relation between the variables. For example, the demand of a product is proved a linear function of its price, and as well the

consumption a linear function of income (KEYNES theory). Nevertheless, the relations between dependent and independent variables are mostly non-linear.

The production function that establishes relation between output and inputs appears non-linear. In order to take into account the three distinct "stages" observed in production curve, COBB and DOUGLAS developed the famous production function expressed mathematically as:

$$\ln y = \ln a_0 + \sum_{i=1}^{n} a_i \ln x_i + e \qquad (7.3)$$

where $y$ is the output, $x_i$ the inputs, $a_i$ the elasticities and *ln* the logarithm function.

The Cobb-Douglas production function is easy to estimate and mathematically manipulated, but is restrictive in the proprerties it imposes upon the production structure, such as a fixed Returns To Scale (RTS) and an elasticity of substitution equal to unity. To overcome these restrictions upon the production structure, various functional forms of production were developed. They included the trans-log, the Constant Elasticity of Substitution (CES) and the ZELLNER-REVANKAR forms.

Actually, two schools of model specification approach exist. According to the traditional approach, model specification was the exclusive preserve of theoretical groundwork. Data entered the scene only to test whether a model stood up to scrutiny and to estimate its unknown coefficients. In contrast, strategies of modern approach share the entire common characteristic that they tend to be more data-centered, meaning that they allow data to play a more predominant role in model specification. To succeed their specification, MUKHERJEE, WHITE and WUYTS (1998) suggested the "general to specific modeling". The first step of the approach consisted of formulating a general model with encompasses rival explanations deemed relevant in the light of theoretical research. The task is to make sure that the initial broader model is itself an adequate specification of the data-generating process. In the second step, the researcher attempts to simplify the general model by imposing restrictions on it, the validity of which can be formally tested. In this way, there is a hope of arrival at a simpler model, which is acceptable in the light of the empirical evidence. The approach seems highly relevant to the context of Less Development Countries. For example, if the interest is to estimate a demand function for food in rural areas, one can rely on demand theory and a wide range of empirical findings to guide the work. In this context, it is preferable to make sure that the general specification includes all variables deemed relevant (in particular socio-cultural variables) and, subse-quently, to proceed by testing downwards. From the foregoing discussion, the

approach “general to specific modeling” is widely used in the study for specification of empirical models.

## 7.2 Specification of Empirical Models

### 7.2.1 Productivity and Technical Efficiency

7.2.1.1 Productivity

AIGNER, LOVELL and SCHMIDT (1977), MEEUSEN and VAN DEN BROECK (1977) and various others first proposed the basic concept of a Cobb-Douglas stochastic frontier production models. Besides, various studies showed that some farmer’s socio-economic characteristics such as education level, sex, age, land tenure, etc. have as well an impact on production. Furthermore, there is a need of introducing the indicators of the projects to estimate their impacts. The model, which combines the Cobb-Douglas and linear specifications, is thereby expressed as:

$$\ln(y_i) = \alpha_0 + \kappa_1 \ln(LAND_i) + \kappa_2 \ln(LABOR_i) + \kappa_3 \ln(CAPI_i) + \alpha_4 IP_i + \alpha_5 PRO_i + \alpha_6 AGE_i + \alpha_7 SEX_i + \alpha_8 EDU_i + \alpha_9 ALPH_i + \alpha_{10} TEN_i + \varepsilon_i \quad (7.4)$$

where ln(.) is the natural logarithm; *i* the ith farmer.

The $y_i$ are the value of land output expressed in fcfa*ha$^{-1}$. They are computed from the main cultivated crops such as maize, cotton, cassava, nuts, beans, and yams. *LAND* is the overall cultivated area in ha while *LABOR* the total family labor used expressed in man-day per ha, and *CAPI* the total capital used in fcfa per ha. The total capital is calculated as the total amount of input expenditures (seed, fertilizer, pesticide, hired labor, etc.).

*PRO* is a dummy variable representing the project type. *PRO*=1 if the project is integrated and 0 if it is single activity project. *AGE* is the age of the farmer (year). *SEX* is a dummy variable expressing the sex of the farmer. *SEX*=1 for a man and 0 for a woman. *EDU* is a dummy education variable. *EDU*=1 if the farmer is formally educated and 0 if not. *ALPH* is a dummy informal education variable. *ALPH*=1 if the farmer had received informal education and 0 if not. *TEN* is a dummy variable of land tenure. *TEN*=1 if the cultivated land is secured and 0 if not.

*IP* are projects’ indicators. These are contact index (*IC*) and goal achievement index (*IS*) defined respectively as in equations (6.2) and (6.3). Two regression models are estimated with each indicator of projects taken separately to the other, but together with the explanatory variables developed above. According to

hypothesis of positive impact of agricultural projects on productivity, the parameters of indicators *IP* are supposed to be positive and significant. As well, the other parameters are expected positive and significant expressing hence the positive impact of their related factors.

The $\varepsilon_i$ are the error terms and the $\kappa$ and $\alpha$ parameters to be estimated. The $\kappa$ give the elasticities of the productivity with respect to the corresponded farm-supplied factors (excluding land[1]) and the $\alpha$ the percentage increases in productivity in response to a unit increase in the related variables.

In the estimation of production functions, land, labor and capital are sometimes considered as endogenous variables, which suggest that the OLS procedure will result in inconsistent estimators. However, ZELLNER, KMENTA and DREZE (1966) argued that since firms were to maximize expected profit rather than *ex post* profit, one can use OLS to estimate the production function. The logic is that if one considers output, land, labor and capital as endogenous variables in a simultaneous equation system, the optimal inputs are derived from the firm's first-order conditions. Solving for the reduced forms for the endogenous variables, it is reasonable to assume that the error terms for land, labor and capital are due to human errors of managerial judgment and that error terms for output are due to acts of nature. Because of these assumptions, land, labor and capital are independent of the error terms for production. Hence OLS estimation gives consistent estimators for the parameters $\kappa$ and $\alpha$.

#### 7.2.1.2 Technical Efficiency

As developed in chapter 3, the economic efficiency can be decomposed into technical efficiency and allocative efficiency. In the study zone, lands are obtained through inheritance and the labor essentially familial. Accordingly, land and labor prices are not available or are the same for farm households, and it appears hence difficult or unrealistic to estimate the cost-frontier function. Therefore the study focuses on estimation of technical efficiency. Following the specifications of BATTESE and COELLI (1995), the stochastic frontier Cobb-Douglas production function is established to model the impacts of projects on technical efficiency of cotton production, which is the main cash crop and benefit more from interventions of agricultural projects. The agricultural output can be subsequently:

$$\ln(y_i) = \beta_0 + \beta_1 \ln(LAND_i) + \beta_2 \ln(LABOR_i) + \beta_3 \ln(CAPI_i) + (v_i - u_i) \quad (7.5)$$

[1] Since the productivity is the output per unit of land, the parameter of land represents the return to scale.

The $v_i$ are random variables which are assumed to be $N(0,\sigma_V^2)$ and independent of the $u_i$, which are non-negative random variables, which are assumed to account for technical inefficiency in production and are often assumed to be $|N(0,\sigma_U^2)|$. The $y_i$ are cotton output (in kg/ha), the variables *LAND*, *LABOR* and *CAPI* the same as defined in equation (7.4) and the $\beta$ parameters to be estimated.

The technical efficiency $TE_i$ of the *ith* farmer is therefore computed as:

$$TE_i = e^{(-u_i)} \tag{7.6}$$

where $e^{(.)}$ is the exponential function.

By modeling inefficiency effects, it is possible to consider the indicators of agricultural projects *IP* within inefficiency factors. In so doing, the technical inefficiency effect for the *ith* farmer, $u_i$, is obtained by truncation of the $N(\mu_i,\sigma^2)$-distribution, where

$$\mu_i = \delta_0 + \delta_1 IP_i + \delta_2 PRO_i + \delta_3 AGE_i + \delta_4 SEX_i + \delta_5 EDU_i + \delta_6 ALPH_i + \delta_7 TEN_i + e_i \tag{7.7}$$

The variables *IP*, *PRO*, *AGE*, *SEX*, *EDU*, *ALPH* and *TEN* are the same as defined in equation (7.4). The $\delta$ are parameters to be estimated and $e_i$ the error terms. Here, the $\delta$ related to the *IP* considered is supposed to be negative and significant according to the hypothesis that agricultural projects have positive impacts on technical efficiency, that means negative impacts on inefficiency. Following the same process as in productivity, two models are estimated with respect to projects' indicators *IP*.

Using the computer program Frontier Version 4.1 provided by COELLI (1996) the processing of the models follows three-step procedure in estimating the maximum likelihood estimates of the stochastic frontier Cobb-Douglas production function. First, the Ordinary Least Squares (OLS) estimates of the function of the equation (7.5) are obtained. Second, a two-phase grid search of inefficiency and its effects is processed. Third, the values selected in the grid search are as starting values in an iterative procedure to obtain the final maximum likelihood estimates.

### 7.2.2 Food Consumption

The strong link between food consumption and income is well documented in consumer demand theory, dating back to ENGEL. For instance, JONES and MUSTIFUL (1996) used scanner data from stores in low- and high-income locations to analyze consuming behavior for breakfast cereals when prices were uniform.

They concluded that low-income consumers made rational consumption decisions, had higher price elasticities of demand, and consume the least expensive products within the product category. As well, many studies showed that food consumption in rural households is influenced by agricultural production, household size, age distribution, level of formal or informal education and cultural background (MCDOWELL, ALLEN-SMITH and MCLEAN-MEYINSSE, 1997). Moreover, participation in agricultural projects is also considered as a factor, which is influential in food consumption. Accordingly, the mathematical empirical model describing food consumption at household level is given by:

$$\ln(Q_i) = \theta_0 + \theta_1 \ln(SIZE_i) + \theta_2 \ln(REV_i) + \theta_3 IP_i + \theta_4 PRO_i + \theta_5 EDU_i + \pi_i \qquad (7.8)$$

where ln(**.**) is the natural logarithm, *i* the *ith* farmer's household.

The $Q_i$ are the total annual food consumption per capita (fcfa per year per capita). Food consumption is computed as the total amount of value given to consumed food provided from production stocks according to prices and the value of food actually bought by the household.

*SIZE* expresses the household size, *REV* the total annual per capita revenue of the household (fcfa per capita). *IP*, *PRO* and *EDU* are defined as in equation (7.4). Following the same process as in the case of productivity, two models are developed with respect to the *IP* indicators. $\pi_i$ are independent distributed error terms assumed to be normal distributed with zero mean and constant variance $\sigma^2$, and the $\theta$ are parameters to be estimated.

Following the hypothesis that agricultural projects have positive impact on food consumption, the $\theta_3$ parameters of *IP* are supposed to be significant and positive. Additionally, those of *REV*, *EDU* and *PRO* are also expected significant and positive, while that of *SIZE* negative and significant. Here the household size and revenue are supposed exogenous from consumption and the Ordinal Least Square (OLS) is used to estimate the consumption function.

### 7.2.3 Land Degradation

Many mathematical models have been used to estimate soil erosion and degradation. The Universal Soil Loss Equation (USLE), developed by WISCHMEIER et al. (1958) is the most common empirical-mathematical model used to estimate soil erosion. In fact, it estimates average annual rates of sheet wash erosion, that are quantified in tons per hectare by integrating natural and man-made factors influencing erosion and degradation. It can also allow predicting erosion rates under proposed alternative management systems.

However, time and resource limitations that characterize the current study did not allow to estimate average annual rates of sheet wash erosion. Therefore, soil degradation is supposed to be distributed within a dummy two-point scale (0=no degradation, 1=degradation), and soil is considered as degraded if the farmer according to his own opinions and appreciation criteria recognizes the erosion.

Since the soil degradation is expressed here as dichotomous variable, limited dependant variable models can be applied for econometric estimation. This type of non-linear statistical model relates degradation probability to explanatory factors. The objective is to model and estimate the probability that farmers know degradation of their soil upon specific farm and farmer characteristics. For this kind of discrete binary value for degradation variable, probit or logit models are most appropriate (VANSLEMBROUCK, VAN HUYLENBROECK and VERBEKE, 2002). Whereas the logit model is based on the logistic Cumulative Distribution Function (CDF), the probit model is based on the normal CDF. According to AMEMIYA (1985), the choice of which continuous probability distribution to use for producing predictions cannot be justified on theoretical grounds. For reasons of convenience and previous experience, the standard normal distribution and thus the probit model is used at plots level and expressed as:

prob($DEGRA_i$=1) = $\Phi(\Theta_i)$ and prob($DEGRA_i$=0) = 1- $\Phi(\Theta_i)$ with

$$\Theta_i = \omega_0 + \omega_1 IP_i + \omega_2 PRO_i + \omega_3 DUREX_i + \omega_4 TEN_i + \omega_5 TA_i + \omega_6 MA_i + \omega_7 AGE_i + \omega_8 EDU_i + \omega_9 ALPH_i + \varpi_i \quad (7.9)$$

where $\Phi(.)$ is used to indicate the cumulative normal distribution, *i* the *ith* farmer, *DEGRA* a dummy soil degradation variable. *DEGRA*=1 if degradation and 0 if not. *DUREX* expresses the number of years the plot was cultivated. *IP*, *PRO*, *TEN*, *AGE*, *EDU* and *ALPH* are defined as in equation (7.4). *MA* and *TA* are the indexes of adoption of modern and traditional technologies respectively, as specified in equations (5.1) and (5.2). $\varpi_i$ are the terms of error and the $\omega$ are parameters to be estimated. Following the process previously described, two models are developed with respect to *IP* indicators.

Given the mathematical form of the cumulative normal distribution function, the parameters $\omega$ can be estimated through maximizing the value of the log-likelihood function. Those of *IP* are expected to be negative and significant, expressing hence a negative impact of agricultural projects on soil degradation and thereby a positive effect on soil conservation as hypothesized.

## 7.3 Empirical Results and Impact Assessment

### 7.3.1 Impact on Productivity and Technical Efficiency

#### 7.3.1.1 Impact on Productivity

The results of the model in equation (7.4) are globally significant and overall satisfactory for the two socio-cultural areas (Tables 7.1 and 7.2). The parameters of indicators *IP* are everywhere significant and positive. It is therefore possible to conclude the projects had positive impact on productivity. Indeed, they popularized and diffused modern production techniques, which allowed the involved farmers to improve in a significant way their productivity. Better, through trainings and formations that they favored, the managerial capacities of producers were strengthened. However, the regression results call for two types of analyses and interpretations.

First, the impacts level varied according to indicator considered. On one side, a unit increase of contact index induced increases of 0.64% and 0.45% in productivity in *Adja* and *Nagot* areas, respectively. When considering only the goal achievement index of the projects, a unit increase of the index induced increases of 3.62% and 2.18% in productivity in *Adja* and *Nagot* areas, respectively. These results shows goal achievement index, which includes overall aspects of management and objectives achievement, provides the highest impact on productivity. In fact, besides the direct contact and working with beneficiaries, the projects helped their organizations to acquire organizational skills of inputs distribution and product commercialization. They also built rural infrastructures such as rural roads, informal education centers, hospitals, etc. These additional activities, which were considered in goal achievement evaluation affected also indirectly productivity. Accordingly, using the goal achievement index in the regressions has helped estimate full impacts of the projects on beneficiaries.

Second, impacts were more raised in *Adja* area than in *Nagot* (Tables 7.1 and 7.2). As formerly explained, lands in *Adja* area had already reached levels of degradation and decline in fertility such that the practices of modern production techniques induced considerable positive effects in production improvement. In contrast, lands in *Nagot* area remained relatively fertile and the impacts of modern production practices although positive stayed even lesser.

**Table 7.1: Estimated Parameters of Factors Affecting Productivity in *Adja* Socio-cultural Area, 2001-2002**

| | | | *Model 1* | | *Model 2* |
|---|---|---|---|---|---|
| Independent Variables | Notations | B | Statistic t | B | Statistic t |
| Constant | - | 9.402*** | 14.882 | 6.112*** | 3.799 |
| Family Labor (Man-day/ha) | *LABOR* | 0.120** | 2.043 | 0.526*** | 4.057 |
| Capital (fcfa.ha$^{-1}$) | *CAPI* | 0.145*** | 2.837 | 0.235* | 1.802 |
| Cultivated Area (ha) | *LAND* | 0.018 | 0.420 | 0.048 | 0.460 |
| Type of Project | *PRO* | 0.08 | 0.976 | 0.187 | 0.836 |
| Formal Education | *EDU* | 0.135*** | 2.979 | 0.034* | 1.968 |
| Sex | *SEX* | -0.011 | -0.163 | -0.072 | -0.424 |
| Age (yr) | *AGE* | 0.001 | 0.533 | 0.004 | 0.809 |
| Informal Education | *ALPHA* | -0.081 | -1.550 | -0.071 | -0.548 |
| Land Security | *TEN* | 0.251** | 2.031 | 0.325 | 1.131 |
| **Contact Index** | ***IC*** | **0.639**** | **2.314** | - | - |
| **Goal Achievement Index** | ***IS*** | - | - | **3.616***** | **5.648** |
| | | | | | |
| Adjusted R2 | | | 0.55 | | 0.80 |
| F Statistic | | | 9.17*** | | 23.96*** |
| Observations Number | | | 60 | | 60 |
| Dependent Variable | *y* | | | | Output (fcfa.ha$^{-1}$) |

*** Significant at 1% ** Significant at 5% * Significant at 10%

**Table 7.2: Estimated Parameters of Factors Affecting Productivity in *Nagot* Socio-cultural Area, 2001-2002**

| | | | *Model 1* | | *Model 2* |
|---|---|---|---|---|---|
| Independent Variables | Notations | B | Statistic t | B | Statistic t |
| Constant | - | 7.230*** | 14.420 | 5.519*** | 8.170 |
| Family Labor (Man-day/ha) | *LABOR* | 0.080* | 1.691 | 0.439*** | 4.500 |
| Capital (fcfa.ha$^{-1}$) | *CAPI* | 0.364*** | 8.290 | 0.274*** | 4.149 |
| Cultivated Area (ha) | *LAND* | -0.026 | -0.870 | 0.131* | 1.909 |
| Type of Project | *PRO* | 0.119* | 1.823 | -0.146 | -1.105 |
| Formal Education | *EDU* | 0.111*** | 2.713 | 0.166* | 2.166 |
| Sex | *SEX* | 0.179 | 1.224 | 0.323 | 0.903 |
| Age (yr) | *AGE* | 0.003 | 1.331 | 0.009* | 1.886 |
| Informal Education | *ALPHA* | -0.017 | -0.383 | -0.054 | -0.463 |
| Land Security | *TEN* | 0.051 | 1.060 | -0.023 | -0.195 |
| **Contact Index** | ***IC*** | **0.448***** | **3.247** | - | - |
| **Goal Achievement Index** | ***IS*** | - | - | **2.181***** | **4.455** |
| | | | | | |
| Adjusted R2 | | | 0.84 | | 0.9 |
| F Statistic | | | 36.15*** | | 54.9*** |
| Observations Number | | | 60 | | 60 |
| Dependent Variable | *y* | | | | Output (fcfa.ha$^{-1}$) |

*** Significant at 1% ** Significant at 5% * Significant at 10%

### 7.3.1.2 Impact on Technical Efficiency

Following the definition of economic efficiency, the positive impacts of agricultural projects on productivity could be the effects of technical efficiency improvement or those of allocative one. Since price of some production inputs varied little, the study focused mainly on technical efficiency effects. The empirical results show that technical inefficiency exist only in case of considering the goal achievement index in *Adja* area. In this case, parameters of stochastic frontier model give prediction of the variance parameters in terms of $\sigma_s$ and $\gamma$, as well as the Likelihood Ratio of One-Side Error Test of 69.31, which exceeded the $\alpha$=5% critical value of 14.68 ($\chi^2_{(2\alpha;9)}$). Thus, the hypothesis $H_0$:$\gamma$=0 was rejected in favor of $H_1$:$\gamma$>0. Additionally, the high values of $\gamma$-parameter (0.88) allowed us to conclude that 88% of residual variation were due to inefficiency effect, $u_i$, in cotton production, and that the random error, $v_i$, accounted only for 12%.

As regard the technical inefficiency, the coefficient of goal achievement index in equation (7.7) is negative (–0.58) and significant at $\alpha$=5% in case mentioned above. Therefore, considering their goal achievement index in *Adja* area, the projects had negative impact on technical inefficiency, meaning they helped cotton producers improve technical efficiency. According to YANG (1994), a factor level affects productivity in two distinct ways. First, it affects the worker managerial skills by enhancing better utilization of existing inputs (technical efficiency aspect). Second, it influences as well the farmer's ability to select the optimal mix of inputs according to markets and prices (allocative efficiency aspect). Whereas the allocative effect is inherently predicated on disequilibrium, KYI and VON OPPEN (1999) suggested that the technical effect of the factor could be also more likely to arise during disequilibrium caused by technical changes. In agriculture, this may be because technical change renders the existing cultural practices obsolete or inadequate and calls for an adjustment. In that case, the projects in which the farmers participated could allow them to make the required adjustment more quickly. Actually, BIRKHAUESER, EVENSEN and FEDER (1991) explained this positive effect in that an agricultural project could bridge through an effective extension the gap between the discoveries from the experimental station and changes in the individual farmer's field. In addition to information about cropping techniques, optimal input use, high yielding varieties and prices, project's teams can inform stakeholders about improved record keeping and aid in the development of their managerial skills, thus facilitating a shift to more efficient methods of production.

### 7.3.2 Impact on Food Consumption

The empirical results presented in Tables 7.3 and 7.4 show a positive impact of revenue on food consumption. Thereby, when the revenue rose, food consumption also increased. On the other hand, the impact of household size on food consumption was negative. Indeed, the overall household revenue in rural areas is mainly brought by activities of the head. As change in household size does not significantly induce change in revenue, the share in food consumption within members would decrease.

As regards agricultural projects, the coefficients of contact index are not significant in the two areas, and express the projects had no significant impact on food consumption. As the contact frequency does not take into account efficiency in working with the beneficiaries and success in goal achievement of the projects, it may not help to show impacts of the projects on food consumption. In opposite, coefficients of goal achievement index are positive and significant in the two areas. From this, the impacts on food consumption were therefore significant and positive in the two socio-cultural areas. Actually, the projects favored accessibility to food by providing storage and primary processing techniques, infrastructures for agricultural transportation (rural roads), etc. Likewise, some projects targeted food quality mainly for children by giving information and training to women on nutritive contents of different foods. For instance, local people recognized that agricultural projects helped them through these technical supports to quantitatively access food and to take care of quality by diversifying the consumption over days, and henceforth to improve their food security. The goal achievement index, which takes into account success in achievement of these activities, have therefore helped to estimate full impacts on food consumption.

The analysis with respect to areas shows the impacts achieved in *Adja* area were higher as compared to *Nagot* area (3.89 and 3.24 respectively, Tables 7.3 and 7.4). As reason, food balance was largely positive in *Nagot* area and accessibility did not appear a very serious problem. In contrast, food balance was negative in *Adja* area, and imports from food abundant zones allowed for improvement of food security. The projects facilitated these imports and contributed to storage improvement through rural roads building, training in storage techniques, etc. Accordingly, their impacts on food consumption may be greater in *Adja* area than in *Nagot* area.

**Table 7.3: Estimated Parameters of Factors Affecting Food Consumption in *Adja* Socio-cultural Area, 2001-2002**

| | | | *Model 1* | | *Model 2* |
|---|---|---|---|---|---|
| Independent Variables | Notations | B | Statistic t | B | Statistic t |
| Constant | - | 6.646*** | 5.515 | 6.430*** | 5.852 |
| Total Annual Revenue (fcfa/capita) | *REV* | 0.299** | 2.580 | 0.275** | 2.598 |
| Household Size | *SIZE* | -0.396*** | -4.312 | -0.342*** | -4.005 |
| Formal Education | *EDU* | -0.249** | -2.246 | 0.019 | 0.192 |
| Type of Project | *PRO* | 0.592*** | 2.990 | 0.451** | 2.437 |
| **Contact Index** | ***IC*** | **0.480** | **0.921** | - | - |
| **Goal Achievement Index** | ***IS*** | - | - | **3.886*** ** | **7.295** |
| Adjusted R2 | | | 0.79 | | 0.82 |
| F Statistic | | | 44.5*** | | 55.8*** |
| Observations Number | | | 60 | | 60 |
| Dependent Variable | *Q* | Annual Food Consumption (fcfa per capita) | | | |

*** Significant at 1% ** Significant at 5% * Significant at 10%

**Table 7.4: Estimated Parameters of Factors Affecting Food Consumption in *Nagot* Socio-cultural Area, 2001-2002**

| | | | *Model 1* | | *Model 2* |
|---|---|---|---|---|---|
| Independent Variables | Notations | B | Statistic t | B | Statistic t |
| Constant | - | 5.033*** | 6.428 | 5.561*** | 9.074 |
| Total Annual Revenue (fcfa/capita) | *REV* | 0.523*** | 7.121 | 0.360*** | 5.619 |
| Household Size | *SIZE* | -0.318*** | -3.410 | -0.142* | -1.855 |
| Formal Education | *EDU* | -0.027 | -0.269 | 0.130* | 1.717 |
| Type of Project | *PRO* | 0.034 | 0.180 | -0.181 | -1.212 |
| **Contact Index** | ***IC*** | **0.229** | **0.314** | - | - |
| **Goal Achievement Index** | ***IS*** | - | - | **3.237*** ** | **7.029** |
| Adjusted R2 | | | 0.79 | | 0.87 |
| F Statistic | | | 44.8*** | | 79.4*** |
| Observations Number | | | 60 | | 60 |
| Dependent Variable | *Q* | Annual Food Consumption (fcfa per capita) | | | |

*** Significant at 1% ** Significant at 5% * Significant at 10%

### 7.3.3 Impact on Soil Degradation

Empirical results showed contrast in impact of agricultural projects on soil degradation according to indicators of projects considered in the models (Tables 7.5 and 7.6). While the coefficients of contact index were not significant, those of goal achievement index were negative and significant, meaning the projects helped to avoid more land degradation and to improve land fertility. Subsequently, when considering their goal achievement index at beneficiaries level, agricultural projects helped farmers to improve conservation of soil fertility. In

addition to anti-erosion techniques, soil conservation practices that the implemented projects diffused at beneficiary level, they played various other positive roles as regards natural resources protection. For example, the diffusion of agro-forestry techniques helped to regenerate more than 5,000ha of vegetation in *Adja* area and 8,000ha in that of *Nagot*. Additionally, the projects' teams fought against activity of charcoal processing, which is highly forest destructive. Through training and information about the negative effects of this activity, they have succeeded in reducing the number of persons involved. At the same time, the projects promoted small income activities such as processing of agricultural products, mushroom production, snail or small animals breeding, etc., which have low environment demands. These activities, which account for success in activities of the projects have impacts on soil fertility conservation that contact frequency may not fully consider. Therefore, it is quite reasonable that the impact provided by goal achievement index is positive and significant.

**Table 7.5: Estimated Parameters of Factors Affecting Soil Degradation in *Adja* Socio-cultural Area, 2001-2002**

| | | *Model 1* | | *Model 2* | |
|---|---|---|---|---|---|
| Independent Variables | Notations | B | Statistic t | B | Statistic t |
| Constant | - | 1.923*** | 22.864 | 2.135*** | 24.034 |
| Age | *AGE* | -0.0018 | -1.026 | 0.0011 | 0.6305 |
| Informal Education | *ALPH* | -0.0889** | -2.422 | -0.187*** | -4.906 |
| Formal Education | *EDU* | 0.2072*** | 9.302 | 0.285*** | 12.242 |
| Land Security | *TEN* | -0.525*** | -11.665 | -0.362*** | -7.869 |
| Farming Duration | *DUREX* | 0.0012 | 0.397 | -0.007** | -2.217 |
| Adoption of Modern Technologies | *TA* | -1.025*** | -19.091 | -1.056*** | -19.606 |
| Adoption of Local Technologies | *MA* | 0.851*** | 11.736 | 0.639*** | 8.674 |
| Project Type | *PRO* | -0.422 | -12.344 | -0.072* | -1.714 |
| **Contact Index** | ***IC*** | **-0.152** | **-1.382** | - | - |
| **Goal Achievement Index** | ***IS*** | - | - | **-1.742*** ** | **-13.337** |
| Pearson Goodness-of-Fit $\chi^2$ | | | 14192.71*** | | 11275.76*** |
| Degree of Freedom | | | 110 | | 110 |
| Significance Probability | | | 0.00 | | 0.00 |
| Number of Observations | | | 60 | | 60 |
| Dependent Variable | | | Probability of Soil Degradation | | |

*** Significant at 1% ** Significant at 5% * Significant at 10%

Furthermore, land availability may widely explain the difference observed in impacts according to region where the projects were implemented. For example, *Adja* lands achieved a critical level of degradation and fertility decline as demographic growth and increase in land pressure worsened the situation. Consequently, modern technology of soil conservation that the projects diffused

in *Adja* area contributed to higher positive impact on fertility improvement. Conversely, land pressure and degradation were less critical in *Nagot* area, and agricultural projects had therefore less positive impact on soil conservation, comparatively to *Adja* area. However, according to TOVO (1995), farmers of this area could achieve soil sustainability if nothing is done to thwart peasants in degradation of forests and lands. Agricultural projects should therefore focus in *Nagot* area more on prevention of land degradation by organizing the ecological and economic viable access and use of forests and lands. In this case, for long-term environmental sustainability, agricultural development projects have to put more emphasis on generating income activities enumerated above by facilitating access to credit and needed inputs. Actually, these activities permit to minimize pressure on natural resources because they help local people to reduce intensity of activities, which cause strong damage to the environment.

**Table 7.6: Estimated Parameters of Factors Affecting Soil Degradation in *Nagot* Socio-cultural Area, 2001-2002**

| | | *Model 1* | | *Model 2* | |
|---|---|---|---|---|---|
| Independent Variables | Notations | B | Statistic t | B | Statistic t |
| Constant | - | 0.693*** | 8.208 | 2.086*** | 23.95 |
| Age | *AGE* | -0.003*** | -3.493 | -0.01*** | -10.459 |
| Informal Education | *ALPH* | 0.0441 | 1.544 | -0.0235 | -0.792 |
| Formal Education | *EDU* | 0.755*** | 30.815 | 0.75*** | 26.845 |
| Land Security | *TEN* | -0.677*** | -9.840 | -0.187** | -2.649 |
| Farming Duration | *DUREX* | 0.007*** | 3.637 | -0.016*** | -7.701 |
| Adoption of Modern Technologies | *TA* | -0.132** | -2.849 | -0.259*** | -5.912 |
| Adoption of Local Technologies | *MA* | 0.342*** | 4.533 | -0.967*** | -12.715 |
| Project Type | *PRO* | 0.176*** | 3.956 | -0.42*** | -11.271 |
| **Contact Index** | ***IC*** | **-0.1997** | **-1.052** | - | - |
| **Goal Achievement Index** | ***IS*** | - | - | **-0.461*** ** | **-3.726** |
| Pearson Goodness-of-Fit $\chi^2$ | | | 12088.2*** | | 10240.303*** |
| Degree of Freedom | | | 110 | | 110 |
| Significance Probability | | | 0.00 | | 0.00 |
| Number of Observations | | | 60 | | 60 |
| Dependent Variable | | | Probability of Soil Degradation | | |

*** Significant at 1% ** Significant at 5% * Significant at 10%

## 7.4 Impacts on Capacity Building

In the previous section, impact assessment has emphasized mainly production efficiency, food consumption and degradation issues of sustainability. In this section, the impact evaluation is completed by exploring how much the projects built and empowered stakeholders' capacity to own the development actions and programs through technical assistances. This aspect is very important because it may represent also key indicator to appreciate sustainability of the impacts.

### 7.4.1 Capacity Building as Sustainability Dimensions

As developed in the conceptual framework, capacity building of local people remains important aspect of sustainability. In fact, by reinforcing the organizational skills and self-reliance capacity of the local people through technical assistance, the projects may guarantee the continuity of their activities a long time after their termination. According to the study results, impacts of agricultural projects on capacity building seemed to be satisfactory. Indeed, all indicators pointed out a net growth and improvement of organizational capacity of local people as Table 7.7 illustrates. Actually, agricultural projects implemented in Benin often retained the reinforcement of capacities of local populations among their objectives, and tried more or less to achieve the objective. Moreover, the objective stayed one of the main requirements by the GTZ, WORLD BANK and IMF for sustainable development. However, the success was also enhanced by an exogenous factor known as the "change of the regime of 1990s". For instance, democratic system of governance established since the 1990s authorized free associations and organizations of citizens and encouraged organizational growth, in particular in rural areas. Teams of agricultural projects held henceforth the legal tool to implement capacity building of local people and somehow succeeded. Regarding the impact of the projects on capacity building, three aspects can be distinguished: (1) institutional supports, which helped the local people to have the skill and authority over the distribution of inputs and organization of the product commercialization, (2) women empowerment, which gave women opportunity to diversify their income generating activities and reinforce the role they play in the community development, and (3) technical supports to decentralization, which helped the local people to own strategies and actions for their development.

#### 7.4.1.1 Institutional Supports

In villages of the study zone, various associations or organizations of producers were created and supported technically. The assistance was completed through

education and training to let the producers have the self-control of the production, harvest and commercialization organization. The most important technical support dealt with cotton production. In this sector, the local communities are currently able to organize and to supervise the distribution of inputs, the transport and commercialization of the product. Their associations consequently earn the returns of this self-control and are capable of contributing to public investments such as infrastructure building, financial participation in social activities, etc. As cotton producers are able to continue the inputs distribution and product commercialization even when most of the projects stop their activities, the success of capacity building shows thus the better achievement of technical assistance to enable sustainable development.

In contrast to capacity building through technical assistance to producers' organizations, one can notice decline in cultural and traditional concerns. With advent of agricultural projects, traditional rules, taboo, myths and other cultural norms established by local people to protect sacred lands and forests could not work any more. Though some project's teams collaborated with heads of traditional organizations, cultural and traditional norms declined in rural areas. Actually, the government considered the traditional institutions illegal and instituting official collaboration with them became henceforth difficult in practice. However, they had the legitimacy of the rural people who recognized the key role they play to ensure protection and sustainable management of forests and lands. From this, the question remains on what to consider between legality and legitimacy as important when trying ensuring sustainable management of natural resources (Table 7.7).

#### 7.4.1.2 Women Empowerment

The role that rural women play in development of a community has been well demonstrated, but they are still marginalized because of socio-cultural norms in rural areas. Therefore, development assistances put emphasis on women empowerment to enhance their statue such as they can more contribute to development. In the study area, most of the projects retained objective of helping women to develop. Actions consisted of giving them credit to explore some income generating activities and increase the annual income of the family. Additionally, they gave women trainings, formal and informal educations to improve their statue in the society such as they can better contribute to development. Even though these technical supports met opposition of socio-cultural norms, they succeeded. In fact, the analysis of their statue before and after the projects implementation shows that the empowerment and social trans-

formation of women were acceptably improved (Table 7.7). However, actions should be reinforced and more focused on women capacity building.

#### 7.4.1.3 Supports to Decentralization

In addition to capacity building at farmers' level, the German Cooperation and other international institutions supported technically the government in processes of decentralization and transfer of competences to local communities. The technical supports consisted of preparing and diffusing at local level papers and laws related to decentralization. Besides, they organized seminars, radio or television programmes to allow the local people knowing their rights and obligations in the decentralization process. As a result, these technical supports awakened consciousness of local people, and they saw they should own actions and strategies for development. Nevertheless, aspects such as planning and action to address problems and ownership of development process, etc. indisputably still experienced little improvement and should be given more attention in future for better success of the decentralization process.

### 7.4.2 Partial Conclusion: Impact of Financial versus Technical Assistances

According to the foregoing discussions, it is quite important to distinguish the impact of the financial assistance to that of the technical assistance. With the technical assistance, the impact on capacity building was undoubtedly positive. In fact, the technical supports helped the local communities to improve their organizational skills and capacity reinforcement, and consequently to own actions and programs for sustainable development. This aspect of technical assistance for sustainability seems to be very important because of its linkage with decentralization. In fact, the transfer of competences to local people and the reinforcement of their capacity building can give them opportunity to design and plan themselves, closely to their problems and realities, development projects. Conversely, the impacts, when they exist, disappear after the termination of the financial assistance. Therefore the technical assistance may provide more sustainable impacts than the financial support. Accordingly, recommendations for more sustainability of agricultural projects should focus on reinforcement and improvement of capacity building of local people.

**Table 7.7: Impact of Agricultural Projects on Capacity Building of Local People, 2001-2002**

| Indicators of Capacity Building | Before the Projects | After the Projects | Appreciation |
|---|---|---|---|
| Organizational growth | Very low | High | High improvement |
| Strength of local awareness of issues and options | Very low | Medium | Medium improvement |
| Strength of existing individual and organizational capacities | Very low | Medium | Medium improvement |
| Participation in decision-making, planning and action to address problems | Very low | Low | Little improvement |
| Perceptions of ownership of the development process | Very low | Low | Little improvement |
| Empowerment and social transformation of women | Very low | Medium | Medium improvement |
| Creation of linkages between socio-cultural groups | Very low | Very low | No improvement |
| Protection of sacral forests and lands | Very high | Low | High decline |
| Strength of traditional institutions for forests and lands management | Very high | Low | High decline |

## 7.5 Opinions of Local People about the Impacts

### 7.5.1 Development Demands Versus Development Supplies

To conceptualize the agricultural projects, they are defined as markets where development demands and supplies have key functions. Development supplies of projects are measured by their objectives and impacts, and development demands of local people by their survival problems. To understand and explain opinions of local people about the impacts, there is a need to compare the supplies and the demands while the opinions could be related to the difference observed.

The information collected from various sources led to achieve the comparison by ranking development demands and supplies according to their importance. The outcomes provide evidence of disparities between demands and supplies and call for two sides of analysis (Table 7.8).

**Table 7.8: Weights of Factors (%) showing Importance of Development Demands and Supplies based on Opinions of Local People, 2001-2002**

| Items | Development Problems (Demand Side) | *Adja* Area Activities of the Projects (Supply Side) | Development Problems (Demand Side) | *Nagot* Area Activities of the Projects (Supply Side) |
|---|---|---|---|---|
| Access to land | 10 | 1 | 5 | 1 |
| Soil degradation and fertility fall | 10 | 10 | 5 | 10 |
| Access to labor | 4 | 1 | 4 | 1 |
| Access to fertilizer and pesticides | 4 | 40 | 4 | 40 |
| Access to credit | 20 | 10 | 20 | 10 |
| Food security | 2 | 10 | 2 | 10 |
| Informal education | 10 | 10 | 10 | 10 |
| Women empowerment | 1 | 10 | 1 | 10 |
| Access to water and health | 4 | 4 | 4 | 4 |
| Price stability and commercialization | 25 | 2 | 25 | 2 |
| Socio-cultural empowerment | 10 | 2 | 20 | 2 |
| Total | 100 | 100 | 100 | 100 |

First, development demands are different according to the socio-cultural area though they have some common demands. For example, price stability and commercialization of agricultural products as well as access to credit remains the most common development demands for the two areas. At the same time, soil degradation and fertility decline as well as access to land are more important in *Adja* than in *Nagot* area. Conversely, protection and empowerment of socio-cultural order in the village is a more essential demand in *Nagot* area where the people have experience of traditional and cultural institutions.

Second, supplies and demands diverge in the two socio-cultural areas. The supplies that agricultural projects provide to development have little meaning for local people because they neglect demands that are imperative for rural development.

For instance, importance is given to supply of access to fertilizer and pesticides as well as to food security that local people do not judge as threats while few actions are done to resolve price stability and good commercialization as well as access to credit problems that stakeholders considered as their most significant problems. Actually, the difference observed in supply and demand would be due to disparities in interests between local people and project suppliers, i.e. international institutions and government. By designing, planning and implementing the projects, the suppliers expect productivity improvement of cash crops to ensure a raise in export for foreign currencies gain and for raw material production for industries of developed countries. Emphasis was hence more put on use of fertilizer and pesticide. Moreover, they tried to control the prices and the trade of agricultural products for profit maximization. In contrast, local people would like to control agricultural commercialization and to have good prices, to benefit from credit, and to preserve socio-cultural and traditional issues of their society, which seems not very important for project suppliers. The analysis shows a wide difference in objectives of the two actor groups though they are both involved in agricultural projects. Lessons learnt here call for the project suppliers to reconcile and adjust their interests with those of local people by giving significance to outcomes of projects that the stakeholders can have. Somehow, agricultural development projects are supposed to be designed and implemented for development of rural areas.

### 7.5.2 Perceptions of Local People about the Impacts and Projects' Usefulness

Perceptions of stakeholders about the impacts of agricultural projects are closely related to analysis done above. Though most of stakeholders thought that the projects are indispensable and can enable rural areas to develop, opinions about impacts and usefulness of projects contrasted sharply from their expectations. Here, opinions of usefulness depict how much impacts of the projects solved development problems of local people. Questions were asked if the projects helped them to solve their problems as regards living conditions (agricultural production, revenue, food consumption, soil fertility fall, health, products commercialization, social statues, rural infrastructures, etc. The opinions of usefulness of the projects was then ranked according to percentage of positive answers. The rank 1 corresponds to very useless (0-20% of positive answers), 2 to useless (20-40%), 3 to medium or acceptable (40-60%), 4 to useful (60-80%), and 5 to very useful (80-100%). The results show 20% and 32% of stakeholders found the projects' impacts very useless or useless in *Adja* and *Nagot* areas respectively. In contrast, 60% and 37.5% of stakeholders in *Adja* and *Nagot* areas respectively said the impacts are useful. At the same time, 20.5% and 30% found the impacts medium in the same

order. The difference in perceptions observed between the two socio-cultural areas would express the relative satisfaction of *Adja* people with projects' supply as all the assessed impacts were found higher comparatively to *Nagot* area.

From another point of view, opinions of stakeholders about the usefulness of the projects varied according to their income level. Actually, about 60% of low income stakeholders found the projects either useless or very useless for them while about 80% of high income expressed good opinions of projects' usefulness (Figure 7.1). The low-income stakeholders said they have little decision power during the project process and their opinions were as well poorly taken into account. Consequently, the projects made them poorer while the rich stakeholders were better off.

From these discussions, opinions of uselessness of projects could be explained by the fact that they did not, for the moment, supply the real development demands of stakeholders, and in particular those of the poorest and most disadvantaged ones. However, perceptions of usefulness strengthened more the view that agricultural projects are indispensable for rural area development since they have capacity to provide development. Actually, perceptions of local people about agricultural projects, their impacts and usefulness can be summarized as following:

"*agricultural projects are indispensable and can enable rural development. To achieve this goal, their objectives should be reoriented and adapted to development problems of rural areas. In particular, problems of the most disadvantaged and poorest stakeholders should be given more attention. As well, organizational issues should be improved*".

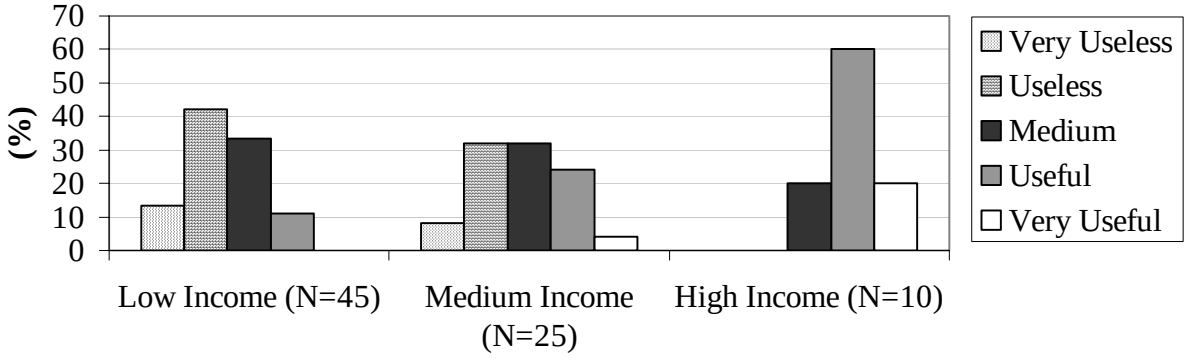



**Figure 7.1: Opinions of Stakeholders (N=80) about the Usefulness of the Projects according to their Income Level, 2001-2002**

## 7.6 Concluding Remarks

Assessment of projects' impacts showed different issues according to indicators of projects taken into account and socio-cultural areas. As regards the contact index, the impacts were significant and positive on productivity, but not significant on food consumption and soil fertility conservation. Conversely, taken into account goal achievement index, all the impacts were significant and positive in the two areas of the study zone. This difference may express high contact frequency did not necessary mean high efficiency in working with the projects' teams. Likewise, the projects implemented various activities, in addition to individual contacts with beneficiaries. These activities, which were indirectly benefits for stakeholders, are not taken into account by contact index. Therefore this index may not help show fully the impacts as goal achievement index does.

Analyzing the impacts with respect to socio-cultural areas shows the impacts were higher in *Adja* area, as compared to *Nagot*. As explained in previous chapters, *Adja* farmers experienced more land pressure and soil degradation, and their agricultural production was more difficult to ensure. Likewise, food balance was negative in this area. Consequently, the implemented projects may induce better impacts in *Adja* comparatively to *Nagot* area in terms of productivity, food consumption and land fertility conservation.

Regarding capacity building, the impacts were undoubtedly positive. In fact, the technical supports helped the local communities to improve their organizational skills and capacity reinforcement, and consequently to own themselves actions and programs for sustainable development. This aspect of technical assistance for sustainability seems to be very important because of its linkage with decentralization. In fact, the transfer of competences to local people and the reinforcement of their capacity building can give them opportunity to design and plan themselves development projects closely to their problems and realities. Therefore the technical assistance may provide more sustainable impacts than the financial support.

Additionally, the study explored opinions and perceptions of local people about the projects, their impacts and usefulness, and the results were little positive. Differences were observed between the projects' supplies and the development demands supposed to be the problems, which hurt local people. Consequently, some stakeholders, in majority the poorest, found the projects useless with few impacts although they hopefully thought the projects were indispensable and could enable their development. There is hence a necessity of adapting the projects and their impacts to the needs of local people, particularly to those of the poorest.

The positive impacts provided by contact and goal achievement indexes of the projects at beneficiaries level allow us to conclude that improvement on design, management and monitoring, and on goal achievement of the projects will induce improvement on impacts. Therefore, recommendations for improvement on impacts will be more focused on design, management and monitoring improvement for better goal achievement. However, this improvement should be directed so as its derived impacts can better solve development problems of beneficiaries.

In this chapter, opinions of projects' usefulness the local people built are qualitatively analysed. The next chapter extends the analysis, and the opinions are viewed as feed back of overall satisfactions with design, management, monitoring and goal achievement, as well as impacts of the projects. Modelling as latent variables in structural equations, the analysis helps estimate factors that can influence participation and adoption decisions. Likewise, it allows to link together goal achievement and impacts of the projects with participation and adoption decisions of beneficiaries in order to completely draw the sustainability cycle.

# 8 FACTORS AFFECTING FARMERS' DECISIONS

In chapter 7, impacts of agricultural projects have been assessed. The results showed undoubtedly they have impacts on local populations even if those impacts depend closely on indicators considered and socio-cultural areas. As earlier stressed in the conceptual framework, as long as the farmers will be getting involved in projects and adopt modern diffused technologies, the impacts may remain. Thus, the long-term durability of the impacts is strongly related to the decisions of farmers to get involved in projects and to adopt modern technologies. In this chapter, factors that affect these decisions of participation and of adoption are estimated through latent variables structural equation modeling. The study expects here to give out, as results, factors that significantly influence decisions of farmers to be involved in projects and to adopt modern technologies. In the last section, the results obtained lead to derive effects that scenarios of improvement on goal achievement and impacts could have on participation and adoption decisions, as well as on sustainability of the impacts.

## 8.1 Concept of Structural Equation Modeling

The structural Equation Modeling is a very general and powerful multivariate analysis technique that includes specialized versions of number of other analysis methods as special cases. The concept is strongly based on variance, covariance and correlation. In this section, the study explores the basic idea behind the concept and compares the structural modeling with the classical econometric modeling.

### 8.1.1 Basic Idea Behind the Structural Equation Modeling

One of the fundamental ideas taught in intermediate applied statistics courses is the effect of additive and multiplicative transformations on a list of numbers. For example, it is proved statistically that if one multiplies every number in a list by some constant *k*, the mean of the number will be multiplied by *k*. Similarly, the standard deviation will be multiplied by absolute value of *k*, and the variance by $k^2$. The point is, if one has a set of numbers *X* related to another set of numbers *Y* by the equation $Y=kX$, then the variance of *Y* must be $k^2$ times that of *X*. Consequently, one can test the hypothesis that *Y* and *X* are related by the equation $Y=kX$ by comparing the variances of *Y* and *X* variables.

This idea above is generalized, in various ways, to several variables inter-related by a group of linear equations. Even if the rules become more complex, and the calculation more difficult, the basic message remains however the same: *one can*

*test whether variables are or not interrelated through a set of linear relationships by examining the variances and covariances of the variables*.

Statisticians have developed procedures for testing whether a set of variances or covariances in a covariance matrix fits a specified structure. From these, the use of structural equation modeling has been common in sciences. Its major applications include:

(1) causal modeling, or path analysis, which hypothesizes causal relationships among variables and tests the causal models with a linear equation system;

(2) confirmatory factor analysis, which is an extension of factor analysis in which specific hypotheses about the structure of the factor loadings and intercorrelations are tested;

(3) second order factor analysis, a variation of factor analysis in which the correlation matrix of the common factors is itself factor analyzed to provide second order factors;

(4) regression models, an extension of linear regression analysis in which regression weights may be constrained to be equal to each other, or to specified numerical values;

(5) covariance structure models, which hypothesize that a covariance matrix has a particular form. For example, one can test the hypothesis that a set of variables all have equal variances with this procedure;

(6) correlation structure models, which hypothesize that a correlation matrix has a particular form. A classic example is the hypothesis that the correlation matrix has the structure of a circumplex.

Based on the objective of the study, causal modeling or path analysis is used.

### 8.1.2 Structural Equation Modeling versus Econometric Regression

One of the great myths of statistics is that regression is considered as analysis of causal relationships because of the controversial words "dependent" and independent". Nonetheless, that is not the case. Regression is merely an analysis of correlations or relationships, performed in a specific way. A structural modeling is a much more specific form of analysis that looks explicitly at cause.

Moreover, in case of multiple regressions, the partial regression coefficients have to spread the common variance among predictor variables across the set of predictors. If the predictor variables are uncorrelated, then the use of multiple regression approach and the analyses become straightforward and simple to

explain. Each effect is independent of all other effects. Therefore, total variance accounted for in any dependent variable is the sum of the independent effects, and the multiple regression coefficients are the simple regression coefficients, which, in the standardized case, are the correlations. In contrast, if the predictor variables are highly correlated, then there is a problem of collinearity or multicollinearity and the use of regression cannot yield fit results. In structural modeling, the causal effects of predictors are clearly distinguished from correlations among them. Consequently, it forces the statement of an explicit theory about relationship rather than simply testing a set of data for any relationship, as it is the case in regression. In addition, it produces a clear and explicit result of the strengths of the mathematical relationships contained within variables (DARLINGTON, 1990; WALKER, 1998).

## 8.2 Path Diagrams and Analysis

The current section presents theoretically the definition of variables involved in structural equation modeling and the construction of path diagrams as well as the outline of analysis path. They draw heavily on STEENKAMP and VAN TRIJP (1996), MARUYAMA (1997), VON BACH and NUPPENAU (1997) where more details can be found.

### 8.2.1 Observed Variables

Observed (or manifest) variables are those obtained by measurement. They are endogenous or "dependent" when drawn from the system. In the case, they are effects of causal variables. In contrast, causal observed variables are exogenous or "independent".

### 8.2.2 Latent Variables

In contrast to observed variables, latent variables are not measured. Known as well as theoretical variables, they are constructed to put together group of manifest variables yielded by factor analysis. As it is the case for observed variables, latent variables can be also endogenous, i.e. generated from the system or exogenous. By modeling the path analysis, exogenous latent variables go with related exogenous observed variables, and endogenous latent variables with related endogenous observed variables.

### 8.2.3 Modeling the Path Diagrams

According to the rules of establishment of path diagrams, wires and arrows help to connect variables, representing, respectively undirected and directed relationships. Additionally, path diagrams should guarantee that the diagram will represent accurately any model, which fully accounts for all variances of all variables, both manifest and latent. One way to ensure this is to require: (1) representation of all variances and covariances among exogenous variables, (2) no variances or covariances to be directly represented in the diagram for endogenous variables, and (3) all variables in the diagram be involved in at least one relationship. These considerations lead to the following rules: (1) manifest variables are always represented in boxes (squares or rectangles) while latent variables are always in ovals or circles, (2) directed relationships are always represented explicitly with arrows between two variables, (3) undirected relationships need not to be represented explicitly, but when represented explicitly, they are shown by a wire from a variable to itself, or from one variable to another, (4) endogenous variables may never have wires connected to them.

The adoption of consistent standard for path diagrams facilitates clear communication of path models, regardless of what system is used to analyze them. However, there is a significant practical problem with many path diagrams because of lack of space. In many cases, there are so many exogenous variables that there is simply not enough room to represent adequately the variances and covariances among them. Thereby, the path diagrams illustrated in Figure 8.1 show simply how observed and latent variables are directly or indirectly related. Variances and covariance among the exogenous variables are not explicitly represented, but the other rules for path establishment are respected. In the figure, variables are positioned according to their validity so that latent exogenous variable should cause latent endogenous variable. In the same time, manifest endogenous variables Y are not directly linked with manifest exogenous variables X. As regard relationships between measured variables and their related latent one, there are different ways of thinking about such relationships. Nevertheless, in the structural equation field, those relationships typically are viewed as reflecting influence of the constructed on the measured variable. Consistent with this logic and factor analysis, the unmeasured variable "causes" the measured one because the later assesses variability from the former. Thus, the arrows of path modeling will go from the underlying constructed to the measured unless the case can be made that the measured causes the theoretical variable (MARUYAMA, 1997; also for more discussion of causal indicators, see MACCALLUM and BROWNE, 1993).

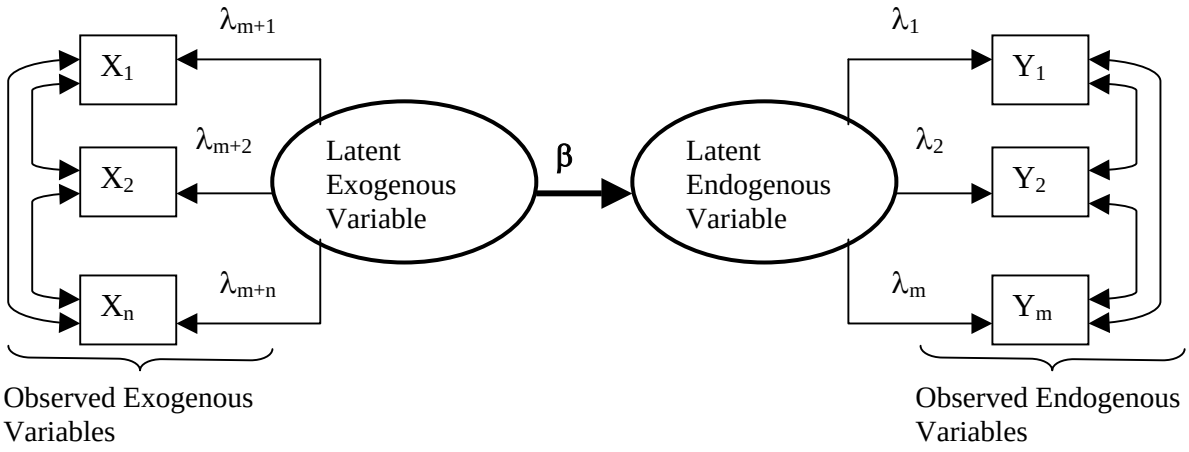



**Figure 8.1: Illustration of Path Diagrams with Observed and Latent Variables**
Source: Adapted from VON BACK and NUPPENAU (1997)

### 8.2.4 Measurement and Structural Models

#### 8.2.4.1 Measurement Model

The measurement model is the model relating measured to theoretical variables of factors. It contains information about how theoretical variables are operationalized in each study. Mathematically, it can be expressed as:

$$Y = \Lambda_Y \eta + \varepsilon \tag{8.1}$$

$$X = \Lambda_X \xi + \delta \tag{8.2}$$

where

$\Lambda_Y$ and $\Lambda_X$ are respectively factor pattern matrix relating respectively observed endogenous variables to theoretical endogenous variables and observed exogenous variables to theoretical exogenous variables, $\eta$ and $\xi$ are respectively vectors of endogenous and exogenous variables, $\varepsilon$ and $\delta$ are vectors of residuals for the observed measures.

#### 8.2.4.2 Structural Model

The Structural Model is the regression part of latent variable structural equation modeling. According to MARUYAMA (1997), the primary differences between latent variable structural models and basic analytic models are that (1) the variables in latent variable models typically are not measured (the exception is where there is only a single indicator of a conceptual variable) and that (2) when calculating values for parameters estimates, no distinction needs to be made between recursive and nonrecursive models or models with residual covariation

among latent variables. Therefore, all models can be handled by the general regression equation. The variables in the regression equation are the η and ξ from the measurement model of equation (8.1) and (8.2). Those variables are linked through the general regression equation as following:

$$\eta = \beta\eta + \Gamma \xi + \zeta \tag{8.3}$$

where

β is a matrix of regression weight interrelating endogenous η, Γ is the matrix of regression weights relating exogenous ξ to endogenous η, and ζ is a vector of residuals for the endogenous latent variables. If the β matrix is or, by interchanging rows, can be made lower triangular (i.e., all elements above the main diagonal are 0), then the model is recursive and has unidirectional flow; if it cannot be made lower triangular, then the model is nonrecursive. Unlike regression approaches, regardless of recursivity, the model is estimated in the same way.

## 8.3 Application of the Model to the Study

### 8.3.1 Observed Variables and Definition of Latent Variables

In the conceptual framework and methodological approach, linkages between agricultural projects and sustainability were outlined. Here, observed variables involved in modeling farmers' decisions of participation in projects and of adoption of modern technologies are heavily drawn from factors highlighted by the linkages formerly outlined and explained in the conceptual framework.

According to STEENKAMP and VAN TRIJP (1996), inaccuracies and imprecision in defining latent variables are usually called specification error. To overcome these, he proposed a factor analysis to explore how the manifest variables go together. Consequently, the exploration of groups of factors involved in linkages between agricultural projects and sustainability, completed by factor analysis, leads to define the latent variables of the structural model. Thus, five with related measured variables were defined as shown in Table 8.1. Most of the observed variables were coded into 5-point bipolar scale (examples of poles: 1=very low, 5=very high for per capita annual revenue, or 1=very young, 5=very old for age, or 1=high hillside, 5=flat with inundation for land hillside, etc.). Additionally, when the observed variable took the value 0, the score=0.

**Table 8.1: Latent and Related Observed Variables Involved in Structural Modeling of Farmers' Decisions**

| Latent variables | Observed variables | Codes | Definitions |
|---|---|---|---|
| Human capital | Informal education of the farmer | *ALPHLE* | ALPHLE=1 if informally educated, 0 if not |
| | Age of the farmer | *AGE* | 5 poles scales (very young/very old) |
| | Formal Education of the farmer | *EDU* | EDU=1 if formally educated, 0 if not |
| Perception on satisfaction of production and consumption | Revenue of the farmer | *REV* | 5 poles scales (very low/very high) |
| | Size of the household | *SIZE* | 5 poles scales (very low/very high) |
| | Farm productivity | *OUTPUT* | 5 poles scales (very low/very high) |
| | Food consumption | *FOOD* | 5 poles scales (very low/very high) |
| Availability of and access to production inputs | Land security | *TEN* | TEN=1 if land is secured, 0 if not |
| | Amount of credit obtained | *CREDIT* | 5 poles scales (very low/very high) |
| | Family labor | *LABOR* | 5 poles scales (very low/very high) |
| | Hired labor | *HILABOR* | 5 poles scales (very low/very high) |
| Perception on satisfaction on soil fertility | Soil Slope | *SITOP* | 5 poles scales (high hillside/inundation) |
| | Soil structure | *SOSTRUC* | 5 poles scales ("terre de barre"/alluvial) |
| | Vegetation cover | *VEGCOV* | 5 poles scales (low /high covered) |
| | Farming duration | *DUREX* | 5 poles scales (very short/very long) |
| | Soil degradation | *SODEGR* | 5 poles scales (very low/very high) |
| Decision of participation in agricultural projects | Contact index | *IC* | 5 poles scales (very low/very high) |
| | Goal achievement index | *IS* | 5 poles scales (very low/very high) |
| | Opinions of projects' Usefulness | *UTILPRO* | 5 poles scales (very useless/very useful) |
| | Relation with projects' teams | *RELPRO* | 5 poles scales (very low/very high) |
| Decision of adoption | Adoption of local technologies | *TA* | 5 poles scales (very low/very high) |
| | Adoption of modern technologies | *MA* | 5 poles scales (very low/very high) |

The first latent variable, named human capital characterizes the human property that the stakeholder can use to produce. It included manifest variables such as age, formal schooling and informal education.

The second latent variable was regarded as the perception of the farmer on satisfaction of agricultural production and food consumption. Here, the related manifest variables were: income per capital of the household, family size, agricultural productivity and food consumption per capita of the household.

The third latent variable constituted the perception of the farmer on satisfaction of soil fertility. Factors of agro-ecological concerns and farming systems were mostly related to this latent variable: soil hillside, soil structure, vegetation cover, degree of soil degradation and farming duration.

The fourth latent variable was the availability of and access to production inputs. Family labor, hired labor, land security and credit per hectare were observed variables that were hypothesized to characterize better this latent variable.

The fifth latent variable was regarded as the stakeholder's decision of participation in agricultural projects. Variables of factors related to agricultural projects were linked to this latent variable. These variables are contact index, goal achievement index, relation with projects' teams and opinions about usefulness of the projects.

Finally, the sixth latent variable was regarded as the decision of adoption of modern technologies. This latent variable was supposed to be related to two measurement variables, these are the degree of adoption of local technologies and that of modern ones.

After the conceptualization of the latent variables, hypothesizing and defining the exogenous and endogenous variables can help to complete the structural modeling.

### 8.3.2 Definition of Exogenous and Endogenous Variables

The definition of exogenous and endogenous variables goes from decomposition of relationships. As stressed previously in this study, a proved relationship between variables does not explain the causal effects and their direction. Care is therefore needed to decompose the relationships by using the logic introduced by path analysis before defining exogenous and endogenous variables.

In this study, variables related to farmers' decisions (latent and observed variables) were hypothesized to be caused and generated from the system by the other variables. Thus, the latent variables "decision of participation" and "decision of adoption", as well as related observed variables are endogenous in the system. Likewise, latent variables such as human capital, perception on satisfaction of production and consumption, perception on satisfaction of land fertility, and availability of and access to production inputs, as well as their related observed variables are considered as exogenous. One can therefore draw the structural modeling of factors affecting farmers' decisions of participation and of adoption by materializing the possible linkages between variables. However, the main assumption, which allowed the use of the model to be more relevant to estimation of decision factors should first be assumed.

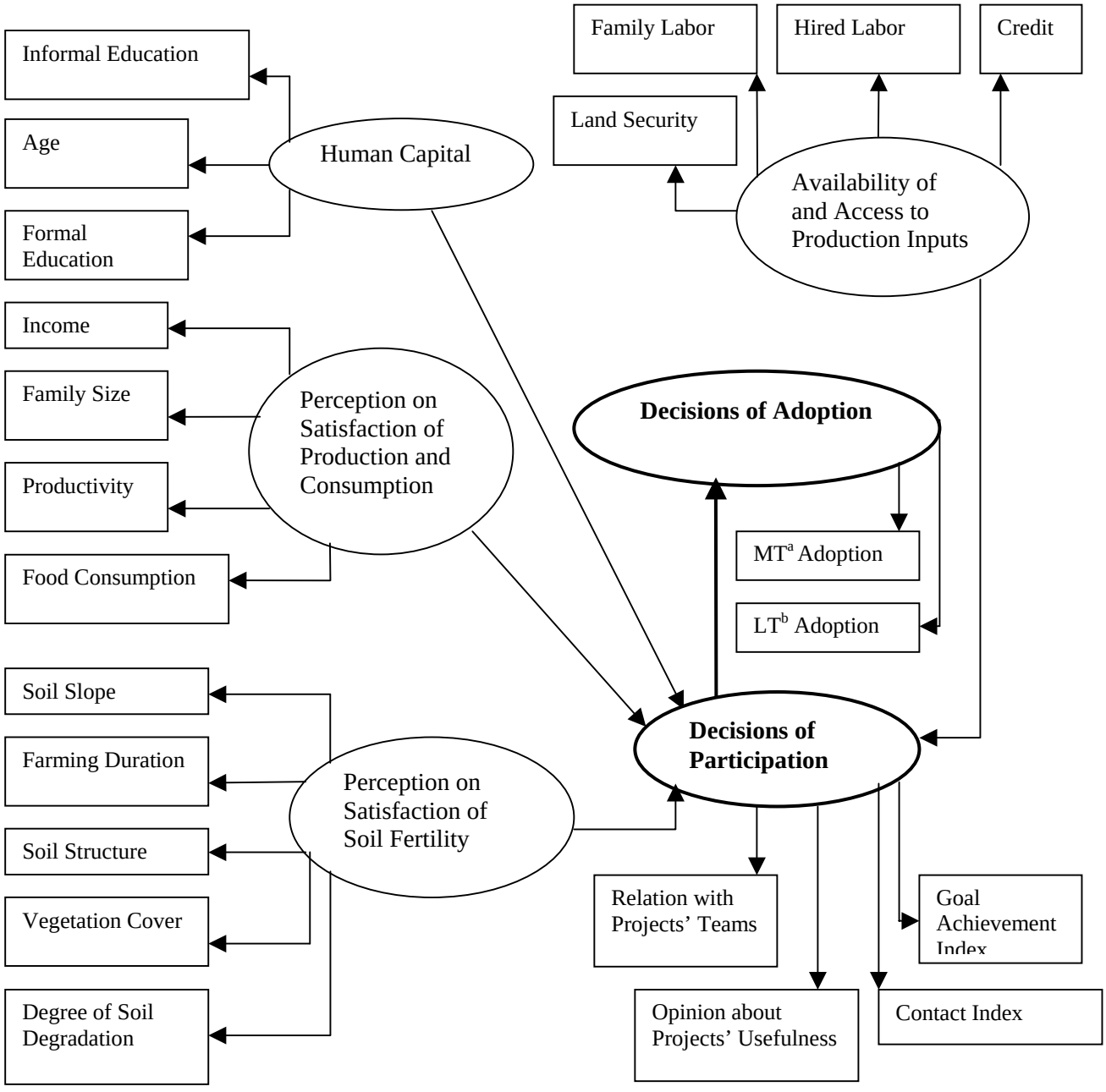
### 8.3.3 Main Assumption: Recursivity of the Model

In order to have more relevant argument of the use of the structural modeling for the study, and to facilitate highly the procedure of estimation, the study assumes that the structural model is recursive. In the structural equation literature, models in which the causal arrows flow in more than one direction are called nonrecursive models. In contrast to recursive models, nonrecursive ones may not be uniquely solvable, even in instances in which the degrees of freedom suggest overidentification. The nonrecursive model may include feedback loops through which causality turns back on itself, reciprocal causal relationships in which two or more variables cause each other simultaneously, or even both (KENNY, 1979). For instance, as regard the study, perception on satisfaction of soil fertility and that of production and consumption may cause farmers' decisions of participation in projects. In addition, the decisions of participation can, over time, cause the perception on satisfaction. Thus, the variables may cause each other simultaneously. Likewise, decisions of participation in project may cause decisions of adoption of modern technologies, as the latter may, over time, cause also the former. However, the notion of simultaneous causation is both difficult to envision and somewhat controversial. In previous chapter, the study focused on impacts of projects on production, consumption and soil fertility. Since the main goal of this chapter is to identify factors affecting farmers' decisions of participation in projects and of adoption of modern technologies, the study supposes consequently one direction of causality from latent exogenous variables towards decisions of participation and of adoption, which means the recursivity of the model.

### 8.3.4 Structural Modeling of Factors Affecting Farmers' Decisions

Following the rules of drawing path diagrams and the main assumption of the study, the structural modeling of factors affecting decisions of participation in projects and of adoption of modern technologies is designed in Figure 8.2. In order to make clearly readable the figure, the variances and covariances among variables are not schematized. As well, one can remark that indirect relationships are not explicitly represented. Actually, the model aims at focusing more on highlighting the direct causalities between decisions of participation in projects and of adoption of modern technologies and factors supposed to affect them. According to LANGYINTO (1996) and SAMANTHA (2001), human capital, perception on satisfaction of production, consumption and soil fertility, availability and access to production inputs may strongly affect decision of participation in projects (see also the conceptual framework in chapter 3). Thus, human capital, perception on satisfaction of production, of consumption and of

soil fertility, and access to production input are hypothesized to cause farmers' decision of participation in projects. Moreover, international institutions have argued that projects are motors of modern technology adoption because they diffuse them by providing needed inputs and facilities (BMZ, 2000). From this, decision of participation in projects is hypothesized to cause that of modern technology adoption.




a: MA=Modern Technologies; b : LT=Local Technologies

**Figure 8.2: A Structural Equation with Latent and Observed Variables Modeling the Factors Affecting Farmers' Decisions**

### 8.3.5 Specification of Empirical Models

The definition of the different variables involved in the model and linkages among them in previous sections leads to write following mathematical functions of the empirical models.

8.3.5.1 Empirical Measurement Model

Endogenous Variables Side

$$IC = \lambda_1 DEPA + \varepsilon_1 \quad (8.4)$$

$$RELPRO = \lambda_2 DEPA + \varepsilon_2 \quad (8.5)$$

$$UTILPRO = \lambda_3 DEPA + \varepsilon_3 \quad (8.6)$$

$$IS = \lambda_4 DEPA + \varepsilon_4 \quad (8.7)$$

$$TA = \lambda_5 DEADO + \varepsilon_5 \quad (8.8)$$

$$MA = \lambda_6 DEADO + \varepsilon_6 \quad (8.9)$$

Exogenous Variables Side

$$ALPHLE = \lambda_7 HUCA + \delta_1 \quad (8.10)$$

$$AGE = \lambda_8 HUCA + \delta_2 \quad (8.11)$$

$$EDU = \lambda_9 HUCA + \delta_3 \quad (8.12)$$

$$REV = \lambda_{10} PSPC + \delta_4 \quad (8.13)$$

$$SIZE = \lambda_{11} PSPC + \delta_5 \quad (8.14)$$

$$OUTPUT = \lambda_{12} PSPC + \delta_6 \quad (8.15)$$

$$FOOD = \lambda_{13} PSPC + \delta_7 \quad (8.16)$$

$$SITOP = \lambda_{14} PSSF + \delta_8 \quad (8.17)$$

$$DUREX = \lambda_{15} PSSF + \delta_9 \quad (8.18)$$

$$SOSTRUC = \lambda_{16} PSSF + \delta_{10} \quad (8.19)$$

$$VEGCOV = \lambda_{17} PSSF + \delta_{11} \quad (8.20)$$

$$SODEGR = \lambda_{18} PSSF + \delta_{12} \quad (8.21)$$

$$LABOR = \lambda_{19} AAPI + \delta_{13} \quad (8.22)$$

$$HILABOR = \lambda_{20} AAPI + \delta_{14} \quad (8.23)$$

$$TEN = \lambda_{21} AAPI + \delta_{15} \quad (8.24)$$

$$CREDIT = \lambda_{22} AAPI + \delta_{16} \quad (8.25)$$

*DEPA* and *DEADO* represent the latent endogenous variables "decision of participation in projects" and "decision of adoption of modern technologies" respectively. *HUCA*, *PSPC*, *PSSF* and *AAPI* represent the exogenous variables human capital, perception on satisfaction of production and consumption, perception on satisfaction of soil fertility, and availability of and access to production inputs respectively. The other variables in the equations are those defined in Table 8.1. The λ are parameters to be estimated and the ε and δ the residuals.

#### 8.3.5.2 Empirical Structural Model

As the model contains two endogenous latent variables, the mathematical form of the structural model can be expressed as:

$$DEPA = \gamma_1 HUCA + \gamma_2 PSPC + \gamma_3 PSSF + \gamma_4 AAPI + \zeta_1 \tag{8.26}$$

$$DEADO = \beta_1 DEPA + \zeta_2 \tag{8.27}$$

or in matrix form,

$$\begin{pmatrix} DEPA \\ DEADO \end{pmatrix} = \begin{pmatrix} 0 & 0 \\ \beta_1 & 0 \end{pmatrix} \begin{pmatrix} DEPA \\ DEADO \end{pmatrix} + \begin{pmatrix} \gamma_1 & \gamma_2 & \gamma_3 & \gamma_4 \\ 0 & 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} HUCA \\ PSPC \\ PSSF \\ AAPI \end{pmatrix} + \begin{pmatrix} \zeta_1 \\ \zeta_2 \end{pmatrix} \tag{8.28}$$

where *DEPA*, *DEADO*, *HUCA*, *PSPC*, *PSSF* and *AAPI* are latent variables defined former in equations (8.4) to (8.25), the β and ξ parameters to estimate, and the ζ residuals.

### 8.3.6 Estimation Techniques and Procedures

The techniques and procedures of estimating the model of the study are based on Generalized Least Squares (GLS) followed by Maximum Likelihood (ML). By default, this option is selected. The technique performs five iterations using the Generalized Least Squares estimation procedure, regardless of the current setting in the maximum number of iterations field in the global iteration parameters group in the analysis parameters dialog. At that point, it shifts to Maximum Likelihood estimation. According to MARUYAMA (1997), HU and BENTLER (1995), there are a number of alternative ways in which to estimate coefficients from latent variables structural equation modeling. They include Ordinary Least Squares (OLS), Unweighted Least Squares (ULS), Generally Weighted Least Squares (GWLS), Diagonally Weighted Least Squares (DWLS), and Asymptotic Distribution-Free (ADF) estimators. The first two are, in general, similar to

Generalized Least Squares and Maximum Likelihood in their requirements and properties but yield fit statistics that perform less well than Maximum Likelihood statistics. The latter three differ in that they provide estimation procedures that do not require multivariate normality in the data. Nevertheless, work on fit statistics has found that the Asymptotic Distribution-Free estimators, in comparison to Maximum Likelihood estimates, have not produced estimates with desirable properties, particularly in small samples. Therefore, assuming that the data of the study do not strongly violate an assumption of multivariate normality, the study seems to lose little by staying with Generalized Least Squares (GLS) followed by Maximum Likelihood (ML) estimates.

The statistical package *STATISTICA* was used to process the data and to estimate the model whose main results are presented and discussed in the following section. Since some data related to agricultural projects were not available for farmers without project, the processing and estimation were done only for farmers involved in projects.

## 8.4 Empirical Results and Discussions

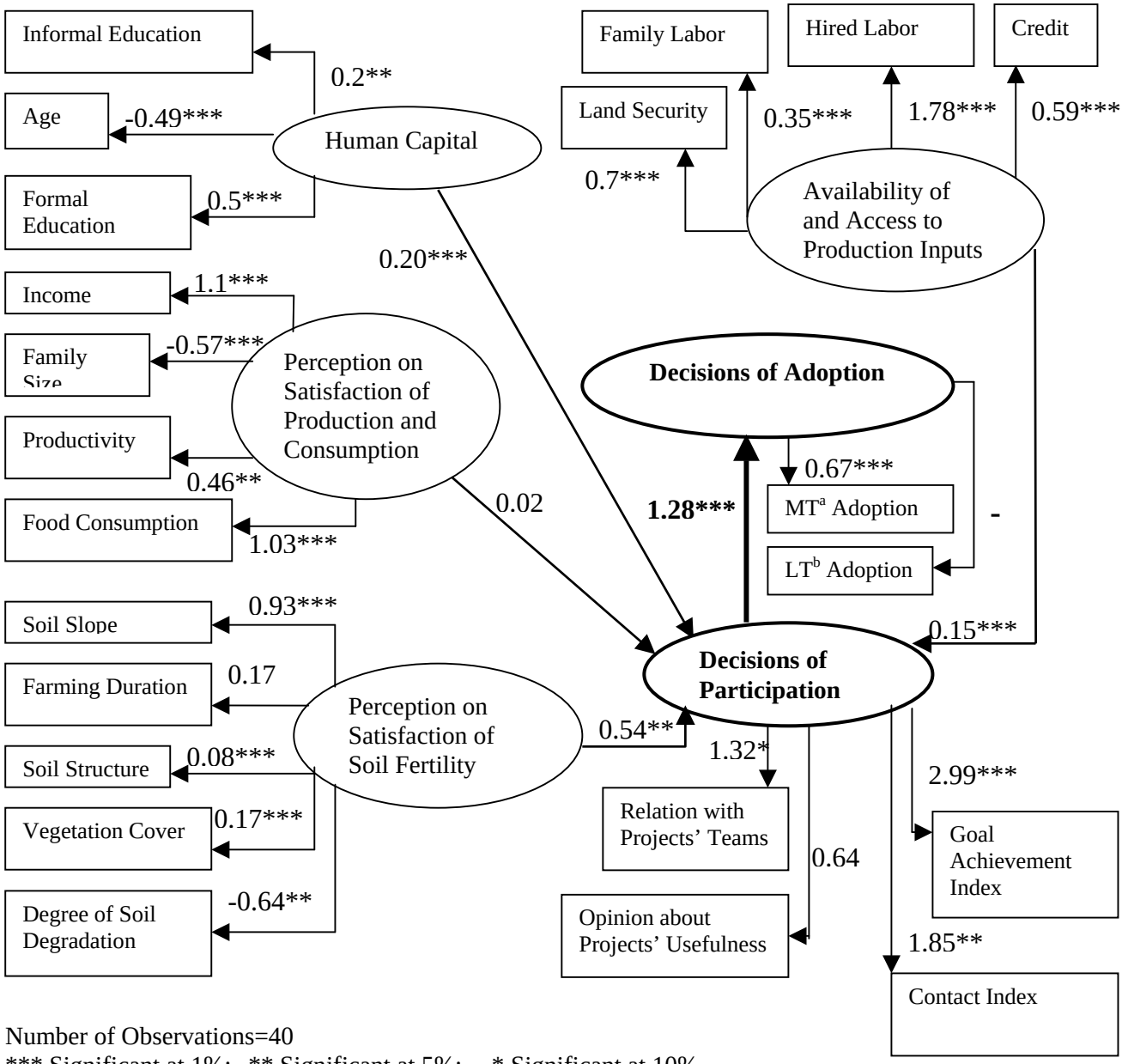
### 8.4.1 Case of *Adja* Area

The interpretation of the model results in *Adja* area (Figure 8.3) depicts that perception on satisfaction of production and consumption had no significant impact on participation decision though its coefficient was positive. In contrast, human capital, perception on satisfaction of soil fertility and availability of and access to production inputs affected positively and significantly decision of participation in agricultural projects, but their effects seemed low. In fact, when human capital, perception on satisfaction of soil fertility and availability of and access to production inputs increased by 1 unit, participation decision augmented by 0.20; 0.54 and 0.15 unit respectively. It undoubtedly means that human capital, perception on satisfaction of soil fertility and availability of and access to production inputs represented the most important factors that allowed to guarantee better participation of *Adja* farmers in agricultural projects. With particular regard to soil fertility, the results confirmed that of field study, which found soil degradation and fertility decline as the most important problems of agricultural production that *Adja* farmers had. Thereby, as far as they get satisfaction with regard to soil fertility, they will continue to be involved in projects.

Besides, the majority of observed exogenous variables were significant with expected signs. For example, it is possible to conclude that human capital increased with formal and informal educations of the stakeholders. Additionally, perception on satisfaction of production and consumption increased with the

productivity, the quantity per capita of food consumed and the revenue per capita of the stakeholders' households. Likewise, the availability of and access to inputs augmented with the land security, the credit amount, the family and hired labors. In contrast, human capital decreased with age of stakeholders as perception of satisfaction of production and consumption did with the family size and that of soil fertility with the soil degradation. Actually, the older the farmer is, the less his physical force is and hence the less his human capital is. As regards the family size, its increase calls for more production and for more food consumption. Thus, the higher the family size, the less the perception on satisfaction of production and consumption. Finally, the more the soil degradation is, the less its fertility is and hence the less the perception on satisfaction of soil fertility is. From these explanations, the coefficients obtained for the observed exogenous variables were quite justified.

The second findings of the structural modeling showed the impact of participation decision on that of adoption was positive and significant. In fact, the increase in participation decision by 1 unit led to increase in adoption decision by 1.28 units. As well, observed endogenous variables such as contact and goal achievement indexes had also positive and significant coefficients. They represented subsequently the key factors to take into account for improvement of participation decision. Brought together, these results supported the idea that the factors determining management and goal achievement of the projects affected indirectly adoption decision through that of participation in projects. The study proved therefore that agricultural projects widely helped farmers to take the decision of adopting modern technologies. These brought out the undoubted key role that the projects played by popularizing and diffusing modern technologies. Additionally, by affecting positively the farmers' decision of participation in projects, factors such as human capital, perception on satisfaction of soil fertility and availability of and access to production inputs influenced indirectly the decision of adoption in *Adja* area through implementation of projects. It can be therefore concluded that projects with good management and high goal achievement that provide positive impacts will directly induce better participation and indirectly lead to high adoption of modern technologies as well as to improvement on agricultural productivity.




Number of Observations=40
*** Significant at 1%; ** Significant at 5%; * Significant at 10%
a: MT=Modern Technologies; b: LT=Local Technologies

**Figure 8.3: Factors Affecting Farmers' Decisions in *Adja* Area, 2001-2002**

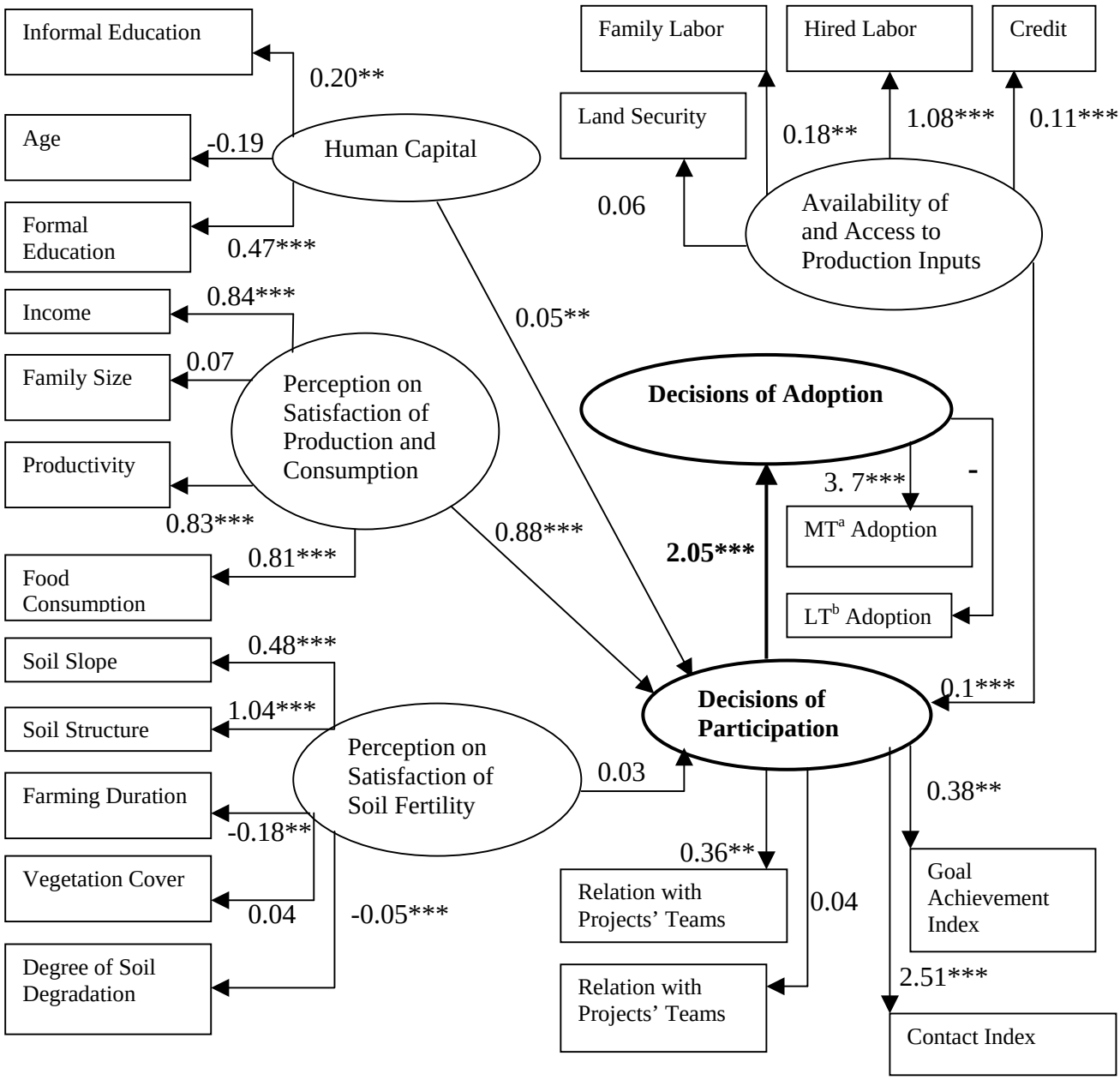
## 8.4.2 Case of *Nagot* Area

The model results for *Nagot* area show differences when compared to those previously described for *Adja* area (Figure 8.4). In fact, perception on satisfaction of production and consumption, human capital and availability of and access to production input affected significantly and positively the decision of participation. Consequently, the better human capital, perception on satisfaction of production and consumption, and availability and access to production input were, the better the participation in projects was. Most observed variables related to these

significant latent variables are also significant and positive. They represented therefore the key factors to take into account for participation and projects' sustainability improvement in this area. Particularly, education of the stakeholder influenced significantly and positively the human capital. It appears therefore important to target education of rural people to give them opportunity to understand the activities of the projects in order to increase their participation. In contrast, observed variables like family size and land tenure did not significantly affect their respective constructed variables. At the moment, these factors do not represent serious constraints for participation in projects and hence for their sustainability in *Nagot* area. As regard land tenure, land was relatively greatly available in *Nagot* area, and very few farmers experienced land insecurity. Nevertheless, access to land could be constraint for participation in projects in future if agricultural development policy does not set about strategies of stopping deforestation and soil degradation.

With regard to the perception on satisfaction of soil fertility, it did not significantly influence the decision of participation in projects in *Nagot* area. As farmers in this area thought their soil was relatively fertile and gave satisfactory productivity, soil fertility decline did not represent very serious treatments. Thus, the decision of being involved in projects was not significantly the causal effect of soil fertility decline, and the perception on satisfaction of soil fertility did not hence cause the participation decision. However, analysis done here is only relevant in static point of view. As earlier stressed, dynamically, the perception on satisfaction of soil fertility could in long term affect the participation decision. In reality, the arrival of new agricultural migrants and demographic growth could in long term worsen availability of and access to cultivated lands. Additionally, land could be less secured. Actually, it becomes urgent to explore ways of improving land security and access, and that is the challenge agricultural projects should deal with in *Nagot* area.

As it was the case in *Adja* area, decision of participation affected positively that of adoption. Indeed, a unit increase in participation decision induced an augmentation of 2.05 units in adoption decision. Therefore, the considered exogenous factors may have indirect significant causal effect on adoption decision through decision of participation in agricultural projects. Actually, the interpretation given previously for *Adja* area is as well valid here. The projects are the motors of popularizing, diffusing and adopting the modern technologies. However, there is needs of good design, management and monitoring for success in goal achievement and high positive impacts.




Number of Observations=40
*** Significant at 1%; ** Significant at 5%; * Significant at 10%
a: MT=Modern Technologies; b: LT=Local Technologies

**Figure 8.4: Factors Affecting Farmers' Decisions in *Nagot* Area, 2001-2002**

### 8.4.3 Scenarios of Improvement on Goal Achievement and Impacts

Analysis done in the previous sections has described in general way the results as regard factors causing participation and adoption decisions. In this section, interpretation is more specifically concentrated on linkage of the results with goal achievement and impacts issues analyzed in previous chapters. To achieve this linkage, the study has explored effects that scenarios of improvement on design, management, monitoring and impacts of the projects may have on participation

and adoption decisions. These help to link all the study findings and explain finally how sustainability of the projects can be achieved and maintained.

#### 8.4.3.1 Scenario of Improvement on Goal Achievement

According to findings with respect to factors of participation and adoption decisions, improvement on projects' factors and goal achievement could have various effects. First, improvement that rises goal achievement will induce directly increase in participation decision as its index coefficient is positive and significant. Secondly, apart from this direct causality, indirect effects may provide interesting interpretations. In fact, results of chapter 7 show improvement on contact frequency and goal achievement induces rise in productivity, food consumption and human capacity building, as well as decrease in soil degradation. Additionally, the structural modeling gives evidence that increase in productivity, human capital, food consumption and decrease in soil degradation induce increase in satisfaction opinions of beneficiaries, which leads to rise in participation and adoption decisions. Together, the two findings allow us to conclude that improvement on contact frequency and goal achievement will indirectly affect beneficiaries through improvement on impacts and overall satisfaction that it induces. However, care is needed to know what to improve on factors, which can provide rise in goal achievement.

On one hand, the structural modeling findings showed that human capital of beneficiaries represented key factor for participation and adoption decisions. Moreover, a scenario of improvement on design, management and monitoring with regard to human capital building may induce better impacts on human capital building. Together, if the projects were designed, implemented and monitored so as they reinforced the human capital (formal and informal educations) and capacity building of stakeholders, they may consequently enhance participation and adoption of modern technologies. As far as participation remains high, improvement on these factors will induce rise in impacts, etc. so that sustainability of the projects will be achieved and maintained. From this, recommendations should target reinforcement of human capital building and empowerment during design, management and monitoring of the projects.

On the other hand, availability and access to production inputs were found to increase participation and adoption decisions. In the study area, cotton producers benefited more from availability and access to production inputs through the implemented projects. This situation may explain largely the relative sustainability of projects that focused on cotton production. Conversely, the other sectors of agricultural production were marginalized so that availability and access to

production inputs represented real constraints for farmers. As a result, lower participation and adoption were observed at level of projects working in these marginalized sectors, which were consequently reported with little sustainable. A scenario of improvement on design, management and monitoring of projects as regards commercialization and distribution of production inputs, and credit access may surely induce rise in participation and adoption decisions of beneficiaries. Therefore, recommendations should be concerned with restructuring organization of production inputs, their commercialization and distribution for better availability and access. In this case, agricultural projects have to target the marginalized production sectors for more production diversification.

#### 8.4.3.2 Scenario of Improvement on Impacts

In the conceptual framework of the study, participation and adoption decisions were viewed as feedback of satisfaction opinions the beneficiaries built from the impacts. The results obtained from the structural modeling confirm more or less this hypothesis. In *Adja* area for instance, the causality of opinions of satisfaction with soil fertility was found positive and significant. At the same time, impact assessment showed the projects helped the stakeholders to conserve their soil fertility. These two results, brought together, proved soil fertility was of big interest for *Adja* farmers. Actually, soil degradation and poor security of access to cultivable land represented serious development problems in *Adja* rural areas. By targeting and reinforcing soil fertility conservation in this area, agricultural projects may be more sustainable. In contrast, soil degradation and access to cultivated land were not of serious problems in *Nagot* area. Accordingly, opinions of satisfaction with land fertility were not found to affect significantly decision of participation in this area, though the impacts on soil fertility conservation were significant and positive when considering goal achievement index. From these results, projects that targeted mainly soil fertility conservation in *Nagot* area may not be sustainable because soil degradation was not relatively a serious problem. In this case, stakeholders in this area may find such projects little useful and may lower their participation.

From discussions above, scenario of improvement on positive impact may have various effects on participation and adoption decisions according to development problems the beneficiaries face. For example, increase in positive impact on soil fertility will help to improve on participation and adoption in *Adja* area, but not systematically in *Nagot* area. Therefore, impacts of projects should be improved on issues that solve real development problems of beneficiaries. These imply that development actors should design and implement their projects according to development problems of rural people.

## 8.5 Model Limitations and Results' Validity

Many criticisms have been leveled against the users of Structural Equation Modeling (SEM). These are mostly related to the scientific capacity of the SEM to estimate in reality causality effects (for more details about the criticisms, see CLIFF, 1983; BRECKLER, 1990; LING, 1982). Even though they show limitation of using the model, none of the criticisms provides a reason for the SEM techniques to be totally discarded as inappropriate. Rather, they provide different philosophies about ways in which to use available data plus guidance about ways in which to use SEM approaches effectively. The study focuses therefore on limitations that are relevant to the main assumption.

The major limitation of the study comes from the assumption of the recursivity of the model. This is especially when considering the period when the stakeholders judge the outcomes of the projects to take the decision of continuing the participation and adoption of modern technologies. Actually, implementation of an agricultural project can be subdivided into three different phases: (1) at the beginning of the project, the farmer gets involved by having hope that the project can improve his welfare; (2) after certain time of participation, he judges the project's outcomes from his overall satisfactions and takes the decisions on whether to continue with the participation and adoption of modern technologies or not; (3) if the decision is to continue, the participation will go on affecting positively his environment and the impacts will hence remain as long as the situation remains so. In contrast, if the decision is not to go on getting involved, alternative phase of (3) will be that the project stops or continues but without any sustainability. Phase (3) expresses the sustainability of the impacts, but depends widely on phase (1) and (2). As chapter 7 focuses on impacts, the use of structural modeling targets mainly phase (2) so that the results can be utilized to derive recommendations for phase (3). Therefore, the results presented in this chapter are valid only if one considers phase (2). By taking into account another phase, the model specification will surely change. For instance, in phase (1) the causal effects will go from participation in project and adoption to human capital, overall satisfaction and availability of and access to inputs. With regard to phase (3), inter-causality will occur and both project variables and those of environment of local populations will affect each other. This gives rise to a nonrecursive model. Among the projects considered in the study, none is at phase (1), but some of them are at phase (3) or at its alternative. Assuming all of them at phase (2), the model is not therefore strictly conformable to the reality and constitutes subsequently a limitation for the validity of the results.

## 8.6 Concluding Remarks

The results obtained from the structural modeling of farmers' decisions show importance of some factors in guaranteeing participation and adoption decisions of the stakeholders. In the two areas, formal and informal educations, and age of the stakeholders constructed the human capital latent variable, which was shown to maintain high the participation of the farmers in projects. Actually, the decision of participation increased with their augmentation. Likewise, participation decision increased with availability and access to production inputs. Nonetheless, there is some variation in findings according to the socio-cultural area. For example, factors related to soil fertility and land security appeared very important to consider in *Adja* area where land pressure were relatively greater and land security lesser. Thus, by setting down strategies to address land security and availability, agricultural projects can give incentives to farmers in this area to increase their participation. In contrast to *Adja* area, the per capita income, per capita annual quantity of food consumed and productivity constructed positively the perception on satisfaction of production and consumption latent variable, which influenced positively the participation decision of *Nagot* stakeholders. Nevertheless, the factors related to soil fertility and land security did not affect significantly the stakeholders' decision of participation. According to their opinions, availability and access to cultivated land did not represent serious problems.

Another view point of the results in the two areas showed the particular key role that agricultural projects played was to popularize and diffuse modern technologies for improvement of productivity. In fact, decision of adoption increased significantly with that of participation, which also augmented with goal achievement of the projects.

These results imply that scenario of design, management and monitoring, which reinforces improvement on human capital and capacity building of beneficiaries will enhance participation and adoption of modern technologies, as well as sustainability of the projects. Moreover, scenario of restructuring organization of production inputs commercialization and distribution that improves on availability and access may increase participation and adoption decisions. Finally, scenario of improvement on impacts will lead to more sustainability of the projects if these are made on issues that solve real development problems that the stakeholders experience. Therefore, these aspects should be part of recommendations for more effective design, management and monitoring of agricultural projects in order to induce better goal achievement and impacts, maintain and improve on participation of stakeholders for sustainability of the impacts.

# 9 CONCLUSION AND RECOMMENDATIONS

The study summary presented in this chapter includes results of field study with regard to characteristics of local people. Likewise, quality of projects' factors, their goal achievement and impacts, as well as factors affecting farmers' decisions found by the study are outlined. Putting all these results together, sustainability of the projects are viewed as combination of three cogged wheels working simultaneously. These permit to derive recommendations for sustainability relatively to actors involved. Questions for further researches are as well developed at the end to resolve some of the study limitations.

## 9.1 Main Empirical Findings

### 9.1.1 Field Study Results

The exploration of characteristics of the rural people depicted the differences that existed between the two socio-cultural areas of the study zone. As land pressure was greater and natural resources more degraded in *Adja* area than in *Nagot*, farming system was more intensive in the former and farmers adopted, not only fertilizers and insecticides, but also other modern agricultural technologies. Moreover, land endowment of *Adja* farmers was poorer but more efficiently used since the average added value of land was higher than that of *Nagot*. To face the more increased risk of agricultural production, they developed off-farm activities that have increased their total annual incomes.

### 9.1.2 Management and Goal Achievement of the Projects

Analysis of management and goal achievement of the selected projects showed poorer design, conception, implementation, monitoring and evaluation than expected. While international funds, English and related projects were better designed, implemented and evaluated, and had therefore relative high effective management, national ones were worse due to their rigidity, complexity, low transparency and control and high corruption, meaning they had relative low effective management. From these results, rigidity, complexity, low transparency and control associated with high corruption, as well as low participation of beneficiaries could be considered as factors of poor quality of management.

Factors of success in goal achievement were identified as quality of internal organization, funding level and management transparency, as well as intensity of local population participation. However, correlation of funding level was very low, meaning it should be associated with high management transparency for better goal achievement. Conversely, good design and conception, definition of

excellent objectives and activities planning as well as good monitoring and evaluation systems planning did not lead to better goal achievement, probably because of poor implementation and control. Therefore, recommendations for improvement on design, management, monitoring and goal achievement should be more focused on these weaknesses.

As living conditions were made more difficult in rural areas, the population willingness to get involved in agricultural projects and go on working with their teams for welfare improvement was higher. In reality, local people in either *Adja* or *Nagot* had built opinions that agricultural projects are useful and have capacities to enhance their welfare. However, empirical results showed that stakeholders involved in single projects had better indicators (productivity, consumption, soil fertility, etc.) than those involved in 2 or more projects. In reality, several projects offset each other instead of being complementary. Conversely, local stakeholders thought they could maximize outcomes from projects by getting involved in many projects at the same time. As a result, they did not have enough time to go on working with the projects' teams and to be actively involved. Therefore, they did not benefit as the stakeholders who concentrated their participation on single projects did.

### 9.1.3 Impacts of the Projects

#### 9.1.3.1 Assessed Impacts

Assessment of projects' impacts showed different issues according to indicators of projects taken into account and socio-cultural areas. As regards the contact index, the impacts were significant and positive on productivity, but not significant on food consumption and soil fertility conservation. Conversely, taken into account goal achievement index, all the impacts were significant and positive in the two areas of the study zone. This difference may express high contact frequency did not necessary mean high efficiency in working with the projects' teams. Likewise, the projects implemented various activities, in addition to individual contacts with beneficiaries. These activities, which were indirectly benefits for stakeholders, are not taken into account by contact index. Therefore this index may not help show fully the impacts as goal achievement index does.

Analyzing the impacts with respect to socio-cultural areas shows the impacts were higher in *Adja* area, as compared to *Nagot*. As explained in previous chapters, *Adja* farmers experienced more land pressure and soil degradation, and their agricultural production was more difficult to ensure. Likewise, food balance was negative in this area. Consequently, the implemented projects may induce better

impacts in *Adja* comparatively to *Nagot* area in terms of productivity, technical efficiency, food consumption and land fertility conservation.

The positive impacts provided by contact and goal achievement indexes of the projects at beneficiaries level allow us to conclude that improvement on design, management and monitoring of the projects for better goal achievement will induce improvement on impacts. Therefore, recommendations for improvement on impacts will be more focused on improvement of these factors. However, this improvement should be directed so as its derived impacts can better solve development problems of beneficiaries.

Nonetheless, the model used in the study to assess the impacts targeted mainly the farmers level. Compared to the GTZ impact model, it did not take into account higher and highest aggregated development steps, to which the projects could have contributed. For example, poverty reduction or increase in employment figures at regional level could be the effects of projects' implementation.

#### 9.1.3.2 Impacts on Capacity Building: Technical versus Financial Assistances

The distinction between technical and financial assistance showed difference in the impacts. With the technical assistance, the impact on capacity building was undoubtedly positive. In fact, the technical supports helped the local communities to improve their organizational skills and capacity reinforcement, and consequently to own actions and programs for sustainable development. This aspect of technical assistance for sustainability seems to be very important because of its linkage with decentralization. In fact, the transfer of competence to local people and the reinforcement of their capacity building can give them opportunity to design and plan themselves, closely to their problems and realities, development projects. Conversely, the impacts, when they exist, disappear after the termination of the financial assistance. Therefore the technical assistance may provide more sustainable impacts than the financial support. Accordingly, recommendations for sustainability of agricultural projects should focus on reinforcement and improvement of capacity building of local people.

#### 9.1.3.3 Local People' Opinions about the Impacts

In addition to impact assessment, the study explored opinions and perceptions of local people about the projects, their impacts and usefulness. Here, the results were little pleasing. Differences were observed between the projects' supplies and the development demands which are the problems that affect local people. Consequently, some stakeholders found the projects useless with few impacts although they hopefully thought the projects were indispensable and could enable

their development. Moreover, opinions of local people about the usefulness of the projects varied according to interest groups. In fact, low-income stakeholders found the projects helpless and thought they make the rich farmers wealthier while they become poorer. At the same time, high proportion of high-income farmers approved the projects' usefulness. Therefore, derived recommendations should be concerned with: (1) the necessity of adapting the projects and their impacts to the needs of local people, and (2) the need for taking into account all the groups in order to balance the impacts and to let the impacts be sustainable.

### 9.1.4 Factors Affecting Farmers' Decisions

The results obtained from the structural modeling of farmers' decisions show importance of some factors for guaranteeing the participation and adoption decisions of the stakeholders. In the two areas, formal and informal education, as well as age of the stakeholders constructed the human capital latent variable, which was shown to maintain high the participation of the farmers in projects. Actually, the decision of participation increased with their augmentation. Likewise, participation decision increased with availability and access to production inputs. Nonetheless, there are some variation in findings according to the socio-cultural area. For example, factors related to soil fertility and land security appeared very important to consider in *Adja* area where land pressure were relatively greater and land security lesser. Thus, by setting down strategies to address land security and availability, agricultural projects can give incentives to farmers in this area to increase their participation. In contrast to *Adja* area, the per capita income, per capita annual quantity of food consumed and productivity constructed positively the perception on satisfaction of production and consumption latent variable, which influenced positively the participation decision of *Nagot* stakeholders. Nevertheless, the factors related to soil fertility and land security did not affect significantly the stakeholders' decision of participation. According to their opinions, availability of and access to cultivated land did not represent serious problems.

Another point of view of the results in the two areas showed the particular key role that agricultural projects played was to popularize and diffuse modern technologies for improvement of productivity. In fact, decision of adoption increased significantly with that of participation, which also augmented with goal achievement of the projects.

These results imply that scenario of design, management and monitoring, which reinforces improvement on human capital and capacity building of beneficiaries will enhance participation and adoption of modern technology, as well as

sustainability of the projects' impacts. Moreover, scenario of restructuring organization of production inputs commercialization and distribution that improves on availability and access may increase participation and adoption decisions. Finally, scenario of improvement on impacts will lead to more sustainability of the projects if these are made on issues that solve real development problems the stakeholders experience. Therefore, these aspects should be part of recommendations for more effective design, management and monitoring of agricultural projects in order to induce better goal achievement and impacts, maintain and improve on participation of stakeholders for sustainability of the impacts.

### 9.1.5 Putting all Together: The Sustainability Wheels

Putting together all the results described previously, hypotheses developed in the conceptual framework are confirmed. Sustainability of agricultural projects can be viewed as three cogged wheels rotating each other. The rotation of design, management, monitoring and goal achievement wheel will induce that of impacts, which will turn participation and adoption wheel. In that case, goal achievement wheel will start again so as the system will not stop working, even after the termination of the projects (Figure 9.1). Therefore, improvement on goal achievement is expected to increase the impacts, which will induce higher participation and adoption decisions. As long as the decisions are kept higher, the system will start again and sustainability of the impacts can be achieved and maintained. As described, each part of the system is indispensable for sustainability, and failure in any of them will break the overall working of the system so that the sustainability will not be achieved. For instance, if the goal achievement is poor, the impacts will be low, and participation and adoption decisions little. As a result, there will be little sustainability. Likewise, if the goal achievement is high, but induce impacts that solve little development problems of beneficiaries, they will lower their participation and adoption so that the sustainability will not occur.

In this system of three cogged wheels that turn each other, that of goal achievement seems to be the most important because it is directly related to the quality of design, management and monitoring of the projects. Therefore, the system starts working from there and the sustainability may strongly depends on these projects' factors. Consequently, recommendations derived from the results focused mainly on improvement of goal achievement of the projects through the quality of design, planning, management, evaluation and monitoring.

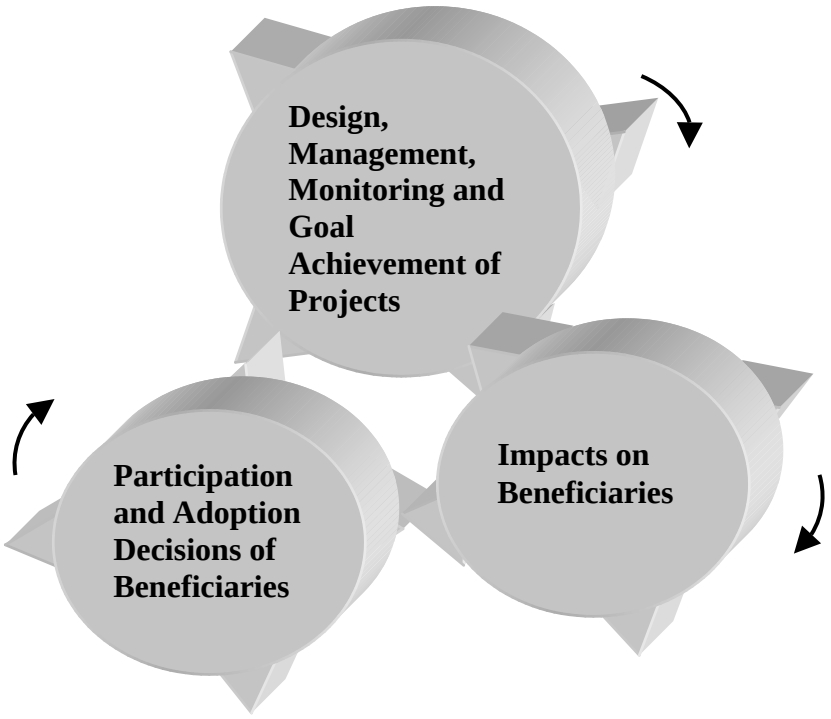



**Figure 9.1: Illustration of Sustainability of Agricultural Projects**

## 9.2 Derived Recommendations

The recommendations derived from empirical results presented above are outlined in this section according to participants involved in projects' implementation (funds institutions, government, projects' teams, local populations), but also to some external actors such as university researchers, deputy parliament, etc. Actually, the participants have their own interests, and decision powers are not equal between them. However, each of them has the possibility of making some positive changes for the projects' sustainability.

### 9.2.1 For the International Funds Institutions

Since international funds institutions are involved in financing and evaluating the projects, following recommendations will help to improve the design, management, monitoring and impacts of the projects:

(1) One of the important empirical results was the gap between the real implementation and the initial design and planning. International funds institutions have to reinforce controls to know if the projects are managed as designed and planned. In the case, necessity of any adaptation or direction change should be made when necessary.

(2) They can conduct, as far as possible, own parallel assessment of projects to verify the reliability of data and information given by the projects' teams.

(3) They should ask for the inclusion of the local people in the group that are in charge of design and planning of projects' activities, as well as in evaluation teams. By doing so, the participation can be improved and hence the sustainability of the projects.

(4) Actually, the impacts of the projects varied according to the socio-cultural area. Likewise, effects that scenario of improvement on impacts could have on sustainability of the projects were found positive only if these are concerned with issues that solve real development problems of beneficiaries. It could hence be better to put emphasis on financing small projects concentrated at area or village level, with lesser funds, but that target the needs of small groups with homogenous interests. Those types of projects seemed more effective and their impacts more sustainable than those implemented country-widely.

(5) The study showed that large part of the funds were used for equipment, administrative services, seminars and conferences. At the same time, little were utilized for field actions and consequently gave out low success. International funds institutions should therefore put priorities on financing projects in which greater part of the funds will be invested to field actions for more success and impacts on local people.

(6) The study showed the importance of capacity building through technical assistance, which can enable sustainable development. The funding institutions should therefore put more emphasis on capacity building by reinforcing the technical support in combination with financial support. For this, actions should be more oriented toward support to decentralization as the German Cooperation was doing.

### 9.2.2 For the Government

The government seems like the central actor in project design and implementation. It negotiates with international funding institutions according to rules of international diplomatic relationships, but has to provide in the same moment positive change in welfare of local people. Though political considerations can complicate their application, the following recommendations could give path for inducing sustainability of the impacts:

(1) The study found that projects' administration was very complex with many working offices among which some are little useful. In addition, the information was top-down and little decision autonomy was given to the projects' teams.

These caused in particular poor effectiveness of government projects and led therefore to low goal achievement and impacts. It appears therefore indispensable to ease the projects' administration and to give some decision autonomy to the projects' teams. It can help to diminish funds spend for administrative issues and to avail more funds for field actions. Additionally, the improvement on funds management transparency will allow to increase in goal achievement of the projects. To succeed, the government should fight against corruption by punishing and judging any projects' head who turns over funds for own business.

(2) The Government should also give priority to small local projects instead of spending billions of fcfa in countrywide projects that may yield little or no impact. The reinforcement of capacity building of local communities should be the most important framework of rural development policy. Thereby, with the help of decentralization, the transfer of project management to local authorities will lead to overall improvement of projects' sustainability in Benin. With little interference, the government can give supports only when they are needed.

(3) The government should not take the projects as political remuneration of local population voices. In fact, the study found that designing and implementing the projects country-widely without taking into account specific problems and realities of each area are the results of political considerations. Actually, the government aim is to excite local people in order to influence their decisions in future elections. The consequences are that some projects had high impacts in some socio-cultural areas and appeared useful, but poor impact in others where they appeared useless. By putting the projects objectively (without any political consideration) in areas where the implementation can improve on welfare of local people, the government will play better role of guaranteeing equal development chance to local people.

(4) In *Adja* area, land security appeared a very serious problem for agricultural development. Thus, the study found that the more land was secured, the more the participation and adoption of modern technologies were. The acceleration of land titling process in this area could improve on security of land access and hence on the projects' impacts and sustainability.

(5) The agricultural policy that consisted of giving priority to cash crops in general and cotton in particular, and of marginalizing the other sectors appeared little useful for sustainability of projects. In order to balance impacts of agricultural policy through rural development projects, crop diversification will be necessary. Therefore, the government has to develop production of the other crops, particularly the food crops.

(6) The study found that the more the human capital (age, informal education, formal schooling, etc.) the more participation and adoption of modern technology. Moreover, scenario of improvement on design, management and monitoring with regard to human capital building was found positive for sustainability of the projects. Though the government fights ceaselessly to improve the human capital building of local people, the action should be reinforced and more funds given. However, it would be better to target farmers' education in French instead of their education in local language. Indeed, French is the official spoken language, and information are written and given in French. In reality, it does not help fully the farmers to be informed like education in French can do.

### 9.2.3 For the Projects' Teams

The projects' teams are the practitioners and are in charge of conducting and monitoring the implementation. Subsequently, they hold great opportunity of improving the management and monitoring of projects. Thus, the following recommendations are made to induce more sustainability of the projects:

(1) The little respect of design and retained objectives, evaluation procedures led these factors not to be correlated significantly with goal achievement. Therefore, the projects' teams have, as far as possible, to implement the projects like they were designed and planned. Thus, better design, objectives and evaluation system could induce better goal achievement and sustainability of the projects.

(2) The projects' teams should be aware that the projects are not designed for their own development, but for rural development. Actually, the use of most part of funds for buying cars and for organizing conferences and seminars did not favor the projects' sustainability. It becomes hence imperative to let local stakeholders benefit more from projects' funds by using the greater part for field actions.

(3) The collaboration between the projects' teams and the stakeholders looked like that between teacher and students. In particular, extension service viewed local people as without knowledge, and they thought they have to learn and apply what they teach them. In this case, stakeholders' participation was poor. In order to improve the participation, the projects' teams have to realize that local people have some knowledge that guides their behavior. As well, the projects' teams or extension service should also learn from stakeholders and understand their behavior. Subsequently, the services that they provide should be as far as possible stakeholders driven. That can improve the quality of collaboration and hence the intensity of participation in projects.

(4) The study found that participation of local people was lower as expected because most of stakeholders' organizations were created to satisfy institutional needs of the projects' implementation. Therefore, the stakeholders accepted to be members of the organization because of interests they thought to benefit from the projects. As a result, the organizations appeared little sustainable since they disappeared with the termination of the projects. This aspect is very important for the projects' impacts and sustainability. In order to make sustainable stakeholders' organizations and to reinforce the capacity building, the projects' teams should rely upon organizations with good working experience that existed before the projects were initiated.

### 9.2.4 For the Local People

The local people are the most concerned by the projects, which are designed and implemented for their development. Somehow, they also hold the responsibility of projects' sustainability and should therefore build up progressive behavior that can lead to impacts' sustainability. For this, the following recommendations are suggested:

(1) The opinions of local people that the projects are created to disburse for them money is an error. Actually they have to be aware that the projects are designed and implemented to help them develop and adapt their behavior accordingly.

(2) One of the main study findings was that participation at the same time in several projects did not give stakeholders benefit as in a single project. It would be therefore more efficient and beneficial for stakeholders to get involved in a single project instead of several projects at the same time.

(3) The behavior that consisted of taking part in organizations because of immediate interests that the projects are supposed to bring did not contribute to better capacity building achievement and to sustainability. The local people should know that they could build self-capacity by setting down effective working organizations without waiting for a project. By doing so, they will surely enhance their decision power during the projects' implementation and making local population-driven the projects' activities so that their capacity building will be effective for sustainable development.

### 9.2.5 For the External Actors

The external actors are not directly involved in design and management of development projects. Nevertheless, they can influence indirectly sustainability of

their impacts through the power that they hold. Therefore, the study suggested suitable recommendations for two of the most important external actors:

(1) The university researchers can influence design and implementation of projects by collaborating with their teams for researches, impact assessment, etc. If researchers can share with the projects' teams their studies' results, it could help to improve approach of designing, planning and monitoring the projects.

(2) The deputy parliament are in charge of voting laws and of controlling government actions. They can therefore question the government on how the projects are negotiated at international level, and as well, on how the projects are implemented and on the outcomes. They can happily suggest improvement on design and planning before ratifying agreements of project financing between the government and international funding institutions.

## 9.3 Suggestions for Future Studies

As earlier stressed, the study was prone to some limitations. Thus, any future study that will consider them could produce results complementary to those of the study. For this, three aspects appear interesting to explore in the future:

(1) One of the limitations of the study was its static aspect because of lack of time. In order to have data that are more reliable and relevant empirically, future studies could target dynamic aspect. In this case, data collected following each step of project implementation from the beginning to the termination (and may be after) will be less erroneous. By applying dynamic models, empirical results would reveal how long the impacts could remain or sustain.

(2) The study was not able to use complex modeling because of some assumptions that were not relevant to rural areas. Future studies can use those complex models to assess impacts of projects at regional or country level where the main assumptions seem more appropriate. However care will be needed to isolate the real effects of the projects in the complex economic system where many factors interact.

(3) Finally, the study was not able to take into account the phase of discussions and negotiations between the international funding institutions and the government for projects financing. This aspect requires using techniques of international relations science. Actually, behavior of international funding institutions with regard to development projects seems ambiguous. Indeed, they provide funds to projects whose implementation marginally changes rural people living conditions, but they continue to finance. Do they have interest to always go on financing projects in rural areas of Less Developed Countries, though they poorly succeed?

On the other hand, has someone any interest in seeing rural areas be ceaselessly helped throughout agricultural projects? Are international funding institutions and their governments effectively willing to bring rural areas out of poverty and projects' cycles? Future studies on international issues of project negotiations could bring some answers to these above questions.

# ZUSAMMENFASSUNG (GERMAN SUMMARY)

**Agrarentwicklungsprojekte und nachhaltige Entwicklung ländlicher Gebiete in Benin: Erfolgskontrolle, Partizipations- und Adoptionsentscheidungen**

## Hintergrundinformationen, Problemstellung und Zielsetzung

Die Wirtschaftslage der meisten Entwicklungsländer wird in starkem Maße vom landwirtschaftlichen Sektor geprägt. Trotz dieser Schlüsselrolle wird die Landwirtschaft durch verschiedene wirtschaftspolitische Maßnahmen benachteiligt und mit Problemen konfrontiert, die ihren Fortschritt verlangsamen und das Überleben der Landwirte erschweren. Gleichzeitig werden die Naturressourcen wie Land, Wald und Wasser geschädigt bzw. verbraucht. So führt der Rückgang der Bodenfruchtbarkeit zur Abnahme der landwirtschaftlichen Produktivität. Verbunden mit der Senkung und der Instabilität der Exportproduktpreise führen die geschädigten Naturressourcen zu einer drastischen Verringerung des landwirtschaftlichen Einkommens. Um zur Entwicklung landwirtschaftlicher Gebiete in den Entwicklungsländern beizutragen, kämpfen internationale Institutionen wie die WELT BANK, die FAO (Food- und Agrarorganisation), die GTZ sowie Nicht-Staatlich-Organisationen (NGOs) unaufhörlich gegen diese Probleme an. Seit längerem werden sog. Agrarentwicklungsprojekte durchgeführt, um die Landbevölkerung zu unterstützen, die Landwirtschaft weiter zu entwickeln und folglich ein stabiles Einkommen zu sichern.

Die durchgeführten Projekte sollen die Entwicklung eigener Fähigkeiten und die Selbstbestimmung der ländlicher Bevölkerung fördern und sie dabei unterstützen, das Einkommen zu vergrößern und den Zugang zu Sozialeinrichtungen zu verbessern. Der nachhaltige Erfolg dieser Projekte ist jedoch strittig. In der entwicklungspolitischen Literatur wird häufig berichtet, dass aufgrund einiger Unzulänglichkeiten der Einfluss von Projekten auf den Entwicklungsverlauf geringer ist als erwartet. Positive Projektwirkungen sind oft nur kurzfristiger Natur, und nach Ende der Projekte wird wieder der alte Entwicklungspfad eingeschlagen. Demzufolge ist es notwendig, die Effizienz der Projekte und ihrer Einflüsse zu evaluieren und ebenso die Schlüsselfaktoren für ihre Nachhaltigkeit zu identifizieren. Um dies zu gewährleisten, zielt die vorliegende Studie einerseits auf eine Evaluierung des Einflusses der Agrarentwicklungsprojekte auf den Entwicklungsstand der betroffenen Gebiete und ihrer Bevölkerung und andererseits auf die Identifizierung der Nachhaltigkeitsschlüsselfaktoren ab. Aus den Ergebnissen dieser Analysen werden Vorschläge abgeleitet, die zur nachhaltigen Entwicklung führen können.

## Datensammlung und methodologischer Ansatz

Die Studie kombiniert quantitative und qualitative Methoden zur Analyse der Projektwirkungen, wobei zwei verschiedenen Ebenen unterschieden werden. Auf der Projektebene wurden 20 Projekte nach spezifischen Kriterien ausgewählt. Durch offene Diskussionen, Fokus-Gruppen, Interviews, etc. mit Projektträgern und Zielgruppen wurden qualitative und quantitative Daten gesammelt. Auf der Zielgruppenebene wurden zwei soziokulturelle Gebiete (*Adja* und *Nagot*) ausgewählt, in denen alle Typen von Projekten durchgeführt wurden. Ebenso wurde eine Stichprobe von drei Gruppen von Bauern zufällig ausgewählt, um nach dem "*With-Without*" Prinzip eine Wirkungseinschätzung zu ermöglichen: (1) eine Gruppe ohne Projekt, (2) eine Gruppe mit einem einzelnen Projekt und (3) eine Gruppe mit 2 oder mehr Projekten. Mit Hilfe von strukturierten Umfragen mit Hilfe eines Fragebogens wurden quantitative Daten auf Haushaltsebene gesammelt. Zusätzlich erlaubten offene Diskussionen, Fokus-Gruppen, Interviews, etc., die Sammlung qualitativer Daten auf Dorf- und Haushaltsebene, die die quantitativ gesammelten Daten ergänzten.

Nach einer kritischen Literaturanalyse erschien es notwendig, eine Analysemethode zu entwickeln, um die für die Zielgruppen relevanten Wirkungen einzuschätzen und ebenso die Faktoren zu identifizieren, die für die Nachhaltigkeit der landwirtschaftlichen Projekte wichtig sind. Als methodologische Ansätze der Studie werden ökonometrische Modelle und die sog. Pfadanalyse (”*Structural Equation Modeling”*), die mit latenten Variablen arbeitet, eingesetzt. Mit Hilfe dieser Ansätze werden die Daten nach dem “*With-Without*”- und “*Before-After*”-Prinzip analysiert.

Die quantitativen Analysen wurden mit Hilfe der Statistiksoftware *SPSS*, *STATISTICA* und *Frontier Version 4.1* ausgeführt.

## Empirische Ergebnisse und Diskussionen

Die Analyse der sozioökonomischen Bedingungen der Bauernhaushalte zeigt deutliche Unterschiede zwischen den zwei ausgewählten soziokulturellen Gebieten in Benin. Da in der *Adja*-Region das „Land unter größerem Druck steht“ und Naturressourcen knapper sind als in *Nagot*, ist das Landwirtschaftssystem im erstgenannten Gebiet intensiver, so dass die Bauern in stärkerem Maße Dünger, Insektizide und andere moderne landwirtschaftliche Technologien nutzen. Außerdem ist die Bodenfruchtbarkeit in der *Adja*-Region geringer, aber das Land wird effizienter genutzt, weshalb die durchschnittliche Produktivität des Landes höher als im *Nagot*-Gebiet ist. Um das vergrößerte Risiko der landwirt-

schaftlichen Produktion auszugleichen, entwickelten die *Adja*-Landwirte außerlandwirtschaftliche Aktivitäten, um sich ein höheres jährliches Einkommen zu beschaffen.

Aus der Analyse der Projektverläufe konnten folgende Schlüsselfaktoren identifiziert werden: Design und Konzeption der Projekte, Management-Effizienz, innere Organisation, Teilnahme der Bevölkerung und Evaluierungssystem. Während internationale Institutionen mit zusammenhängenden Projekten ein besseres Design hatten, besser durchgeführt und evaluiert wurden, waren die nationalen Projekte aufgrund von Starrheit, Komplexität, niedriger Transparenz und Kontrolle weniger erfolgreich. Als Erfolgsfaktoren der Projekte wurden vor allem Qualität der inneren Organisation, Management-Effizienz und Teilnahmegrad der Bevölkerung identifiziert. Im Gegensatz dazu hatten gutes Design und gute Konzeption, klare Definition der Projektziele und Planung der Tätigkeiten ebenso wie ein effizientes Evaluierungssystem keine signifikante Beziehung zu dem Projekterfolg, wahrscheinlich wegen der schlechten Durchführung der Projekte.

Weil die landwirtschaftliche Produktion im *Adja*-Gebiet schwieriger ist, waren die Bauern dort eher als im *Nagot*-Gebiet bereit, an landwirtschaftlichen Projekten teilzunehmen, um ihre Wohlfahrt zu verbessern. Tatsächlich glauben die Bauer des *Adja*- oder *Nagot*-Gebietes, dass landwirtschaftliche Projekte nützlich sind und die Möglichkeit bieten, ihre Wohlfahrt zu erhöhen. Jedoch bleibt die Aufgabe auszumachen, ob die Projekte positive Einflüsse auf ihre wirtschaftliche und soziale Situation haben.

Die Evaluierungsergebnisse der Projekte waren unterschiedlich je nach berücksichtigten Erfolgsindikatoren und betrachteten soziokulturellen Gebieten. Bezüglich des Kontaktindexes hatten die Projekte einen positiven signifikanten Einfluss auf die landwirtschaftliche Produktivität, aber keinen signifikanten Einfluss auf den Nahrungsmittelverbrauch und die Erhaltung der Bodenfruchtbarkeit im ganzen Studiengebiet. Umgekehrt, bei Berücksichtigung des Zielerreichungsgradindexes waren alle Einflüsse signifikant und positiv in den beiden Gebieten der Studienzone. Die Einflüsse waren dennoch im *Adja*-Gebiet höher als im *Nagot*-Gebiet. Jedoch halfen die Projekte, die Vegetation durch land- und forstwirtschaftliche Techniken zu regenerieren. Gleichzeitig förderten die Projekte manche Aktivitäten, die niedrige Umweltansprüche hatten, um den Druck auf Naturressourcen zu reduzieren.

Die Projekte konnten auch die organisatorischen Fähigkeiten und Leistungen der Bauern verbessern und haben dazu beigetragen, Problemlösungen möglichst aus

eigener Kraft zu entwickeln. Unterschiede bestehen folglich zwischen den Wirkungen der technischen und der finanziellen Entwicklungszusammenarbeit.

Zusätzlich erforschte die Studie Meinungen und Wahrnehmungen der Bevölkerung über die Projekte, ihre Einflüsse und Nützlichkeit. Hier waren die Ergebnisse durchaus überraschend. Unterschiede wurden zwischen den Projekt-angeboten und den Nachfragen der Bauer beobachtet. So fanden einige Teilnehmer die Projekte nutzlos bzw. mit geringen Einflüssen, obwohl sie hoffnungsvoll dachten, dass die Projekte neue Impulse geben und ihre Entwicklung fördern würden. Es besteht folglich eine Notwendigkeit, die Projekte und ihre Einflüsse den Bedürfnissen der Bauern anzupassen.

Die Ergebnisse der strukturellen Modellierung von der Bauernentscheidungen zeigen die Bedeutung einiger Faktoren, damit die Teilnahme- und Adoptions-entscheidungen der Entscheidungsträger garantiert wird. In den beiden Gebieten wurden Ausbildung, Alphabetisierung und Alter der Bauern (Humankapital) identifiziert, um ihre hohe Beteiligung an Projekten aufrechtzuerhalten. Ebenso nahm die Teilnahme-Entscheidung mit der Verfügbarkeit und demZugang zu Produktionsinputs zu. Dennoch unterscheiden sich die Ergebnisse je nach soziokulturellem Gebiet. Ebenso wichtig sind Faktoren wie Bodenfruchtbarkeit und Landsicherheit im *Adja* Gebiet. So können durch Strategien, die darauf abzielen, Landsicherheit und Verfügbarkeit zu vermehren, landwirtschaftliche Projekte den Bauern dieses Gebiets Ansporn geben, ihre Beteiligung an Projekten zu vergrößern. Die Produktivität, das Pro-Kopf-Einkommen und die jährliche Pro-Kopf-Nahrungsmenge beeinflussten - im Gegensatz zum *Adja*-Gebiet - die Teilnahme-Entscheidung der *Nagot*-Projektbeteiligten positiv und bewirken eine positive Auffassung und Zufriedenheit mit der Produktion und dem Verbrauch. Die Faktoren Bodenfruchtbarkeit und Landsicherheit hatten keinen signifikanten Einfluss auf Teilnahme-Entscheidung in diesem Gebiet. Ihrer Meinungen nach haben die *Nagot*-Landwirte keine Zugangschwierigkeit zu Land.

Eine andere Betrachtungsseite der Ergebnisse zeigte in den zwei Gebieten der Studienzone die besondere Schlüsselrolle, die Agrarentwicklungsprojekte bei der Implementierung und Verbreitung moderner Technologien zur Verbesserung der Produktivität spielen. Die meisten Faktoren beeinflussten die Teilnahme-entscheidungen der Landwirte, nicht direkt sondern indirekt durch die Teilnahme an Projekten. Es ist ohne Zweifel klar, dass die Adoptionsentscheidungen mit einer Erhöhung der Teilnahmebereitschaft positiv zusammenhängen, was auch den Projekterfolg vergrößert. Deshalb sollen Empfehlungen für ein effizienteres Management der Projekte die zentrale Aufgabe sein, um einen größeren Erfolg zu

erlangen und die Teilnahme der Bauern an Projekten zu verbessern und aufrechtzuerhalten, um daraufhin die Nachhaltigkeit der Projekte zu verbessern.

## Schlussfolgerung und Vorschläge für zukünftige Studien

Die Studie kommt zu dem Ergebnis, dass die Nachhaltigkeit der landwirtschaftlichen Projekte durch drei zentrale Bereiche (Management und Zielerreichungs-, Einfluss und Teilnahme und Adoptionsbereich) bestimmt wird, die eng miteinander verzahnt sind. Die Nachhaltigkeit der positiven Projektwirkung hängt vor allem von der Effizienz ihres Managements, der Orientierung an lokalen Problemlagen und der Anpassung der Beteiligten an die veränderten wirtschaftlichen Bedingungen ab. Deshalb richten sich Empfehlungen stärker auf Tätigkeiten, die zum effizienteren Management und zur Verbesserung der Teilnahme der lokalen Bevölkerung führen können. Drei Haupteinschränkungen sind aber bei dieser Studie zu berücksichtigen: (1) das benutzte Modell ist statisch, (2) die vorliegende Arbeit konzentriert sich auf das Haushaltsniveau und (3) die Planungs- und Verhandlungsphasen der Projekte konnten nicht erforscht werden. Deshalb sollten zukünftige Studien sich auf diese Aspekte konzentrieren, damit weitere relevante und ergänzende Ergebnisse erzielt werden können.

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# APPENDICES

## Appendix 1: Description of the Selected Projects

| Name | Sector of Activity | Socio-cultural Areas | Funds Institution(s) | Beginning Year |
|---|---|---|---|---|
| 1. PAGER | Integrated (Credit, Provide Revenue Increase, etc.) | Adja, Nagot, Fon | Fonds Européen pour le Développement (FED), Benin Government | 1998 |
| 2. PADSA | Integrated (Credit, Provide Revenue Increase, etc.) | Adja, Nagot, Fon, Bariba | Denmark, Benin Government | 1998 |
| 3. PAMR | Integrated (Credit, Technical Support, Credit | Adja, Nagot | Belgium, Benin Government | 1998 |
| 4. PILSA | Food Security | Adja, Nagot, Fon, Bariba | GTZ, IDA Credit, Benin Government | 1995 |
| 5. PDE | Livestock Development | Adja, Nagot, Fon, Bariba | African Fund for Development (AFD) | 1998 |
| 6. PRRF | Natural Resources Management | Nagot | GTZ | 1996 |
| 7. PGTRN | Natural Resources Management | Adja, Nagot, Fon, Mahi, Ditamari, Dendi | GTZ, French Agency for Development | 1998 |
| 8. UGPPAD-Dévé | Provide Bio Production | Adja | China | 1976 |
| 9. AGEFIB | Integrated | Adja, Fon | World Bank | 1994 |
| 10. CAGEA | Management Advices | Adja, Fon, Mina | French Government | 1998 |
| 11. PROMIC | Integrated Project | Nagot, Bariba | International Fund for Agricultural Development (IFAD), Benin Government | 1999 |
| 12. PAS (Protos) | Agricultural Development | Adja, Nagot | AFVP (French Association for Progress Voluntary | 1996 |
| 13. Hunger Project | Education and Formation for Food Security | Adja, Nagot, Mina, Bariba | England USA | 1997 |
| 14. Project for Food Security | Food Security | Adja, Nagot | USA (USAID) | 1996 |
| 15. Project for Gender Development | Agricultural Credit | Nagot | KFW-DED | 1997 |
| 16. PADAV | Technical Support, Formation | Adja | Plan International | 1998 |
| 17. PAZH | Natural Resources Management | Adja, Fon, Nagot | The Netherlands, Benin Government | 1998 |

**Description of the Selected Projects (Continued)**

| Name | Type | Socio-cultural Areas | Funds Institution(s) | Beginning Year |
|---|---|---|---|---|
| 18. RAMR | Agricultural Development | Adja, Nagot, Fon, Bariba | The Netherlands, Benin Government | 1990 |
| 19. Projet d'Appui au Développement à la Base | Rural Development | Adja, Nagot | The Netherlands (CBDD-SNV) | 1998 |
| 20. PAS | Improvement of Small-Households Health | Adja, Fon | Plan International | 1998 |

## Appendix 2: Criteria to Evaluate Quality of the Projects

- **Quality of Design, Conception and Planning**

1. Have Pre-feasibility and feasibility studies, and verifications been done? If yes, by what institution(s)?
2. Before planning, have local population problems, priorities, possibilities, disposability and socio-cultural acceptance been analysed and taken into account?
3. During design, conception and planning, have local important persons, social groups and institutions playing indispensable role during the project execution been concerted and their opinions been taken into account?
4. Has the project been planned to work with collaboration of local institutions?
5. Are the diffused modern technologies farmers driven?
6. Are the modern technologies compatible with local population possibilities and disposability?

- **Quality of Objectives**

1. Do the beneficiaries participate in definition of the objectives?
2. Do financial partners, government, national NGOs or local population accept the project objectives?
3. Can the activities planned help to achieve correctly the objectives?
4. Can the objectives be achieved in meaning time?
5. Can objectives achievement be clearly measured during evaluation?

- **Quality of Internal Organization**

1. Are the functions defined during the implementation compatible with their objectives?
2. Can the projects' teams take some decisions or are decisions top down, coming from donors, government or project heads?
3. Is the qualification of the project agents compatible with these tasks?
4. Have the project agents good experiences as regards the language, culture, social issues of the area where the projects are implemented?
5. Are rules and internal organizations established to control administrative working of the projects strictly followed?
6. Are there interests conflicts between projects' teams and beneficiaries?

- **Quality of Funding and Funds Management Transparency**

1. Are the percentage of the total funds exactly assigned to field activities above 50%?
2. Are the funds frequently available?
3. Have the financial management procedures been strictly respected?
4. Has the financial management frequently controlled?
5. Do the beneficiaries participate in control of funds management?
6. Does the authority punish the persons who turn over part of funds?

- **Intensity of Beneficiaries Participation**

1. Do local populations and their associations participate in decision taking during the project implementation?
2. Do they contribute financially to the projects?
3. Do stakeholders have clear idea of their roles in the project activities?
4. Do the projects' teams help the beneficiaries find themselves solutions for their problems?
5. Do stakeholders participate in choice of the projects' teams?

- **Quality of Monitoring and Evaluation Systems**

1. Does a monitoring plan exist?
2. Are the indicators to measure the project' success clearly defined?
3. Are they measurable?
4. Do databases exist?
5. Are the beneficiaries involved in the monitoring and evaluation systems?

## Appendix 3: Structural Model of Farmers' Decisions in *Statistica* Package

(HUCA)-1->[ALPHLE]
(HUCA)-2->[AGE]
(HUCA)-3->[EDU]

(PSPC)-4->[REV]
(PSPC)-5->[SIZE]
(PSPC)-6->[OUTPUT]
(PSPC)-7->[FOOD]

(AAPI)-8->[TEN]
(AAPI)-9->[CREDIT]
(AAPI)-10->[LABOR]
(AAPI)-11->[HILABOR]

(PSSF)-12->[SITOP]
(PSSF)-13->[SOSTRUC]
(PSSF)-14->[VEGCOV]
(PSSF)-15->[DUREX]
(PSSF)-16->[SODEGR]

(DELTA1)-->[ALPHLE]
(DELTA2)-->[AGE]
(DELTA3)-->[EDU]
(DELTA4)-->[REV]
(DELTA5)-->[SIZE]
(DELTA6)-->[OUTPUT]
(DELTA7)-->[FOOD]
(DELTA8)-->[TEN]
(DELTA9)-->[CREDIT]
(DELTA10)-->[LABOR]

(DELTA11)-->[HILABOR]
(DELTA12)-->[SITOP]
(DELTA13)-->[SOSTRUC]
(DELTA14)-->[VEGCOV]
(DELTA15)-->[DUREX]
(DELTA16)-->[SODEGR]

(DELTA1)-17-(DELTA1)
(DELTA2)-18-(DELTA2)
(DELTA3)-19-(DELTA3)
(DELTA4)-20-(DELTA4)
(DELTA5)-21-(DELTA5)
(DELTA6)-22-(DELTA6)
(DELTA7)-23-(DELTA7)
(DELTA8)-24-(DELTA8)
(DELTA9)-25-(DELTA9)
(DELTA10)-26-(DELTA10)
(DELTA11)-27-(DELTA11)
(DELTA12)-28-(DELTA12)
(DELTA13)-29-(DELTA13)
(DELTA14)-30-(DELTA14)
(DELTA15)-31-(DELTA15)
(DELTA16)-32-(DELTA16)

(DEPA)-33->[IC]
(DEPA)-34->[IS]
(DEPA)-35->[UTIPRO]
(DEPA)-36->[IE]

(DEADO)-->[TA]
(DEADO)-37->[MA]

(EPSILON1)-->[PROTYP]
(EPSILON2)-->[IC]
(EPSILON3)-->[IS]
(EPSILON4)-->[UTIPRO]
(EPSILON5)-->[IE]
(EPSILON6)-->[TA]
(EPSILON7)-->[MA]

(EPSILON1)-38-(EPSILON1)
(EPSILON2)-39-(EPSILON2)
(EPSILON3)-40-(EPSILON3)
(EPSILON4)-41-(EPSILON4)

(EPSILON5)-42-(EPSILON5)
(EPSILON6)-43-(EPSILON6)
(EPSILON7)-44-(EPSILON7)

(ZETA1)-->(DEPA)
(ZETA2)-->(DEADO)

(ZETA1)-45-(ZETA1)
(ZETA2)-46-(ZETA2)

(HUCA)-47->(DEADO)
(PSPC)-48->(DEADO)
(AAPI)-49->(DEADO)
(PSSF)-50->(DEADO)
(DEPA)-51->(DEADO)

## About the Author

**Afouda Jacob Yabi** was born in 1972 in Benin. He studied at the Faculty of Agriculture, National University of Benin, Benin from 1992 to 1998 where he graduated with a B.Sc. degree in Agriculture in 1996 and a M. Sc. degree in Agricultural Economics in 1998. Immediately on completion of his studies, he joined a program of research and evaluation of development projects on management and protection of natural resources in Benin where he worked as research assistant. In 2000, he joined the Justus-Liebig University, Giessen, Germany for a doctorate programme.

## About the Book

The most criticisms of agricultural projects are that their design, management and monitoring are little efficient and consider little development needs of stakeholders. These weaknesses induce low impacts on sustainable development of beneficiaries, as well as low participation and adoption of modern technologies, which make the projects little sustainable. This book investigates therefore the impacts of the projects on sustainable development of stakeholders and the factors affecting their participation and adoption decisions, using a with-without approach and a structural modelling. The results show the impacts were positive, but depended closely on the area where the projects were implemented. As feedback, overall satisfactions that the stakeholders view from the impacts, human capital and access to production inputs were key factors of participation and adoption. Therefore, the solution for more sustainable impacts of agricultural projects lies on designing and implementing small-scale projects that target real development problems of stakeholders, improvement on human capital and access to production input.