THE DETERMINANTS OF INCOME DIVERSIFICATION IN RURAL HOUSEHOLDS IN TAHOUA DEPARTMENT, NIGER

by

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DEDICATION

To my mother,

In Memoriam.

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ABSTRACT

Income diversification has become the norm within rural households in developing countries. Participation in multiple activities helps reduce risk and allows households to ensure their livelihood. This is a case study that examines empirical evidence for income and crop diversification for a sample of rural households in Niger in order to determine which category of households, poorest or wealthiest, have the most diversified incomes. The study also examines the impacts of household characteristics and location on diversification. Results indicate that households at greatest risk of falling into destitution are pushed into diversifying income as a strategy to mitigate risk. Diversification depends on the availability of both physical and financial capitals, and on the regions in which households are located. In addition, results suggest that, although female-headed households have less access to resources, they are more diversified than households headed by men.

CHAPTER ONE

INTRODUCTION

For many rural households in sub-Saharan Africa, food consumption and economic conditions are worsening (FAO 1995). Chronic economic crisis, unequal distribution of resources between rural and urban areas, commodity price fluctuations, lack of access to credit and other productive resources are major problems that rural households face in developing countries. Farm production in Africa, especially in arid and semi-arid zones appears to be threatened by long term issues such as recurring droughts and underdeveloped credit and insurance markets (Reardon 1997). Food security is in jeopardy because of shortfalls in crop production. The consequences are low stocks of agricultural products during the dry season (Reardon 1997).

Since instability and risk are prevalent in arid and semi-arid regions, rural families manage production and consumption related risks and shocks by diversifying their income sources. Households search out and exploit opportunities to earn extra income to ensure food security during the dry season or during periods of drought. This occurrence has been studied under the term "income diversification" (Reardon, Matlon and Delgado 1992; Reardon 1997; Barrett et al. 2000; De Janvry and Sadoulet 2001). According to these studies, income diversification has become the norm in regions where rural households face income and production related risks and where access to capital is increasingly difficult due to credit constraints.

1.1 Objectives of the Study

Although income diversification is widespread among rural households, the factors and constraints associated with it and the category of households (poorest or wealthiest) most likely to diversify is subject to debate. Indeed, rural households' ability to ensure their livelihood is very much influenced by the way households are structured, the resources available, the agro-ecological conditions in which household productive activities take place, gender of the head of household, to list a few. These factors vary so much across countries and continents that it is difficult to make generalizations. Findings valid for Burkina Faso may not apply in Peru where rural households face different constraints.

This paper identifies the factors that influence rural household decisions to engage in multiple activities, and the differentials in income source among poorer and wealthier households in Niger. Drawing on data from Tahoua, Niger, empirical evidence for the determinants of income diversification is examined.

The data used in this study were collected as part of the *Household Livelihood Security* (HHLS) study. The data came from a survey conducted in Tahoua, rural Niger, between April and May 1998 by the University of Arizona's Bureau of Applied Research in Anthropology (BARA), under CARE International. The sample consisted of 405 households randomly selected from fifteen villages, categorized into five agro-ecological areas. These households were assumed to be statistically representative of rural Tahoua at the regional level with respect to demographic and socio-economic characteristics (Finan, Baro and Langworthy 1998).

1.2 Definitions and Conceptual Issues

Income diversification is defined as the tendency for rural households to combine several income sources in response to shocks to their agricultural production, or to prepare against recurring droughts or other climatic occurrences (Dercon and Krishnan 1996; Reardon 1997). It is a central component of rural households' livelihood diversification. Surveys estimate that roughly 40% of African rural household incomes are derived from non-farm sources (Reardon 1997; Ellis 1998). Similar patterns are found in rural Latin America, where non-farm employment accounts for nearly 40 % of rural incomes (Reardon et al. 2001; De Janvry and Sadoulet 2001).

A substantial empirical literature has addressed diversification measurement (Reardon, Matlon and Delgado 1992; Reardon et al. 1998). There are several ways to measure and compare diversification patterns, ranging from simple computation of shares of income to the use of scalar measures such as the Gini coefficient. For example, Reardon, Matlon and Delgado (1992) use the share of non-cropping income in total income to measure diversification levels among rural households in Burkina Faso. Their method is easily interpreted when one just needs to assess the impact of one income source in total household income, but it may fall short with more complex analyses. In particular, under strict interpretation of this index, a household that receives all of its income from non-cropping sources would be considered to have a highly diversified income.

This study uses a different perspective, focusing on diversification indices as measures of diversification levels using the Herfindhal-Hirshman Index (HHI). The HHI is commonly used in industrial organization economics and is the measure of the level of concentration within and industry. The motivation for using this method stems from the belief that diversity corresponds with the notion of diversification to minimize income variability. The HHI not only incorporates the number of different activities that households are engaged in, but also the relative share of each activity in overall income. It is therefore more appropriate for this study. A detailed analysis of the HHI and the income diversification index is offered in the methodology chapter.

Many authors make the distinction between survival and livelihood strategies. On one hand, livelihood strategies are mechanisms that rural households use in every-day life in order to satisfy their basic needs. Survival strategies are activities that farm households are engaged in to satisfy immediate needs for food and liquidity. Survival strategies include extension of cultivable land, crop diversification, rural-urban migration, petty trade, artisanal activities etc. (Ellis 1998).

It is also important to differentiate between off-farm and non-farm activities. The latter include employment in sectors other than agriculture and activities that are not farm-related, such as petty trade and work-related migration. Off-farm activities can include providing labor to neighboring farms and larger scale production farms for wages and/or cultivate their own parcels of land, in addition to engaging in non-farm activities. The term "off-farm" derives from a spatial categorization of activities (Barrett et al. 2001).

1.3 Organization of the Study

In the second chapter, a review of theories and findings on the determinants of income diversification and non-farm activities among rural households is presented. In addition, the hypotheses to be tested are stated. Chapter three sets the context within which income diversification is undertaken by looking at the demographic and socio-economics characteristics of the study region. Chapter four presents the methodology used to empirically test the hypotheses. Chapter five presents the findings relating to the determinants of the components of household income. In chapter six, income and crop level diversifications are discussed. The final concludes and offers implications for policy and suggestions future research.

CHAPTER TWO

LITERATURE REVIEW AND HYPOTHESES TO BE TESTED

The study of the determinants of income diversification within rural households in sub-Saharan Africa presents serious challenges. Due to the diversity of findings and to the fact that there are many divergent empirical studies addressing the determinants of income diversification, it is difficult to pinpoint the factors that influence the decision of rural households to undertake non-farm activities. Although income diversification widespread in developing countries, it has not been subject to enquiries until the 1970's (Chuta and Liedholm 1979). Most of the studies on income diversification have concentrated on the characteristics of farm households as micro-enterprises, which, in addition to farm activities, undertake non-farm activities in order to increase their income (Chuta and Liedholm 1979; Liedholm and Mead 1986).

Recently several studies have considered empirically the factors that influence the decision of rural households to engage in non-farm activities. They include Reardon, Delgado, and Matlon (1992), Reardon (1997), Reardon and Taylor (1996), Delgado et al. (1994), Dercon and Krishnan (1996). In 2001, *World Development* devoted a special issue for the empirical study of income diversification among rural households. These studies suggest that rural households faced with shortfalls in agricultural production and consumption tend to engage in off-farm or non-farm activities in order to secure households' food needs, and more permanent levels of income.

The different strategies that rural households use to ensure their livelihood are numerous and vary by country. While in many developing countries changes in the rural sector push rural households towards diversification of income sources, a few factors are worth noting, which explain the regional differences in strategies that households adopt to ensure their livelihood. First, productivity of agriculture in sub-Saharan Africa is lower than in most parts of rural South Asia. Findings in the two regions explain these differences by the fact that rural capital and insurance markets are less developed in Africa (Matlon 1987). As a result, farming in South Asia is more capitalized and commercial (Matlon 1987). Second, conditions of access are different for rural African households compared to their counterparts in South Asia. According to Reardon (1997), these differences are explained by the fact that land is more available and more equally distributed in sub-Saharan Africa. In South Asia, landless households are more likely to relocate into the non-farm sector (restricted access to land for the poorer households pushes large numbers into the urban sector), whereas in Africa, poor households, because they lack the means to invest in non-farm activities, stay and make the most of marginal lands (Matlon 1987). The factors discussed above imply that farm income and access to land are not well correlated in rural sub-Saharan Africa, unlike South Asia and Latin America where access to land is more problematic for poorer households.

2.1 Economic Incentives for Diversification

The reasons for income diversification are numerous and vary according to resources available to, and location of households. Many authors put the determinants of

income diversification into two categories: *ex ante* and *ex post*. Reardon, Delgado, and Matlon (1992) posit that some rural households are "pushed" to engage in multiple non-farm activities to cope with shocks (i.e., drought) to their own farming. Indeed, for rural households, problems of food security related to rising inflation, shortages, ecological problems, and input costs continue to act as pressures to diversify cropping systems and to resort to or expand off-farm activities. Others are "pulled" into non-farm activities because the latter often pay more than farming and generate cash, particularly when the rural households concerned are landless and do not have the necessary capital to invest in own farm improvement.

Motivations for diversification are numerous and linked with a wide range activities, associated with both positive and negative outcomes (Dercon and Krishnan 1996). Income diversification can represent a crucial means for rural households to ensure long-term food security. However, not all rural households are able to so due to lack of access to opportunities or credit constraints. Many analysts see income diversification as a vital coping strategy for the rural poor, while recognizing that in many cases it can serve as a mechanism for increasing wealth differentiation among rural households. The choice of non-farm activities is not free but is determined by constraints in space and unequal access to resources.

Overall, there are three main reasons common to almost all developing countries (Reardon, Delgado, and Matlon, 1992; De Janvry and Sadoulet 2001; Escobal 2001). The literature on diversification has argued that households engage in non-farm activities in order to: (1) mitigate risk by diversifying *ex ante*, (2) generate income *ex post* as

response to insurance market failure, and (3) earn cash income where credit markets are underdeveloped.

2.1.1 SAP and Income Diversification

In the era of structural adjustment (SAP), some authors (Bangura 1994) have used the concept of "household coping strategies" to explain the relation between SAP, economic liberalization and the of rural households' attitude towards uncertainty about production and consumption. Bangura (1994) argues that SAP policies have resulted in decline in marketing services, removal of subsidies on agricultural inputs, limiting access to productive resources such as fertilizers. Cutbacks in public funding for health infrastructure, education, and other social services have created needs for additional cash. The consequence is that farm households turn to activities outside of agriculture to create new sources for cash (Bangura 1994).

Changes in the terms of trade also tend to push rural households towards diversification. For example, a study of household income strategies in the Mexican *ejido* sector shows that, although many poor households were given land, as a consequence of structural adjustment policies and cutbacks in public services they have no choice but turn to non-farm activities (De Janvry and Sadoulet 2001).

2.1.2 Seasonal and Annual Variability of Income Sources

Production of a range of agricultural goods and services, the sale of wage labor, individual self-employment and reliance on remittances spread risk from variability of agricultural income. Seasonality of income (as a consequence of seasonality of farming) has important effects for vulnerable household nutrition. According to Berry (1989, p.

17) "... diversification of income earning activities is a key factor because farming in Africa is usually so risky: crop yields are subject to uncertainty of rainfalls and input supply, and farming incomes are subject to the uncertainty of both yields and prices." To protect themselves, households rely on survival or livelihood mechanisms such as income diversification. "A related but distinct role of diversification is to cope *ex post* with the shocks to income" (Reardon 1997, p. 735). When crops fail or livestock die, households must reallocate labor to other pursuits, whether formal employment off-farm (e.g. wage labor), informal employment off-farm (e.g. hunting) or non-agricultural activities on farm (e.g. weaving). Cekan (1992) explains how farm households use seasonal "coping strategies" during the dry season in five different Malian villages. There are numerous ways that households adapt their livelihood strategies to ensure viability. These include temporary migration, cash crop production, and investment in livestock. Barrett and Arcese (1998) show that wildlife poaching in Tanzania in part responds to agro-climatic shocks that affect farm labor productivity. Similar situations are also observed in India. In Gujarat, rural households respond to shocks (such as droughts) by diversifying their income sources through migration, sharecropping, and borrowing and lending (Chen 1989). Non-farm activities help smooth income streams and insure against variability.

2.2 Differences in Opportunities

The opportunities for income diversification open to rural households vary. Reardon, Delgado and Matlon (1992) find that income diversification is affected by market proximity, among other factors. Income diversification also depends on

household size, ethnic groups, age and season. For example, in Burkina Faso, Reardon, Delgado and Matlon (1992) find that the ability of households to diversify incomes depends upon both household characteristics and economic variables. The size of a household is a key variable in determining whether or not a household will engage in non-farm activities. They also find that households' capacity to cope with the drought shocks of the mid-1980s in Burkina Faso was strongly associated with the extent of non-farm diversification. Dercon and Krishnan (1996) suggest that the difference in income portfolios is best explained by differences in ability, location and access to credit. In their study, the size of a household and the existence of personal networks are key variables in income diversification.

2.2.1 Geographic Factors

Survival strategies in sub-Saharan Africa vary by agro-economic zone. Reardon (1997) posits that rural households tend to choose non-farm activities that best suit the conditions. For example, where rainfall is uncertain and soil quality is poor, migration tends to be the chosen activity because households need to diversify outside of the zone. Furthermore, in a given zone, migration varies with rainfall. The reverse has been found to hold for more favorable agro-climatic areas. Haggblade, Hazell, and Brown (1989) and Reardon, Delgado, and Matlon (1992) found that households living in favorable agro-ecological zones (with higher levels of rainfall and richer soils) tend to engage in activities that are farm related. In addition, income inequality among households is less acute in zones with better infrastructure (i.e., roads) and closer to markets and cities where access to labor-intensive employment is greater.

2.2.2 Household Level Factors

For richer households, diversification may represent a strategy for accumulation. For poorer households, income diversification is an important component of their livelihood strategies, as they depend on diverse income sources to supplement low farming income. Squire (1981) found that wealthier households have greater degree of freedom in reducing seasonal variability of income as they have more opportunities to enter off-farm and non-farm employment. They may be more able to hire out labor during the "dry" season to minimize the impacts of the production cycles in agriculture. In Western Kenya, Francis and Hoddinott (1993) note that as more households enter the migratory labor market, they start accumulating capital that allows to invest in education for some members who will acquire the necessary skills to supply labor in the non-farm labor market, and, in turn, increase the household's income level.

Households with greater endowments have greater capacity to enter the non-farm labor market. This creates income differentiation among rural households. In Tanzania, class stratification is deepening in places where only middle or higher income farmers have the capital needed to enter non-farm activities (Barrett and Arcese 1998). Further, Reardon (1997) finds diversification to be directly linked with the household ability to access a credit market. In many developing countries, lack of formal credit markets (Christensen 1989) obliges rural households to turn to informal credit markets, which are not very accessible to poorer households. Reardon and Kelly (1989) found that the Guinean and Sudanian (but not Sahelian) zones of Burkina Faso, households with greater access to non-farm activities, are more likely to purchase fertilizers and productive

resources. Savadogo, Reardon, and Pietola (1994) also found that the ability of farmers in Burkina Faso to invest in crop production is largely determined by the variety of the activities in which they are engaged. Further, non-farm activities help smooth income and serve as insurance against variability.

Many income diversification studies are gender-specific. Gender affects access control, and use of resources. Women may undertake as wide a range of diversifying activities as men, but in men have a greater access (Jiggins 1989). In Africa, where subsistence farming is predominant, women perform nearly all tasks associated with production. Boserup (1970) found that 70% to 80% of all subsistence production was performed by women, even though that work is not recorded in national statistics. Women's income strategies, more than men's may be motivated by coping behavior to deal with shortfalls. In addition to the family farm, women tend small garden to provide for food needs (Boserup 1970). As a means to protect households from fluctuations in food prices and reduce the dependency during periods of low agricultural production, women rely on diversification of household income sources by investing in activities such livestock (Jiggins 1989).

Many women are engaged in the lowest levels of micro enterprise ("survival" activities). Women's activities can be contrasted with men's activities and with the activities of other women. Although a degree of gender-specificity is the norm, in some areas men and women grow similar crops and do similar tasks. Gender differences are greatest in The Gambia where women grow 95% of swamp rice but only 6% of coarse grains (World Bank 1994). When only women are considered, rural activities are diverse

among and within ethnic groups, and even within villages and agro-ecological farming systems (Jiggins 1989). In addition to helping with the farming women carry out other productive activities. Most have personal plots and livestock. Individual women and women's groups in a single village may differ markedly in the crops grown, the livestock kept, tasks performed, and income generated (Cekan 1992). This diversity reflects differences in resources, skills, knowledge and opportunities, as well as the wishes of the community (Jiggins, 1989). In Northern Ghana, Delgado and Abdulai (1999) found that factors such as education and access to infrastructure explain the different participation in non-farm work between married women and men and women.

Although reliable statistics on the different levels of involvement of women and men in rural non-farm employment are hard to find, those that exist point to women not participating equally. Haggblade (1989) shows that in rural areas of Mali, the participation rate of women in non-farm employment is 16 per cent, as opposed to 84 per cent for men. The non-farm activities that women undertake are largely based on their home-making skills and are generally less remunerative compared with men.

2.3 Hypotheses

Most studies of income diversification associate diversification with higher income. Yet, in many instances, poorer and more vulnerable households engage in income diversifying activities whenever the opportunity arises, either in response to shocks to agricultural production, or, *ex ante*, to secure basic needs. Although the literature offers many insights on the factors that income diversification, there are

contradictory hypotheses regarding the motivations of rural households. Why do rural households diversify their income sources? Which rural households are most likely to diversify? Poorest households because they are "pushed" into multiple activities, or wealthiest households because they are "pulled" into non-farm activities?

Using data from Tahoua, Niger, this study aims to empirically examine two possible explanations for income diversification within rural households:

1) As a means of risk management, poorest households, because they are at greatest risk of falling into destitution, will have the most diversified income sources. Poorer households are less able to cope with negative shocks to their income because they have less productive resources.
2) Constrained by lack of access to capital and other productive assets, poorer rural households tend to engage in fewer off-farm and non-farm activities than do their relatively wealthier counterparts. The former will therefore have most diversified income sources.

Household income diversification is also hypothesized to be related to the following factors:

1) Household characteristics, which include household assets, previous year agricultural production, gender of the head of household and education.

2) Location, which reflects agro-ecological conditions and access to markets.

This study examines the impacts of the above factors on household income.

CHAPTER THREE

DATA SOURCE AND STUDY REGION

The hypotheses formulated in the previous chapter are tested using data from a sample survey of rural households in Niger. The survey was conducted under *The Household Livelihood Security* (HHLS) study financed by Cooperative for Assistance and Relief Everywhere (CARE) International. CARE International is a confederation of 11 agencies that delivers relief assistance to people in need and long-term solutions to global poverty. The study was conducted between April and May 1998, with the assistance of the Bureau of Applied Research in Anthropology (BARA) of the University of Arizona. The survey provides information on a wide variety of household and farm characteristics including demographic and socio-economic indicators. The information is intended for use by policy makers and NGOs to identify and target the most needy and vulnerable groups and areas in Niger, and to elucidate the strategies that rural households use to ensure their long-term livelihood.

3.1 Overview of Niger and Tahoua Department

Located on the western part of Africa, Niger is bounded on the south by Nigeria, on the east by Chad, on the north by Algeria and Libya, and on the west by Mali, Benin and Burkina Faso. With a population nearing 10,355,000 habitants (and growing at an annual rate of 3.3%), Niger is a poor, landlocked Sub-Saharan nation, whose economy centers on subsistence agriculture, animal husbandry, reexport trade, and increasingly

less on uranium, because of declining world demand. Over three-fourths of the population depends on agriculture, but good arable land is becoming scarcer due to its growing depletion and to difficult climatic conditions. Shortfalls in agricultural production constitute a threat to food security. The indicators of human and economic developments in Niger are among the lowest in the world. Life expectance at birth is only 42 years, literacy rate 14%, and income per capita is to $180. Niger is one of the world's poorest countries.

The department of Tahoua exhibits the same patterns. The characteristics of the sample households reflect the general socio-economic situation in Niger. The department of Tahoua occupies an area of 106,677 square kilometers, about one-tenth of Niger. Estimates show Tahoua's population at approximately 1,646,600 habitants in 1998, with 70% concentrated in the central and southern parts. Almost 91% is rural. According to the HHLS study, socio-economic indicators such as income per capita, life expectancy at birth, literacy rate are among the lowest in Niger. The socio-economic situation of Tahoua reflects disparities in the spatial distribution of its population (over two-thirds of the population occupy only one-third of the department) and economic activities.

3.2 Agro-ecological Zones

To study the impacts of climatic conditions and population density on economic activities, the department has been divided into agro-ecological zones. The main criterion used is the importance of vegetation in a given area. A categorization of the vegetation in Tahoua is important for two main reasons. First, since vegetation is

function of soil types, climate and land use, it serves as an important indication of productivity and potential land use. Second, over 85% of rural households in Tahoua are engaged in either agriculture or livestock herding and depend on the vegetation for cattle grazing and for a wide range of nutritional purposes. However, vegetation alone does not reflect the differences in socio-economic conditions. Ecological conditions, for example, can dictate production and consumption strategies. For that reason, three other criteria are included in order to help grasp those differences. They are:

- climatic conditions;
- dynamic of human occupation and pressure on the land;
- farming techniques and systems.

These criteria yield three large systems. In the North, a pastoral system occupies 55% of the area. It is known as agro-ecological zone. In the central part of the department is an agro-pastoral or transition zone where agriculture, because it is precarious, is associated with animal husbandry. It occupies 15% of the department and represents the agro-ecological zone two. In the South, the Ader-Doutchi-Maggia area extends over 30% of the department, and encompass three zones. Characteristics of the different zones are summarized in Table 3.1.

Table 3.1 Agro-ecological Zones in Tahoua

Agro-ecological zones	Climatic conditions and vegetation	Dynamic of human occupation	Farming Techniques and systems	Constraints
ZONE1	Annual rainfall: 0-200 mm Soils: plateau and dry valleys Low forage resources and grazing potentials	Ethnic groups: Tuareg, Fulani and Afro-arab, of whom 20% are herders Population density: very low.	Grazing is virtually the only practical form of land use. Extensive animal husbandry	Droughts Lack of water points and over-grazing
ZONE2	Annual rainfall: 200-350 mm Soils: plateau, dune lands and sandy soils Grassland (low shrubs and acacia trees) sparse due to low precipitation	Ethnic groups: Tuareg, Hausa, Fulani and Afro-arab Population density: low to medium. Low human pressure on land	Agro-pastoral activities Extensive herding associated with extensive agriculture. Counter-season crops around water points.	Soils prone to erosion Over-grazing Crucial water problems due to the lack of adequate water points
ZONE3	Annual rainfall: 350-600 mm. Soils: valleys, plateau and sandy, glaciers Pastures affected by *Sida Cordifolia*	Population density: very high. High levels of human pressure on land.	Agriculture is the main activity and can be associated with herding. Agriculture is semi-intensive and uses fertilizers such organic manure	Droughts Depletion of soils
ZONE4	Annual rainfall: 350-600 mm. Soils: dry valleys, plateau, dune lands and glaciers Low grazing potential	Ethnic groups: Hausa and Fulani. Population density: medium Large land availability and fallow	Extensive cultivation, combined with extensive herding. Counter-season crops: dal and black-eye-beans	Droughts Soil erosion and deforestation of marginal lands High pressure from African migratory locust
ZONE5	Annual rainfall: 400-600 mm. Soils: dune lands and glaciers	Ethnic groups: Hausa and sedentary Fulani Population density: very high. High pressure on marginal lands	Prevalence of agriculture, largely associated with animal husbandry. Semi-intensive cultivation. Extensive, semi-intensive and intensive herding systems Counter-season cultivation: dal and sweat potato	Droughts Shortage of agricultural implements High pressure from African migratory locust

Source: HHLS Survey, Care-Niger, 1998

3.3 Household Characteristics

The sample consists of 405 households selected randomly from 15 villages. They are assumed to be statistically representative of rural Tahoua. Households are classified into three categories of vulnerability (A, B and C) with respect to income and consumption, based on households' own perception of their socio-economic conditions. 259 households are considered very vulnerable (the C category, 64% of the sample), 93 vulnerable (the B category, 23% of the sample households), and 53 relatively vulnerable (the A category, 13% of the sample).

Most of the households in the sample are male-headed. Women are heads in only 51 households in the sample, representing 12% of the sample. Households headed by women are identified as the most vulnerable.

3.3.1 Household Size, Labor and Dependency Rates

Household size is important for cultural and economic considerations, as it is strongly correlated with household socio-economic status. Table 3.2 illustrates the disparities between agro-ecological zone and socio-economic status.

The average household size is 7.2, and is relatively large in ZONE 5. Some variations are observed between zones. The largest household size is found ZONE 5 (8.06 persons). ZONE 4 has the smallest average household, with 6.6 persons. Male-headed households are larger than female-headed households (7.6 and 4.6). Household size is strongly correlated with vulnerability. The more vulnerable a household, the smaller its size. The smallest size households are found within the C-category, with a

mean of 6.2. Households in that category are relatively disadvantaged, as subsistence agriculture is very labor-intensive.

Table 3.2 Household Size by Zone, Socio-economic Status, and Gender

	Mean	Median
Agro-ecological zone		
ZONE1	7.67	7.00
ZONE2	6.90	6.50
ZONE3	7.13	6.00
ZONE4	6.59	5.00
ZONE5	8.06	7.00
Total	7.20	6.00
Socio-economic status		
Very vulnerable	6.71	7.00
Vulnerable	7.17	7.00
Relatively vulnerable	9.62	9.00
Total	7.20	6.00
Gender		
Male	7.57	--
Female	4.61	--
Total	7.20	

Source: HHLS Survey, Care-Niger, 1998

Households are rarely nuclear. Due to the fact that agriculture is highly dependent on labor, families tend to stay together, especially when the proportions of children and the elderly are growing. In Tahoua, as in many areas of the developing world, the population is very youthful. Children under 16 constitute almost 49% of the total population. The dependency ratio (proportion of youths to economically active adults) is high. Dependency ratios vary between 1.2 (ZONE 2) and 1.6 (ZONE 1) and are higher in female-headed households than in male-headed households.

3.3.2 Education

Education levels are extremely low, irrespective of vulnerability, the agro-ecological zone, or gender. Table 3.3 offers a breakdown of household levels of education with regard to agro-ecological zone, degree of vulnerability and gender.

Table 3.3 Education Levels (%)

	No education	Koran	Did not complete primary school	Completed primary school	Secondary school	Literacy	Higher Education
Agro-ecological zones							
ZONE1	54	35.3	9.3	0.7	0.3	0.3	
ZONE2	56.5	28.70	8.3	5.2	0.7	0.5	
ZONE3	66.6	23	7.1	1.9	0.9	0.4	
ZONE4	58.2	11.9	17.5	8.4	3.9	0	
ZONE5	54.3	20.9	17.5	8.4	3.9	0	
Total	60.1	24	10.1	3.7	1.4	0.5	
Socio-economic status							
A	58.8	28.9	8.2	3.1	0.3	0.3	
B	65.8	20.2	9.2	2.9	1.4	0.6	
C	58.5	24.1	11	4.2	1.7	0.5	
Gender							
Male	46.9	30	14.2	5.6	2.4	0.9	0.1
Female	73.1	18.4	6.2	1.9	0.4	0.2	0

Source: HHLS Survey, Care-Niger, 1998

In spite of free and universal primary school education, a large proportion of the population is not enrolled. Indeed, 60% of all households in the sample have 0 education. Illiteracy varies between zones, being higher in ZONE 3 (67%) than in ZONE 1 (54%). Access to public schools is very limited. Only one-tenth of the household members are enrolled in primary education. ZONE 4 and ZONE 5 have had the biggest enrollment rate (17%) in primary schools, although those enrolled did not finish. In contrast, enrollment rates are very low in ZONE 3 (about 7%).

Only 0.5% of the households are literate, with great disparities between zones. In ZONE 1 the rate is 0.7%, and zones 4 and 5 approach 8.4%. Only 1.4% attend high school. ZONE 4 and ZONE 5 have the highest enrollment rate of 3.9%. The result reflects a great disparity in access to basic education. Whereas more than half the men in report zero instruction level, nearly three-fourth of women have no formal education. The gap between increases with further education. 14.2% of men have attended primary school. For women, the rare is only 6.2%. Overall, access to education is very limited in all zones. The incidence of poverty is 89 % in households headed by an adult with no education, compared to 24% for those who have attended primary school.

3.4 Agriculture in Tahoua

In Tahoua, as in most parts of Niger, subsistence agriculture is an important economic activity, occupying 80% of the labor force and accounting for approximately 40% of household income. Whereas farming supports approximately 80% of the population (with some disparities between zones), only 2.3 million ha of the land can be classified as arable, of which 85% are actually exploited. Farming is labor intensive; hoes and machete are the basic implements, and animal traction is nonexistent.

3.4.1 Cropping Systems

Traditional farming practices are prevalent and include rain-fed and irrigated cultivations. The cropping systems are dominated by millet, often intercropped with other cereals. Nearly 85% of the land cultivated involves food grains such as sorghum, millet, rice, and maize. Low and uncertain rainfalls cause many crop failures. Farmers

cope with these risks in several ways, including planting several varieties of millet of different maturity lengths.

In rain-fed cultivation, the "pure" systems are centered on millet, black-eye-pea, sorghum, peanut, cotton, maize and rice; and the "associated" ones, which consist of combining millet and sorghum, millet and peanut, sorghum and maize, etc. Irrigated or counter season cultivation includes sweat potatoes, okra, onion and is found around water supply systems such as wells and pumps. The legumes are often grown in combination with other grains and are important for their nutritional value.

Table 3.4 Characteristics of Agriculture by Zone

ZONE	Main crops		Cropping systems		Women's role in production
	Rainy season	Counter-season	Rainy season	Counter-season	
ZONE 1	Millet, black-eye-pea, sorghum	Black-eye-pea, watermelon	Association		Not active at all
ZONE 2	Millet, sorghum, okra, back-eye-pea, peanut, maize, green leafy plants		Association, pure cultivation and rotation practices		Little active
ZONE 3	Millet, sorghum, black-eye-pea, peanut, sesame, okra, green leafy plants, cotton	Dal, sweat potato, onion, tomato, cabbage, lettuce, cassava	Association, pure cultivation (sorghum)	Pure cultivation practices	Very little active
ZONE 4	Millet, sorghum, rice, black-eye-pea	Dal	Association	Pure cultivation practices	Very active
ZONE 5	Millet, sorghum, okra black-eye-pea, peanut, cotton, green leafy plants		Association and pure cultivation practices		Very active

Source: HHLS Survey, Care-Niger, 1998

3.4.2 Agricultural Production

Nearly 85 percent of the farmland is planted in food grains such as sorghum. Average productions per household of the main crops are presented in the table below.

Table 3.5 Average Productions per Household, by Zone (in kilos)

ZONE	Millet	Sorghum	Black-eye-pea	Peanut	Cotton	Onion
ZONE 1	125	33	115	1	0	0
ZONE 2	962	234	189	37	0	2545
ZONE 3	818	312	89	240	366	856
ZONE 4	834	91	268	33	0	0
ZONE 5	2,200	582	138	54	700	0
Male-headed	1,143	334	168	159	548	1,580
Female-headed	432	136	48	0.75	0	0
Total	1062	321	154	156	548	1580

Source: HHLS Survey, Care-Niger, 1998

These averages reflect the disparities in agricultural potential across zones. For example, all households in the sample produce millet, which represents 85% of total agricultural production. Production in ZONE 1 is very small and nonexistent for cotton and onion. Examination of agricultural production data by sex of household head reveals very different outputs between male-headed and female-headed households. First, it is important to note that women are not involved in cotton and onion, which are cash crops. Second, women's average agricultural outputs are relatively low, varying between 0.75 kilo for peanut and 432 kilos for millet. These two observations tend to support the hypothesis that women are disadvantaged with respect to productive resources.

According to the HHLS study, production of these main crops has dropped an average of two percent annually from 1966 –1983. The data suggest unstable outputs,

marked by alternating good and poor performances. Outputs are extremely small (between 100 kilos/ha and 700 kilos for the main cereals and peanut). This situation is mainly due to poor rainfalls, and government agricultural campaigns and management. Reliance on cash crops for export earnings has meant that the vast majority of research and development efforts, as well as economic incentives, are directed towards cotton and groundnuts.

3.5 Animal Husbandry and Herding Systems

Livestock are the second most important farming activity in Tahoua. They dominate the arid zone, whereas they are associated with crops in the remaining zones. The arid zone occupies two-third of Tahoua and herders (Fulanis, Tuaregs and Arabs) constitute 20% of the total population. Animal husbandry continues to be one of the principal activities of the department, in spite of enormous losses sustained as a result of recurring droughts. Livestock are raised on an extensive scale, some herds being constantly on the move.

Three herding systems are found in the sample. First, there is an extensive sedentary system, in which households pool their cattle. In this system, herds are taken out to graze in the morning and taken back to the village in the afternoon. Second, there is an extensive nomadic system, prevalent in ZONE 1, and characterized by cyclical movements, in which herders move the cattle for short or long durations. However that system is becoming less and less common due to the lack of grazing lands and to recurring droughts. Third, a semi-extensive system usually takes place in favorable

agricultural areas because households can use parts of their grain production to feed cattle.

From 1992 to 1997, one year out of two presents a deficit in feeds because of seasonal availability and changes in the quality of forage. As a result, there are constant variations in cattle stocks, with small ruminants (sheep and goats) replacing large ruminants. Table 3.6 summarizes herd populations and forage stocks from 1983 to 1997.

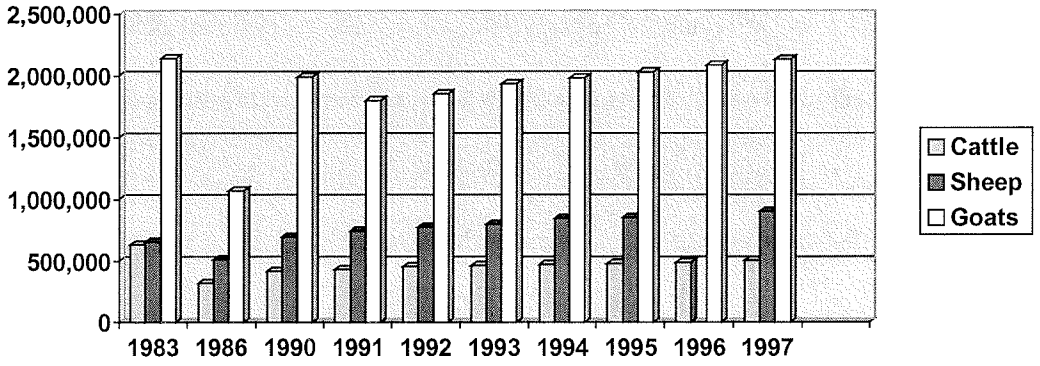
Table 3.6 Livestock Population and Forage Needs

Year	Cattle	Sheep	Goats	Camels	Donkeys	Horses	Forage needs	Available	Balance
1983	632,000	653,000	2,138,000	37,000	222,000	34,000	NA	NA	NA
1986	324,000	510,000	1,065,000	111,000	173,000	36,000	NA	NA	NA
1990	415,100	694,200	1,991,700	115,300	234,000	43,000	1,675,197	NA	NA
1991	433,800	740,500	1,796,000	122,900	239,400	44,600	1,680,560	2,490,181	+809,621
1992	453,800	771,400	1,885,000	125,220	249,100	45,970	1,844,098	3,514,779	+767,068
1993	462,876	800,722	1,932,123	127,098	254,082	46,430	1,883,812	1,790,830	-92,982
1994	472,133	824,744	1,980,426	129,004	259,164	46,895	2,104,852	8,802,839	+6,697,987
1995	481,575	849,486	2,029,935	130,939	264,346	47,364	2,150,388	1,373,327	-777,061
1996	490,375	874,927	2,080,684	132,939	269,633	47,838	2,195,820	3,173,556	+977,736
1997	500,183	901,221	2,132,702	134,897	275,026	48,316	2,243,413	1,799,335	-444,07

Source: HHLS Survey, Care-Niger, 1998

Figure 1.1 describes cattle, goat and sheep populations from 1983 to 1997. All

Figure 1. Herd Populations' Evolution (1983-1997)



species have been steadily increasing in numbers from 1993, with some significant declines from 1983 to 1986. Herd populations started rising again in 1990.

Although three-fourths of the population derive food and income from farming, food insecurity and child malnutrition affect about two-third of the population, especially in the rural areas. The factors contributing to the persistence of low levels of living in Tahoua are the deterioration of productive resources due decreasing rainfall, population pressure on land, lack of adequate management of productive resources, low levels of healthcare and educational infrastructure, and isolation of the department. These factors create vulnerability among rural households and inhibit their economic and social well-being. To survive, rural households seek income-generating activities. These activities allow households to satisfy short-term needs for liquidity and needs for food.

3.6 Household Income

Income sources vary by region, and depend largely on ecological conditions. Agriculture and herding are the main occupations. The average household income in Tahoua is 471,500 francs *Comminaute Financiere Africaine* (FCFA; 700 ≅ US$1), of which about 55% is earned in cash. Agricultural production constitutes 43% total income, followed by the income-generating activities (23%), livestock product sales (22%), and migration remittances (9%). The remaining 3% comes from the sale of other livestock products, the sale of land and aid from support programs such as Food for

Work. Per capita household income is about 69,800F CFA. Table 3.7 gives a breakdown of annual household and per capita incomes by zone.

Table 3.7 Household Income, by Zone

Zone	Annual total income				
	Per Household			Per capita	
	Mean	Median	Households	Mean	Households
ZONE 1	487,080	286,945	52	62,864	52
ZONE 2	421,755	307,425	78	62,845	78
ZONE 3	387,772	287,772	163	61,231	163
ZONE 4	354,765	236,600	59	67,998	59
ZONE 5	916	717,097	53	115,414	53

Source: HHLS Survey, Care-Niger, 1998

The average household income masks some disparities between zones and between male and female-headed households. The highest level of household income is found in ZONE 5 and the lowest in ZONE, with 3, 916,400F CFA and 354,700F CFA. ZONE 5 also exhibits the highest level of per capita household income, with 115,400F CFA. The lowest is within ZONE 3, close to the values found within ZONE 1 and ZONE 2. The average total income within male-headed households is 505,500F CFA, whereas it is only 234,600F CFA within female-headed household. In terms of per-capita income, the trend is the same, 73,000F CFA within male-headed households and 50,000F CFA in households headed by women. This disparity occurs because agricultural production constitutes a large portion of income and greatly depends on access to land, labor and capital. In Tahoua, female-headed households have less access to those resources.

Cash household income, however, is greater within female-headed households. The disparity is because female-headed households, more than male-headed households,

obtain the largest part of their income through the sale of livestock, inherited land, and other external sources. Table 3.8 summarizes total and per capita income data by sex of household head.

Table 3.8 Annual Average and per Capita Income, by Gender

Sex of household head	Average annual income				% of income earned in cash	Contribution of agricultural production to household income (%)
	Mean		Median	Households		
	Total income	Per capita				
Male	505,561	72,692	357,236	354	54%	44%
Female	234,614	49,947	144,275	51	64%	39%

Source: HHLS Survey, Care-Niger, 1998

3.6.1 Agricultural Income

Although rural households practice subsistence agriculture, they often face the dilemma of choosing between consumption and sale. Most of the households must sell part of production. Agricultural income shares vary between less than 1% in ZONE 1 and about 53% in ZONE 4. Table 3.9 gives agricultural income contributions to total income.

Table 3.9 Agricultural Income

Zone and gender	Revenue from the sale of agricultural products	Contribution of agriculture (%)
ZONE 1	0	0.7%
ZONE 2	37,761	47.6%
ZONE 3	20,404	48.2%
ZONE 4	15,374	53.2%
ZONE 5	47,193	49.3%
Male	25,750	43.47%
Female	4,940.5	39%

Source: HHLS Survey, Care-Niger, 1998

3.6.2 Livestock Income

Livestock income comes essentially from the sale of livestock and livestock products. Livestock income constitutes 22% of total income, with less than 2% resulting from livestock product sales. Households keep most of their livestock products for own consumption. Over 90% of livestock income comes from livestock sales. This practice is common to all households in the sample, although less in ZONE 1. Households in ZONE 1 sell more livestock than in any other zone, with annual revenues of 404,000 F CFA. Livestock revenue in the other zones varies between 72, 000F CFA (in ZONE 2) and 170,000F CFA (in ZONE 5). With 67% of household income coming from animal husbandry, ZONE 1 leads the other zones. Indeed, that zone benefits from suitable agro-ecological conditions. Table 3.10 illustrates the disparities between zones in animal husbandry income.

Table 3.10 Livestock Income

Zone and gender	Revenue from the sale of livestock	Contribution to total income (in%)
ZONE 1	404,104	67
ZONE 2	72,165	14
ZONE 3	72,165	14
ZONE 4	82,021	16
ZONE 5	98.569	20
Male	163,542	22
Female	103,105	23

Source: HHLS Survey, Care-Niger, 1998

Comparing female-headed and male-headed households, women are scarcely involved in herding activities, the disparity is negligible when we examine livestock

income by sex of household head. The livestock sales pattern appears more evenly distributed than typically thought, about 22% in both categories.

3.6.3 Income Generating Activities (IGAs)

Income-generating activities (IGAs) represent a risk minimization strategy to achieve subsistence needs. Data show that approximately 80% of households have farming (agriculture and livestock herding) as their main occupations. However, nearly 80% also engage in income-generating activities. These activities are numerous and undertaken the whole year or during the dry season, depending on need. They include petty trade, sale of agricultural products and crafts. IGAs occur in almost all households. Table 3.11 presents a breakdown of households involved in off-farm activities.

Table 3.11 Income Generating Activities, by Zone

ZONE	% of households engaged in IGA	Ranking
ZONE 1	58%	5
ZONE 2	85%	2
ZONE 3	82%	3
ZONE 4	81%	4
ZONE 5	89%	1
Total	79%	

Source: HHLS Survey, Care-Niger, 1998

Except for ZONE 1, over 80% of households are engaged in IGAs. Their contribution to total household income does not vary much by zone or gender of household head. Data are presented in the table 3.12.

The largest contribution of off-farm income to total income is found in ZONE 5 with 25%. The lowest contribution is found in ZONE 1, 21%. Relative contribution is almost the same within both male-headed and female-headed households, 23% and 22%.

Table 3.12 Proportion of IGAs in Household Income

ZONE	% of IGAs in household income
ZONE 1	21%
ZONE 2	22%
ZONE 3	24%
ZONE 4	23%
ZONE 5	25%
Total	23%
Gender of HHH	
Male	23%
Female	22%
Total	22%

Source: HHLS Survey, Care-Niger, 1998

3.7 Emigration

Emigration allows people with relatively low incomes in the rural sector to shift to relatively higher incomes in the urban sector. The HHLS study shows that the phenomenon of migration is growing. Of the 405 households, 220 have at least a member involved in migration, representing 54 % of the sample. Most emigrants come from male-headed households (56%) and are mostly men (93% of the sample households' members). The more vulnerable the household, the more likely is emigration. The numbers in ZONE 3 support that argument, with 104 household members involved. Table 3.13 gives a breakdown of the sample household involvement in migration

Emigration is Tahoua is first and foremost a means for households to earn cash during the dry season. It constitutes approximately 25% of household income. Emigration is seasonal, with a minimum duration of five months. The average amount of cash from migration remittances is approximately 32,500F CFA. Receipt of remittances permits households prepare for potential food crises and to finance agricultural inputs.

Table 3.13: Number of Emigrants and Duration

Agro-ecological area	Emigrants		Duration	
	Number	Mean	Number of months	Number
ZONE 1	8	3.13	3.83	6
ZONE 2	51	1.43	6.85	2
ZONE 3	104	1.44	6.43	75
ZONE 4	30	1.27	4.04	27
ZONE 5	27	1.37	4.7	20
Total	220	1.47	5.76	155

Source: HHLS Survey, Care-Niger, 1998

Data show that in addition to the cash remitted, emigrants also contribute 18,000F CFA in kind (goods such as clothing, food and manufactured goods), to household income. Emigration is therefore an important strategy to supplement their income. However, drawbacks are associated with emigration. As households are dependent on family labor for subsistence production, losing active members to emigration can have devastating consequences.

IGAs are important for rural households in Tahoua. Purchase of agricultural implements, food security and investment capital thrive on the availability of IGAs. But the needs and opportunities to engage in IGAs are different among households, and as a result, income generating patterns vary.

CHAPTER FOUR

METHODOLOGY

This chapter describes the empirical model that will be used to explore the impacts of household resources on agricultural, livestock and off-farm incomes. Three regression models are presented, describing the relationships between household characteristics, access to productive resources and regional location and the different components of household income. The second section of the chapter looks at the measurement of income and crop diversification levels.

4.1 Regression models

The empirical tests use the standard linear regression (OLS). The models take the following forms:

$$(1) \quad OFFFARM_i = \beta 0 + \beta_{1i}ASSETS + \beta_{2i}HHSTRUC + D_{1i}ZONE + u_i$$

$$(2) \quad LSTCKINC_i = \beta 1 + \beta_{1i}ASSETS + \beta_{2i}HHSTRUC + D_{1i}ZONE + u_i$$

$$(3) \quad AGINC_i = \beta 3 + \beta_{1i}ASSETS + \beta_{2i}HHSTRUC + D_{1i}ZONE + u_i$$

where i = 1 to 405 and β_i and D_i are coefficients, OFFFARM, LSTCKINC, and AGINC are off-farm income, agricultural income, livestock income, ASSETS are household assets, HHSTRUC describes the structural composition of the household, and ZONE is the agro-ecological zone to which the household belongs. An explanation of some of these variables follows.

The dependent variables are three different sources of household income. Off-farm income is net income from non-farm/ income generating activities (such as petty trade and crafts), remittances from emigration and the sale of landholdings. Agricultural income is the value of own crop production at the average seasonal producer price, net of costs of inputs. Livestock income is the value of livestock production and livestock product sales.

The survey collected income information only for officially registered residents and those who had been in the household for more than one year. The use of household instead of individual income is based on the consideration that decision to supply labor off-farm often relates to family welfare and is better captured by household income.

The decision of households to cultivate their own farms or to engage in non-farm activities depends on household needs and structural composition. Assuming that household behavior is economically rational and that the decision-makers within the household are fully informed, the decision to allocate labor optimally between on-farm, off-farm and nonfarm activities depends on the assets and activities available to the household.

One of the hypotheses to be tested is that the ability of rural households to engage in multiple activities depends on wealth endowment, and that wealth increases with the household involvement in non-farm and off-farm activities (Reardon, Matlon, Delgado 1992; Reardon, Berdegue and Escobar, 2001). Several variables in the models address the hypothesis that wealthier households have easier access to income generating activities (IGAs). Since participation in IGAs involves monetary costs, a higher

household income implies greater ability to invest in activities outside of the household main occupations. The ASSET variables for wealth are food stock, livestock, productive assets such as agricultural implements and tools, and other household goods and valuables. Household assets and other goods are indices, based on productive and nonproductive assets.

The row vector of household characteristics includes the age, gender and education of household head; total education reported for members of the household; number of dependents and the household labor force. These variables are included to evaluate whether or not human capital has an effect on the decision to diversify.

Gender of head of household is included to identify effects arising from unequal access to off-farm activities. Theoretically, male heads of household are expected to have greater access to agricultural and livestock resources and to off-farm activities due to cultural and social division of labor within rural households (Jiggins 1989; Delgado and Abdulai 1999). Gender is measured by a dummy variable, with a value of 1 the head of household is a male and 0 otherwise. The effect is expected to be negative with regards to agricultural and livestock incomes and positive with respect to off-farm income.

Available information on education includes educational attainment, ranging from no formal education to completed primary school. Total education is computed as an index for total years in primary school. A positive relationship with off-farm income is expected. This is because income diversification may be caused by "pull" factors that

cause the household to join the urban labor market. In contrast, education is expected to negatively affect agricultural income.

Education of the head of household has also been considered. The variable EDU_HHH is introduced to test the household decision to undertake multiple activities. Because there might be a correlation between education of household head and overall household education levels, the two variables cannot be used simultaneously. Only the most relevant will be kept in explaining the relationship between education and income source.

Total household labor (LABOR) is measured by the number of active members plus those not officially registered who have been in the household for more than one year. The presence of a large number of laborers may make it easier for households to trade-off on-farm and non-farm activities. It is expected that LABOR will affect the propensity to diversify positively with respect to off-farm activities, and negatively with regards to farming. Trading off on-farm and non-farm activities may also be influenced by the size of the household. The number of dependents (DEPEND) is included as a variable.

The conditions of the environment are important indications of income sources and diversification patterns. For example, in arid regions where rainfall and irrigation water is scarce, production instability might be a prevalent consideration, while it might not be humid regions. Consequently, the models take into account those considerations.

Incidences of local conditions are measured by dummy variables, representing the different agro-ecological zones (ZONE).

In table 4.1, the mean values (or proportions for the dummy variables) of all independent variables are shown.

4.2 Diversification Measurement

There are many alternatives in measuring diversification: Herfindahl-Hirshman indices, Gini coefficients, shares of income associated with the different income sources index are used (Reardon 1998, Reardon and al. 2000). This study uses the Herfindahl-Hirshman Index (HHI). The HHI is more commonly used in industrial organization as a measure of concentration within an industry. The HHI is the sum of the squared percentage of market share of all firms in an industry.

Formally,

$$\text{HHI} = \sum_{i=1}^{N} (S_i)^2$$

where N is the number of firms in the industry, S_i is the market share of firm i.

The highest possible HHI is 10,000 (a monopoly = 100 percent). On the low end, an HHI can be extremely small because the index declines with each added firm, and there is no limit to the number that can be added. A commonly accepted measure of market concentration, the HHI has been widely used by the U.S. Department of Justice in antitrust cases or to regulate mergers. The Department of Justice Antitrust guidelines consider an industry with an HHI of 1,000 or less to be competitive, and an HHI of 1,800

or more to be concentrated. An increase in the HHI of 100 is considered important enough to trigger a merger review (Shy 1995).

Diversification indices are used here to determine the diversity of income sources within rural households in Tahoua. The index is appropriate because when the number of income sources is greater than one, there are two factors that can affect diversity, the number of income sources and the distribution of income among households. Using the index of diversification will permit comparison among households and determine which ones are more concentrated or more diversified.

A diversity index is obtained by subtracting the HHI:

$$1 - \text{HHI} \text{ or } 1 - \sum_{i=1}^{N} S_i^2 ,$$

where i is the number of income sources and S is the share of each income source in total income.

HHIs increase with concentration, with perfect specialization taking the value of 1 and the extreme diversification level represented by the value of 0. A value of 1 implies that total household income comes from only one source. The closer the value of the index to 1, the more diversified the household.

Table 4.1 Variable Definition and Descriptive Statistics

Variable	Variable Description	Sample mean	Standard Deviation
	Independent Variables		
Hh's Assets			
LAND	Arable land	7.7139	9.16636
LANDSQR	Arable land squared	143.2884	28.78326
FOODSTCK	Beginning food stock	142.65	495.47
FOODSTCKSQ	Beginning food stock, squared	265209.8	2422229.5
LVSTOCK	Value of livestock	508,022.7	1,004,786.545
LVSTCKSQR	Squared value of livestock	1.3E+12	6.635E+12
AG_IMPL	Agricultural implements	0.2815	0.73105
AG_IMPLSQR	Agricultural implements squared	0.6123	1.93466
AG_TOOL	Small agricultural tools	5.1802	2.33242
AG_TOOLSQR	Small agricultural tools squared	32.2617	2.17944
HH_GOOD	Large non productive assets	5.9926	25.59791
HH_GOODSQR	Large non productive assets squared	40.6494	29.65612
HH_ASSETS	Other hh non productive assets	0.0469	0.22310
HH-ASSETSQR	Other hh non productive assets squared	0.0519	0.28105
Hh's characteristics			
AGE_HHH	Age of household head in years	43.76	13.717
AGESQR	Age squared	2102.8889	1334.2461
SEX_HHH	Gender of household head, 1 = M, 0 = F	1.13	0.332
DEPEND	Number of dependents	3.7630	2.49517
DEPENDSQR	Number of dependents, squared	20.3704	26.87091
LABOR	Total of active labor force	3.4370	2.01458
LABORSQR	Total of active labor force, squared	15.8617	28.78326
EDU_HHH	Education of household head; 1 = Y, 0 = N	0.0988	0.41640
HH-PRIM	Total years of education for all members	0.2765	0.99880
HH_PRIMSQR	Total years of education, squared	1.0716	14.39721
Location			
ZONE1	Agro-ecological zone 1 AEZ1=1, 0=otherwise	0.1284	0.33494
ZONE2	Agro-ecological zone 2 AEZ2=1, 0=otherwise	0.1926	0.39482
ZONE4	Agro-ecological zone 4 AEZ4=1, 0=otherwise	0.1457	0.35322
ZONE5	Agro-ecological zone 5 AEZ5=1, 0=otherwise	0.1309	0.33767
	Dependent Variables		
OFFFARM	Estimated share of household income earned in off-farm activities	115,400.9	239,495.5993
LSTCKINC	Estimated share of household income earned in pastoral activities	111,777.6	240,721.2554
AGINC	Estimated share of household income earned on farm	340,984.4	641,248.87385

Source: HHLS Survey, Care-Niger, 1998

CHAPTER FIVE

FINDINGS: COMPONENTS OF HOUSEHOLD INCOME

In this chapter, the determinants of the components of household income are empirically examined. Tables 5.2, 5.3 and 5.4 present the results of the OLS estimates of the determinants of agricultural, livestock and off-farm incomes. Elasticity estimates are also reported for all the statistically significant independent variables. The estimates have been computed using the following formula:

$$\varepsilon_i = [\alpha_i + (2*\beta_i*X_i)]* (X_i/Y),$$

where X_i and Y are sample means for the dependent and independent variables; α_i is the regression coefficient of the independent variable, and β_i the coefficient of the same independent variable, squared. For dummy variables, the estimates[1] are considered as percentage changes in the dependent variable when the independent variables take the value of 1 instead of 0.

5.1 Determinants of Household's Income Sources

Land and labor are highly correlated. This result certainly stems from the existence of constraints such as the lack of sufficient labor to farm the large amount of cultivable land. Indeed, the amount of cultivated land usually depends on the number of active laborers. The greater the labor force available to undertake agriculture, the greater

[1] Estimates were calculated by using the formula: $D_i/\overline{Y}$, where D_i is the coefficient for the independent variable and $\overline{Y}$ the mean value of the dependent variable

the amount of land farmed, and, as the result, the higher will be the level of household agricultural income. Examination of the land resources in Tahoua reveals a large disparity between cultivable land and the amount of land actually farmed. Over 50 percent of the households report labor shortages. An empirical test to assess the impact of labor on the amount of cultivated land, controlling for other household demographic characteristics, foodstock, livestock and regional location is presented in table 5.1.

5.1. Estimation Results for Cultivated Land

Variable Category	Variables	Estimated Coefficients	T statistic
Constant		-.91	-.66
Assets Vector	Foodstock	5.582E-03	4.39***
	Foodstocksqr	-3.44E-07	-1.38
	Livestock	3.035E-06	3.68***
	Livestocksqr	-3.33E-13	-3.01***
Characteristics Vector	Labor	2.09	3.37***
	Laborsqr	-.16	-2.5**
	Hh-Prim	-1.54	-2.21**
	Hh_Primsqr	.24	2.7***
Regional Dummy Vector	Zone1	-6.42	-4.82***
	Zone2	1.2	1.4
	Zone4	5.35	4.93***
	Zone5	1.13	1.01
R^2		.35	
Adjusted R^2		.33	
F		16.9	
N		391	

Source: HHLS Survey, Care-Niger, 1998
*** significant at the 0.01 Level
***significant at the 0.05 level
*significant at the 0.1 level

Available workers, education, and location are important influences on the amount of cultivated land. The coefficient for active labor force is positive and highly significant, suggesting that where households have sufficient labor they are able to farm greater amounts of land. The interdependence between land and other productive

resources is further reinforced by the significance of foodstocks (which denote here the availability of seeds) and livestock. Their coefficients are also positive, suggesting that larger amounts of livestock and foodstocks mean greater ability to farm land.

The effects of regional location are also important. In Zone 1 where land is arid and rainfall levels are very low, agriculture is virtually nonexistent as the soils do not offer any real potential for agricultural production. In contrast, in Zone 4, location is more favorable to agriculture.

Multicollinearity appears a problem because there are significant correlations between land and other independent variables. Tests for correlation were performed using the Pearson test. These revealed that land was correlated with labor, beginning foodstock, livestock and agro-ecological zones at the 1% level. Since amounts of farmed land depends on labor, foodstock, and livestock and location, which in turn determine households' various income sources, land was not explicitly included in the regressions.

5.1.1 Determinants of Agricultural Income

Table 5.2 presents OLS regression results for agricultural income. The R^2, value indicates that the model as fitted explains 74% of agricultural income.

Results show that the demographic characteristics of households are generally not significant, but the signs of the coefficients are as expected. Even though there are differentials in access to productive resources between male-headed and female-headed households in Tahoua, the coefficient for gender of household head (SEX_HH) is negative and reveals a significant gender bias toward female-headed households. This result is surprising taking into consideration that female-headed households have lower

Table 5.2 Estimation Results for Agricultural Income

Variable Category	Variables	Estimated Coefficients	T statistic	Elasticity
Constant		306561.55	1.95	
Assets Vector	Foodstock	-81.59	-1.15	.02
	Foodstocksqr	.20	14.82***	(0.0168)♦
	Livestock	.18	3.96***	.27
	Livestocksqr	-1.840E-08	-3.02***	(0.0339)♦
	Ag_Impl	42066.46	.52	
	Ag_Implsqr	-8090.43	-.26	
	Ag_Tool	28097.43	.96	
	Ag_Toolsqr	7.03	.003	
	Hh_Good	-76097.15	-2.47**	.09
	Hh_Goodsqr	6755.55	3.01**	(0.156) ♦
	Hh_Asset	-292368.4	-1.18	
	Hh_Assets	130120.25	.66	
Characteristics Vector	Labor	-3514.37	-.10	
	Laborsqr	1654.08	.44	
	Depend	3408.93	.18	
	Dependsqr	671.99	.38	
	Hh-Prim	-37915.49	-.99	
	Hh_Primsqr	1064.8	.20	
	Sex_Hhh	-84850.72-850.34	-1.56	
	Age_Hhh	-2.01	-.11	
	Agesqr		-.03	
Regional Dummy Vector	Zone1	-291618.4	-3.98***	-.86
	Zone2	94098.88	1.96**	.28
	Zone4	-29372.99	-.57	
	Zone5	387838.2	6.9***	1.14
R^2		.75		
Adjusted R^2		.74		
F		50.45		
N		403		

Source: HHLS Survey, Care-Niger, 1998
*** significant at the 0.01 Level
***significant at the 0.05 level
*significant at the 0.1 level

agricultural production, are less involved in cash cropping (with zero levels of outputs for cotton and onion) and tend to benefit only from marginal lands with low productivity

♦ Standard deviation for elasticity

potentials. Although female-headed households have relatively lower agricultural productions (five times lower), agriculture contributes about 40 percent of total income within households headed by women.

Livestock ownership has a positive and highly significant impact on agricultural income. In the literature, the prevailing hypothesis is that households with greater access to productive resources are less likely to engage in non-farm activities (Reardon, Berdegue and Escobar, 2001). Farmers can increase their agricultural income through sales of livestock. However, as livestock holdings increase, so does the ability of rural households to invest in multiple IGAs. This is confirmed by the negative and significant coefficient for livestock squared.

When households are able to accumulate large quantities of food and cereals from previous harvests, they are able to increase their stocks of seeds and will consider producing on their farms rather than engaging in uncertain enterprises. The positive and highly significant coefficient for the squared value of beginning food stocks supports that results.

The coefficients for assets and productive resources are not significant except for that of household valuables (HH_GOOD). The coefficient is negative and significant. The presence of valuables reduces the likelihood to say on farm.

The coefficients for location are significant except for ZONE 4. The signs of the coefficients are as expected. ZONE 5 is highly significant, confirming the correlation between agriculture and favorable agro-ecological conditions. Reardon, Matlon and Delgado (1992) in an econometric analysis of the determinants of income diversification

in Burkina Faso found that where rainfall levels are relatively high and soils are richer, rural households invest in activities that are farm related. Data in Tahoua support the findings. Farm incomes are higher in ZONE 5, where the value of agricultural production is the highest, and lower in ZONE 4 where farm outputs are the lowest (table 3.9).

5.1.2 Determinants of Livestock Income

Results of the estimations for livestock income are presented in table 5.3. The R^2 of 0.57 indicates a good fit.

Within the demographic variables, the coefficients for the independent variables are not significant. Education has no significant impacts on household livestock income, even though the sign of its coefficient is as expected. With regards to gender of household head, no significant impact appears. Results thus do not support the argument that livestock income levels are higher among male-headed households.

The coefficient for livestock is positive and highly significant. Livestock constitute one of the major capital assets of smallholder farmers in Africa. In addition to the nutritional advantages, income earned by selling livestock and livestock products brings new opportunities for rural households to invest in herd building. These households get a higher share of their income from livestock, and livestock provide the poor with fertilizer, animal products and draft power along with the opportunity to build collateral and savings.

Table 5.3 Estimation Results for Livestock Income

Variable Category	Variables	Estimated Coefficients	T statistic	Elasticity
Constant		-37217.4	-.34	
Assets Vector	Foodstock	-27.61	-.78	
	Foodstocksqr	9.321E-03	1.36	
	Livestock	.171	7.56***	.76
	Livestocksqr	-3.219E-03	-1.06	(0.0515) ♦
	Ag_Impl	156994.44	3.86***	.31
	Ag_Implsqr	-59205.51	-3.82***	(0.0813) ♦
	Ag_Tool	3298.76	.23	
	Ag_Toolsqr	-451.65	-.37	
	Hh_Good	8065.07	.52	
	Hh_Goodsqr	-1219.72	-1.09	
	Hh_Asset	108864.43	.88	
	Hh_Assets	-41361.69	-.42	
Characteristics Vector	Labor	12864.29	.70	
	Laborsqr	-1115.89	-.59	
	Depend	-6305.09	-.66	
	Dependsqr	784.93	.89	
	Hh-Prim	27105.09	1.4	
	Hh-Primsqr	-831.34	-.32	
	Sex_Hhh	-3963.84	-.14	
	Age_Hhh	233.57	.06	
	Agesqr	5.94	.16	
Regional Dummy Vector	Zone1	74994.88	1.79*	.67
	Zone3	-11118.86	-.46	
	Zone4	-16974.57	-.55	
	Zone5	74076.85	2.35**	.66
R^2		.57		
Adjusted R^2		.54		
F		19.66		
N		403		

Source: HHLS Survey, Care-Niger, 1998
*** significant at the 0.01 Level
***significant at the 0.05 level
*significant at the 0.1 level

The coefficient of agricultural implements is positive and highly significant. When households own fixed productive assets, there is a potential for higher livestock income. However the more agricultural implements, the greater the tendency to invest in

other activities outside of animal farming, as those implements can constitute collaterals to enter into non-farm activities (Reardon 1997)

With regards to location, ZONE 1's coefficient is positive and significant, indicating that the greater the availability of pastures, the higher the levels of livestock income. ZONE 1 is the zone where livestock production is basically the only farming activity.

5.1.3 Determinants of Off-farm Income

Table 5.4 presents the regression results for off-farm income. The R^2 is 0.25, indicating a reasonable fit.

The coefficients of household characteristic variables are generally not significant, except for labor and education of the head of household. However, most coefficient values are consistent with findings in many developing countries (Escobal 2001; Reardon, Matlon and Delgado 1992).

Gender shows no significant impact on the ability of rural households to engage in non-farm activities. The Tahoua data show that male-headed and female-headed households receive approximately the same amounts from off-farm activities, (23 and 22 percent). This finding does not support the hypothesis that male-headed households have more access to off-farm income than their female-headed counterparts, except to the extent that male-headed households have more assets.

Table 5.4 Estimation Results for Off-farm Income

Variable Category	Variables	Value	T statistic	Elasticity
Constant		-105477.6	-.734	
Assets Vector	Foodstock	177.2	3.84***	.20
	Foodstocksqr	-3.621E-02	-4.02***	(0.0325) ♦
	Livestock	-8.298E-02	-2.81**	-.28
	Livestocksqr	1.973E-08	4.97***	(0.0653)
	Ag_Impl	193640.07	3.65***	.38
	Ag_Implsqr	-64736.55	-3.2***	(0.103) ♦
	Ag_Tool	-12704.39	-.67	
	Ag_Toolsqr	758.46	.47	
	Hh_Good	2764.6	.14	
	Hh_Goodsqr	83.03	.06	.12
	Hh_Asset	308863.58	1.96*	(0.0571) ♦
	Hh_Assets	-166650.8	-1.35	
Characteristics Vector	Labor	31834.61	2.5**	.64
	Laborsqr	-1432.427	-1.72*	(0.993) ♦
	Depend	14891	1.18	
	Dependsqr	-992	-.85	
	Edu Head	63781.93	2.11**	.52
	Sex_Hhh	28003.63	.787	
	Age_Hhh	1176.15	.25	
	Agesqr	-17.05	-.35	
Regional Dummy Vector	Zone1	34295.39	.63	
	Zone3	44997.57	1.45	
	Zone4	58574.53	1.46	
	Zone5	121064.39	2.95**	1.05
R^2		.25		
Adjusted R^2		.2		
F		5.31		
N		403		

Source: HHLS Survey, Care-Niger, 1998
*** significant at the 0.01 Level
***significant at the 0.05 level
*significant at the 0.1 level

Education of the household head (EDU-HHH) is significant and positively related to off-farm income. Achievement of primary education by the household increases the probability of engaging in non-farm activity by approximately 5 percentage points. In addition to knowledge, formal education also exposes household heads to new ideas,

which in turn broaden their horizons. Consequently, not only does more education make people better able to hire out labor or make more investments, it encourages them to try opportunities available elsewhere (Reardon, Berdegue and Escobal 2001; Yunez-Naude and Taylor 2001).

The coefficient for labor is positive and significant. Because labor constitutes one of the main productive resources for smallholder farmers, those that do not have enough cultivable land to absorb their available labor force tend to hire out labor or engage in non-farm activities.

With respect to household assets, the coefficient for agricultural implements (AG_IMPL) is significant at the 1% level and is positively related to off-farm income. An increase of one unit in agricultural implements increases household participation in off-farm activities by approximately 40 percent. The higher the value of productive assets, the greater the opportunities for rural households to invest in non-farm activities. Assets can serve as collaterals where credit markets are underdeveloped and less accessible (Christensen 1989).

The coefficient for food stocks (FOODSTOCK) is positive and highly significant, suggesting that households will be able to secure greater income levels and diversify their activities. When squared, the effect becomes negative but still significant. One implication is that large food stocks may reduce incentives to engage in off-farm activities. According to Reardon, Matlon and Delgado (1992), the higher the food stock, the higher the income level of the household. Rural households, when able to secure sufficient food, have less incentive to seek other IGAs.

Livestock is negatively related to off-farm income and is significant. Livestock ownership plays an important role in decisions to enter into off-farm activities. Where a rural household owns sufficient livestock to absorb its active members, the tendency is to move away from non-farm activities. In Tahoua, rural households practice a "transhumant" system in which herds need to be moved around. Some rural households also sell livestock and animal products to supplement household income instead of engaging in multiple activities.

However, when rural households own high numbers of animals, they tend to invest in non-farm activities. This is supported by the positive and highly significant coefficient for livestock squared (LSTCKSQR) and is in keeping with the finding that livestock can serve as an important investment and insurance mechanism where insurance and credit markets are underdeveloped or nonexistent (Christensen, 1989).

The coefficients for location indicate that the likelihood of a household participating in off-farm activities is significantly greater in zones where rainfall levels are relatively higher and with more favorable conditions for agriculture. Higher farming returns mean higher income levels and greater ability to invest in other IGAs. The coefficient for ZONE 5 is positive and significant. Indeed agriculture output in that zone is the highest including cash crops such as cotton. This result is consistent with the evidence that location in a favorable area allows households to undertake non-farm activities (Reardon, Matlon and Delgado 1992).

5.2 Conclusions

The three regressions suggest that household's personal characteristics, access to productive resources, ownership of non-productive resources and location are economically important for rural households as they influence the ability to earn income from each of the three sources analyzed in this chapter. These factors determine diversification within rural households, with the wealthier households less constrained than their poorer counterparts.

CHAPTER SIX

FINDINGS: INCOME DIVERSIFICATION

Diversification involves adding household resource management strategies to earn income from farming, livestock, non-farm, off-farm activities. In Tahoua, most households have diversified incomes. They rely on more than one source. But some households are constrained in access to resources. This chapter examines the differences between households, divided into categories with respect to income levels, socio-economic status and zone. Crop diversification levels are also examined.

6.1 Income Diversification Indices

The Herfindahl-Hirshman Index (HHI) values are obtained by the formula:

$$1 - \sum_{i=1}^{N} S_i^2 ,$$

where i = 3 and indexes all household income sources and S is the income share.

The 405 households in the sample were divided into quartiles with respect to total household income. The 1st quartile represents the bottom of the income distribution with an average total household income of approximately 90,000 CFAF. The 4th quartile encompasses the wealthiest households, with a total income of about 1,401,000 CFAF. The means of off-farm, agricultural and livestock incomes of each quartile were computed as proportions of the mean of total household income. Table 6.1 presents a

breakdown of the different income sources by quartile. The diversification indices are also shown.

Table 6.1 Income Diversification, by Quartile

Income source	**1st quartile**	**2nd quartile**	**3rd quartile**	**4th quartile**	**Full sample**
N	101	101	102	101	405
Agriculture %	50256 56	158771 59	332314 65	822682 59	340984 60
Livestock %	10814 12	51202 19	93504 18	291771 21	111778 20
Off-farm %	29342 32	57701 22	88310 17	286519 20	115401 20
Total	90412	267675	514128	1400971	568163
HHI	0.43	0.43	0.48	0.43	0.44
IDI	**0.57**	**0.57**	**0.52**	**0.57**	**0.56**

Source: HHLS Survey, Care-Niger, 19980

The income gap between the 1st and 4th quartiles is very large. The average household income in the top quartile is 15 times larger that the income in the bottom quartile. There are no significant differences across the three income categories among the quartiles. Agricultural income represents a large share of total income in all categories of the income distribution, between 50 and 60 percent. This finding is different than that of Reardon, Delgado and Matlon (1992), that relatively wealthier households earn the largest portion of their income from non-farm activities. The average off-farm income is the highest in the 1st quartile, with 32 % of total income coming from that source. The implication is that, in Tahoua, the poorest households rely on off-farm income the most. The levels of diversity are almost identical for all quartiles, varying between 0.52 and 0.57, with the poorest and richest households being equally diversified.

Socio-economic status may be important in determining ability to enter several IGAs simultaneously. Although almost all the households in the survey are able to do so, inequality of access is reflected by the disparities in income between the different socio-economic categories. It is therefore important to examine the relation between income and socio-economic status. Socio-economic status is based on the community's own perception of its socio-economic conditions, with a categorization of households ranging from most vulnerable to least vulnerable. Table 6.2 presents household income composition and the diversification levels.

Table 6.2 Income Diversification, by Socio-economic Status

	Socio-economic status			
Source	**Very vulnerable**	**Vulnerable**	**Relatively vulnerable**	**Full sample**
N	249	100	56	405
Off-farm	73101	166270	212645	115401
%	20	27	15	20
Livestock	62599	102762	346547	111778
%	18	17	25	20
Agriculture	222905	347159	854991	340984
%	62	56	60	60
Total	358605	616191	1414183	568163
IDI	**0.54**	**0.55**	**0.55**	**0.56**

Source: HHLS Survey, Care-Niger, 1998

Analysis of income sources by socio-economic shows again that the most vulnerable households have the highest share of agricultural income in total income (62%), and are equally involved in off-farm activities compared to the least vulnerable households. This reinforces the inconsistency of this study's finding with that of Reardon, Matlon and Delgado (1992) that the economically better off the households, the more income they earn from off-farm activities.

Location has also been hypothesized to be an important factor in determining diversification patterns in rural households. Where conditions are favorable, there may be incentives for households to invest in several activities as a means to mitigate risk. For that reason, it is important to examine income shares by region. Table 6.3 gives the decomposition of total household income by source, and shows diversity levels.

Table 6.3 Income Diversification, by Zone

	Zone					
	Zone1	**Zone 2**	**Zone 3**	**Zone 4**	**Zone 5**	**Full sample**
N	52	78	163	59	53	405
Off-farm	106919	70085	104112	100957	241210	115401
%	22.7	14	24	24	18	20
Livestock	363316	55237	52481	59456	188807	111778
%	77	11	12	14	14	20
Agriculture	1243	375050	270822	267124	922188	340984
%	.3	75	64	62	68	60
Total	471478	500372	427415	427537	1352205	568163
IDI	**0.35**	**0.56**	**0.52**	**0.54**	**0.49**	**0.56**

Source: HHLS Survey, Care-Niger, 1998

Overall, the results reflect the fact that income diversification has become the norm in Tahoua. These results are not surprising and reflect the potentials and opportunities that each region presents for IGAs. Except for Zone 1, which has no potential for agricultural production, all the results are as expected, with highest shares of total income coming from agriculture. The share of off-farm income is relatively important in all five zones, with the highest shares found in zones 3 and 4, where conditions are more favorable for both agriculture and animal husbandry. Diversification indices reveal that combination of several income sources is extensively used in zones that face the most severe problems of depletion of soils and droughts. High diversity levels in zones 2 and 4 support that finding. In those two regions, households practice

both extensive cultivation and extensive herding, in addition to undertaking counter-season cultivation. In contrast, in zone 1 where there is very low potential for agriculture, households are the least diversified. In zone 5 where conditions are favorable for agriculture, diversification levels are lower compared to zones 2,3 and 4. These results are in keeping with the hypothesis that households across zones have different incentives to diversify (Reardon, Matlon and Delgado 1992).

6.2 Determinants of Income Diversification

To further explore the relationship between household income and asset endowments, household demographic characteristics, and regional location, an empirical test is necessary. The diversification index is regressed on the asset, demographic and locational variables. The index for the diversification of income sources (DINDEX) was constructed by taking account of the shares of income made up of all household activities.

The equation was estimated using OLS. Only about one-fifth of the coefficients were statistically significant. Heteroscedasticity among zones was thought to be the source of the nonsignificance of the other coefficients. It is possible that diversification patterns vary with location, based on availability of off-farm activities. Subsequently, a White's heteroscedasticity test of the null hypothesis of whether the variance is constant among zones was conducted. The White test result is 13.2, which has, asymptotically, a chi-square distribution with 4 df. The 1% critical chi-square for 4 df is 13.27, which fails to reject the null hypothesis.

Estimation coefficients and results are presented in table 6.4.

Table 6.4 Estimation Results for Income Diversification Index

Variable Category	Variables	Estimated Coefficients	T statistic	Elasticity
Constant		.25	2.781	
Assets Vector	Foodstock	-5.983E-05	-1.51	
	Foodstocksqr	6.785E-09	.89	
	Livestock	-2.539E-08	-1.0	
	Livestocksqr	3.117E-15	.91	
	Ag_Impl	6.728E-02	1.45	
	Ag_Implsqr	-1.943E-02	-1.09	
	Ag_Tool	3.607E-02	2.15**	3.536E-08
	Ag_Toolsqr	-3.257E-03	-2.32**	(0.0881) ♦
	Hh_Good	5.591E-03	.32	
	Hh_Goodsqr	-4.434E-04	-.35	
	Hh_Asset	.116	.84	
	Hh_Assets	8.218E-03	.08	
Characteristics Vector	Labor	1.877E-02	.92	
	Laborsqr	-2.173E-03	-1.04	
	Depend	1.878E-02	1.741*	-9.48E-07
	Dependsqr	-1.391E-03	-1.40	(0.0516) ♦
	Hh-Prim	-6.656E-03	-.31	
	Hh-Primsqr	2.841E-03	.97	
	Sex_Hhh	-6.498E-02	-2.08**	-.2
	Age_Hhh	-3.00E-03	-.74	
	Agesqr	3.656E-05	.88	
Regional Dummy Vector	Zone1	-.11	-2.59**	-.33
	Zone2	-6.157E03	-.23	
	Zone4	1.001E-02	.33	
	Zone5	1.694E-02	.54	
R^2		.16		
Adjusted R^2		.11		
F		3.05		
N		391		

Source: HHLS Survey, Care-Niger, 1998
*** significant at the 0.01 Level
***significant at the 0.05 level
*significant at the 0.1 level

Estimation results show that only the coefficients for number of dependents (DEPEND), household's assets (HH_ASSET) and ZONE1 are significant. Surprisingly household demographic characteristics have no significantly impacts on households' income diversification levels, except for the number of dependents and the gender of the

head of household. The coefficient for gender of the head of household is negative and significant at the 5% level, indicating a bias in the direction of female-headed households. The latter have more diversified income sources than do male-headed households. A possible explanation is that female-headed households are more vulnerable, and therefore at greatest risk with respect to food security. This result is in keeping with data in Tahoua, which show that dependency ratios are higher within female-headed households.

The coefficient for dependent (DEPEND) is positive and significantly related to income diversification. One possible explanation is that the presence of dependents (children and elderly) significantly influences participation in non-farm activities in addition to own farming. Indeed, households with greater numbers of dependent members, because they may be at greatest risk with respect to seasonal variability in agricultural production and income, are "pushed" towards diversifying their income. The strong relationship indicates that income diversification is more relevant in households that face food insecurity.

The regression results also show a positive relationship between household assets and income diversification. The coefficient for household assets (HH_ASSET) is positive and significant at the 5% level, suggesting that where rural households have access to significant amount of valuables, they may be able to secure some capital for non-farm activities such as petty trade.

Location also plays an important role in income diversification as shown by the coefficients for zone. The coefficient for ZONE 1 is significant and negatively correlated

with income diversification. Analysis of data in Tahoua (see Table 3.11) shows that in ZONE 1 only 58 percent of the households are engaged IGAs, against an average of 80 percent in the remaining zones. Households in ZONE 1 also have the smallest proportion of non-farm income in total household income.

6.3 Crop Diversification Levels

Generally, traditional African farming systems grow a variety of crops and cereals based on the potentials in zones in which they live. Due to uncertain rainfalls and the cyclical characteristic of droughts, farmers diversify crops to ensure some. In Tahoua, crop diversification is an important part of household livelihood, as it may mean potential yield improvement and increased income levels. Households use mixed cropping to expand harvest periods and to help alleviate seasonal food shortages. Although all households have millet as their main cereal, farmers cultivate a variety of other cereals (refer to table 3.5).

Since agriculture is one of the major sources of income, the study examines differences in crop diversification between the four categories of the income distribution. Data show that households get the largest value of agricultural production from millet. The latter accounts for 40 percent of the value of crop production. It is higher in the lowest quartile, with about 46 percents.

Total agricultural production of the lowest three quartiles combined is less than that of the 4^{th} quartile. Cash crop values of outputs such as cotton, onion and peanut are higher in the 4^{th} quartile, indicating that richer household production is less concentrated

on subsistence. Access to IGAs may be a crucial factor in ability to purchase inputs and agricultural implements.

Table 6.5 Mean Values of Agricultural Outputs, in FCFA

Agricultural source	**1st quartile**	**2nd quartile**	**3rd quartile**	**4th quartile**	**Full sample**
N	101	100	102	101	404
Millet	25389.68	79592.1	149552.9	293022.2	137062.4
%	46.14	47.15	44.14	33.94	38.59
Sorghum	4203.1	10984.35	29879.56	56842.33	25524.33
%	7.64	6.51	8.82	6.58	7.19
Black-eye-pea	3557.26	9873.21	18522.56	43858.84	18974.37
%	6.47	5.85	5.47	5.08	5.34
Peanut	82.94	1283.34	2887.79	10976.56	3811.63
%	0.15	0.76	0.85	1.27	1.07
Cotton	.0000	374.9	2604.8	6738.47	2435.06
%	0	0.22	0.77	0.78	0.69
Onion	925.74	3825	12583.33	57059.41	18620.05
%	1.68	2.27	3.71	6.61	5.24
Tomato	5047.38	14278.84	26846.68	183006.8	57326.03
%	9.17	8.46	7.92	21.2	16.14
Green leafy plant	15647.37	48914.88	91910.67	188657.3	86388.99
%	28.44	28.98	27.13	21.85	24.32
Others	168.39	1365.93	3990.95	14648.19	5049.86
%	0.31	0.81	1.18	1.7	1.42
Total value of production	55022.76	168804.5	338779.3	863358.3	355192.7

Source: HHLS Survey, Care-Niger, 1998

The data suggest the existence of farm diversification differentials among rural households, with the poorer households relying more on subsistence production and the wealthier households being more advantaged with respect to cash crop production. Therefore, wealthier households have more diversified cropping levels.

Following the method from the previous section, diversity indices are computed for crop diversification within households. Table 6.6 reports the crop diversification index (CDI) for each quartile.

Table 6.6 Crop Diversification, by Quartile

% share	1st quartile	2nd quartile	3rd quartile	4th quartile	Full sample
Millet	46.14	47.15	44.14	33.94	38.59
Sorghum	7.64	6.51	8.82	6.58	7.19
Black-eye-pea	6.47	5.85	5.47	5.08	5.34
Peanut	0.15	0.76	0.85	1.27	1.07
Cotton	0	0.22	0.77	0.78	0.69
Onion	1.68	2.27	3.71	6.61	5.24
Tomato	9.17	8.46	7.92	21.20	16.14
Green leafy plant	28.44	28.98	27.13	21.85	24.32
Others	0.31	0.81	1.18	1.7	1.42
HHI	3124.99	3217.57	2871.28	2196.69	2452.47
CDI	**0.69**	**0.68**	**0.71**	**0.78**	**0.75**

Source: HHLS Survey, Care-Niger, 1998

Crop diversification indices are relatively high (closer to the upper bound of 1), implying that in Tahoua, although the largest parts of their agricultural production are concentrated on subsistence, households cultivate multiple crop. The bottom of the income distribution has the lowest diversification index, whereas diversification index is higher for the wealthiest quartile. But the crop diversification index for the lowest quartile still is greater than that of the 2nd quartile.

Correlations between crop diversification levels and socio-economic status, and zone are also examined. The diversity indices are presented in tables 6.7 and 6.8.

Surprisingly, the pattern of crop production does not show any striking differences in crop diversification when comparing across socio-economic groups. All households, whether the most vulnerable or the relatively better-off, are very diversified with respect to crop production. However, the community's own perception of its socio-economic conditions may not have reflected the actual income distribution.

Table 6.7 Crop Diversification, by Socio-economic Status

	Socio-economic status			
	Very vulnerable	**Vulnerable**	**Relatively vulnerable**	**Full sample**
N	259	92	53	405
Millet	100757.5	151570.4	289293.2	137062.4
%	38.8	42.8	35.1	38.6
Sorghum	19369.29	30557.17	46866.49	25524.33
%	7.5	8.6	5.7	7.2
Pea	19890.38	15995.13	19669.56	18974.37
%	7.7	4.5	2.4	5.3
Peanut	4856.26	1391.96	2906.92	3811.63
%	1.9	0.4	0.4	1.1
Cotton	1450.64	752.99	10165.57	2435.06
%	0.6	0.2	1.2	0.7
Onion	19231.66	8684.78	32877.36	18620.05
%	7.4	2.5	4	5.2
Tomato	27616.64	42928.62	227501.4	57326.03
%	10.6	12.1	27.6	16.1
Green leafy	62242.29	94645.91	190056.2	86388.99
%	24	26.7	23.1	24.3
Others	4178.06	7851.45	4447.01	5048.86
%	1.6	2.2	0.5	1.4
Total	259619.72	354378.41	823783.71	355191.7
CDI	**0.76**	**0.72**	**0.74**	**0.75**

Source: HHLS Survey, Care-Niger, 1998

The high levels of crop diversification in zones 1 and 2 indicate that households that are located in high risk and barren zones are somewhat more diversified. This result is surprising because those two regions have low agricultural potential. However, it fits the explanation of diversification as a strategy to mitigate drought related risks. Locational factors do not seem to affect the range of crops that households can grow. The diversification levels in zones 3 and 5 support the theory that a favorable environment allows households to grow a variety of crops and sustain higher production levels

Table 6.8 Crop Diversification, by Zone

	Agro-ecological zone					
	Zone 1	**Zone 2**	**Zone 3**	**Zone 4**	**Zone 5**	**Full sample**
N	52	78	163	59	53	405
Millet	362.98	139742.8	120562.3	123935.2	332285.5	137062.4
%	22.5	35.8	42.5	44.5	34.8	38.6
Sorghum	170.05	24004.07	27037.96	5256.65	70573.16	25524.33
%	10.5	6.2	9.5	1.9	7.4	7.2
Pea	453.37	21873.37	11262.16	48548.52	23530.52	18974.37
%	28.1	5.6	4	17.4	2.5	5.3
Peanut	6.33	628.32	8460.56	629.16	1562.96	3811.63
%	0.4	0.2	3	0.2	0.2	1.1
Cotton	0	0	1841.3	0	12933.5	2435.06
%	--	--	0.6	--	1.4	0.7
Onion	0	66583.33	14376.54	0	0	18620.05
%	--	17.1	5.1	--	--	5.2
Tomato	397.5	51111.98	24525.85	20930.33	263098.8	57326.03
%	24.6	13.1	8.6	7.5	27.6	16.1
Green leafy	223.08	86086.87	74112.54	76190.37	220251.2	86388.99
%	13.8	22	26.1	27.4	23.1	24.3
Others	0	393.75	1795.42	2732.42	29384.14	5049.86
%	--	0.1	0.6	1	3.1	1.4
Total	1613.3	390424.4	283974.63	278222.65	953619.78	355192.7
CDI	**0.78**	**0.77**	**0.73**	**0.69**	**0.74**	**0.75**

Source: HHLS Survey, Care-Niger, 1998

In summary, the results suggest that regardless of income level, socio-economic status or location, rural households in Tahoua are very diversified with regards to agriculture. However, these three factors alone do not control for other factors influencing households to diversify farm production. Many factors can affect crop diversification. It is possible that the relationships observed between income distribution and overall value of agricultural production might be caused by differences in demographic characteristics and access to resources. For example, the correlation between agricultural production and the amount of cultivated land may not be reflected in crop diversification.

6.4 Determinants of Crop Diversification

To assess the influences of the factors mentioned above, farm diversification level (FINDEX) was regressed against land, gender of household head, education level, beginning food stock, livestock and zone. Estimation results are presented in table 6.9.

Table 6.9 Estimation Results for Crop Diversification Index

Variable Category	Variables	Estimated Coefficients	T statistic	Elasticity
Constant		.62	23.72	
Assets Vector	Land	3.909	2.17**	2.851E-05
	Landsqr	-6.746E-05	-1.55	(0.008) ♦
	Foodstock	-2.741E-05	-1.41	
	Foodstocksqr	4.059E-09	1.08	
Characteristics Vector	Depend	-3.490E-03	-.62	
	Dependsqr	4.788-04	.91	
	Hh-Prim	1.692E-02	1.69	8.5E-07
	Hh-Primsqr	-1.308E-03	-1.94*	(0.0028) ♦
	Sex_Hhh	-2.272E-02	-1.36	
Regional Dummy Vector	Zone 1	-.6	-9.14***	
	Zone 2	3.180E-02	-2.44**	
	Zone 4	-3.203E-02	-2.12**	
	Zone 5	1.702E-02	1.12	
R^2		.27		
Adjusted R^2		.24		
F		9.12		
N		340		

Source: HHLS Survey, Care-Niger, 1998
*** significant at the 0.01 Level
***significant at the 0.05 level
*significant at the 0.1 level

No statistically significant relationship is found between crop diversification level and gender of household head, although the sign of the coefficient shows a bias toward female-headed household.

Total years of education, squared, is negative and significant at the 10% level, indicating that as household members start accumulating years of education, they tend to be less involved in agriculture.

The coefficient for land is positive and significant at the 5% level, indicating that households with greater landholdings are more likely to diversify their crop productions.

The estimates for agro-ecological zones indicate that households living in areas more prone to droughts and difficult conditions are less likely to diversify. The negative and significant coefficients of ZONE 1 and ZONE 4 are in keeping with data in Tahoua. Whereas agricultural production is non-existent in ZONE 1, it is relatively low in ZONE 4 and mostly involves subsistence production.

CHAPTER SEVEN

SUMMARY AND CONCLUSIONS

In many developing countries and drought prone regions, income diversification plays an important role in rural household livelihood strategies. Rural households cope with shocks to their income by engaging in non-farm activities. Although income diversification has been recognized as a vital aspect of household livelihoods, theory is divided as to the motivations for diversification. On one hand, theory has predicted that poor households that face substantial risk are more risk-averse than richer farmers and cannot smooth income through insurance or credit. They have the most diversified incomes. An alternative theory predicts that for those same reasons, wealthiest households diversify the most because they have greater access to credit and capital.

This study has examined income diversification levels among rural households in Niger and to determine which category of households, poorest or wealthiest, have the most diversified incomes. Using a sample of 405 households in Tahoua Department, Niger, the two hypotheses have been examined. In addition, the impacts of demographic characteristics, access to resources, and location have been explored.

The data used in this study has been collected in 1998 as part of the Household Livelihood Security (HHLS) study financed by CARE International, and conducted with the assistance of the University of Arizona's Bureau of Applied Research in Anthropology (BARA). An important characteristic of rural households in Tahoua is that they live in a region where droughts and variability of income are frequent. Moreover,

these households face constraints, such as underdeveloped credit markets, that create a big disparity in opportunities between poorer and relatively wealthier households, and between male-headed and female-headed households. This has presented us with ideal conditions to identify the different factors that influence farmers to enter into non-farm activities.

Income diversification indices were estimated using the Herfindahl-Hirshman Index (HHI). They showed that while there were no significant differences between the different categories of household with regards to income diversification, crop diversification levels were greater within the highest category of the income distribution.

Findings also showed that female-headed households have more diversified income sources than households headed by men. This finding leans toward the hypothesis that households at greatest risk are more likely to diversify, taking into consideration the fact that, in Tahoua, female-headed households have less access to productive resources and have higher dependency ratios. However, the findings contradict the theory that predicts higher levels of income and crop diversification in male-headed households due to their greater access to resources.

Another important finding is that the amount of land households can farm depends on the availability of both physical (land) and financial capital, and on the regions in which households are located. The implication is that poor households that do not have the necessary capital and assets are less likely to diversify their crop production.

Location was also found to be important in explaining diversification. Regions with richer soils and less risky conditions offer greater opportunities for rural households

to engage in activities other than farming and animal husbandry. This is consistent with findings in many developing countries across Asia, Africa and Latin America (Reardon, Matlon and Delgado 1992; Reardon and Taylor 1996; Reardon 1997; Escobal 2001, Reardon, Berdegue and Escobar 2001). In terms of crop diversification, these results present a slightly different pattern, with households located in drier zones being more diversified. This is in keeping with the theory that households in poor areas may be pushed into diversification as response to shocks to their income and as means to mitigate risk.

On the whole, the results support the view that, in Tahoua, households at greatest risk are more likely to diversify their income sources although the diversification indices are almost identical among the poorest and the wealthiest groups. The results of crop diversification further support the "risk" hypothesis, with diversity being higher in riskier and more drought prone regions.

7.1 Policy Implications

The results suggest that there is a significant relationship between regional factors and income diversification. Since households in more remote areas, with less access to markets and other services are more constrained to undertake diversification strategies and to reduce the impacts of unequal access to resources, policy makers need to promote investment in infrastructure. For example, investing in seed distribution infrastructure to help in production and stockage of grains can ensure that all households have access.

One feature of households in Tahoua is the disparity between zones with respect to the spatial distribution of the economic activities. It is therefore essential to help promote regional development. This involves creating conditions of access to markets. The existing financial markets do not have the scale to provide insurance against variability. Therefore, a demand-oriented rural financial market appears necessary as a market for insurance services.

7.2 Suggestions for Further Research

Some of the results are consistent with studies conducted in other developing countries, while others differ substantially. The differences may have resulted from a country-specific situation and other factors. For example, this study could not examine risk related factors and how these latter affect poorer and relatively wealthier households, because the data were collected at one point in time and did not include the different ways rural households cope with droughts and risks to their incomes over time. Other factors may underlie income diversification that this study could not account for. A full account of the motivations for diversification in Tahoua needs data on risk factors. It is in that direction that future research on income diversification must go.

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