Activity Diversification in Rural Livelihoods

The Role of Farm Supplementary Income in Burkina Faso

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Abstract

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The present study assesses the contribution of farm supplementary activities to rural livelihoods in low-income regions that are characterised by economic stagnation. Rural households mitigate income risks by developing farm supplementary activities. It is much less apparent, however, whether income diversification provides better livelihood perspectives compared to economic specialisation. Through analysing the complete portfolio of economic activities the study identifies specific aspects of individual and household livelihood diversification. The survey was carried out in villages that are different with respect to endowments of agricultural resources and access to infrastructure. Local non-farm sectors, characterised by excess capacity, provided insufficient technological and institutional development for structurally improving the economic base in the villages. Personal status within the household, *i.e.* authority and gender, is a major determinant for access to farm supplementary activities. Individual characteristics, related to ability, preference, and property, appeared to be less important as determinants for actual involvement in these activities. Individual livelihoods were more specialised than commonly assumed. Attitudes towards risk had a limited impact on daily livelihoods; people who were less risk-averse selected a more diversified income portfolio. Only in the resource-poor villages, more supplementary revenues led to more efficient cereal production. The use of external inputs for crop production did not differ across farm households with different supplementary revenues. Decomposition of household income along the village income spectrum shows that availability of agricultural resources had a major impact on income level and incidence of poverty. Involvement in supplementary activities, however, had a limited effect on the income distributions within the villages. The general conclusion points to the need to emphasise that livelihood diversification, besides its functionality for mitigating income risks, is also a structural result of poverty. Therefore, income diversification itself is an insufficient device to structurally alleviate poverty, and additional attention should be given to the institutions and technologies of the different livelihood components.

Keywords: rural livelihoods, household income diversification, farm supplementary activities, risk preferences, income distribution, crop production, efficiency, less-favoured areas

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Chapter 1

Farm supplementary activities in rural livelihoods

Many farm households in developing countries obtain an important share of their income from economic activities besides farming. Research into the role of these supplementary activities in rural economies has led to divergent conclusions pointing to beneficial as well as adverse consequences of household income diversification (Ellis, 2000a; Reardon *et al.*, 2000). This is not entirely surprising, since the principle of specialisation is generally accepted as one of the core sources of economic growth (Schumpeter, 1947; Hicks, 1969; Verschoor, 2000). Advocating income diversification seems to challenge the principle of growth through specialisation. Hence there is a need to reconsider the advantages of livelihood diversification. The persistence of the problems of poverty in the rural areas of developing countries further calls for a critical reassessment of the ostensible advantages of farm supplementary activities.

This introductory chapter describes how the present study seeks to contribute to current knowledge regarding rural livelihood diversification, defines the research scope, and elaborates the research objectives. This is followed by a justification of the research methodology and a thesis outline.

The study aims at a better understanding of the role of farm supplementary activities in rural villages in sub-Saharan Africa that have achieved limited economic growth during the last decades. First, detailed information is given about the character of actual farm supplementary activities. Second, an assessment of the determinants of involvement in supplementary activities sheds light on possible entry barriers for others to engage in supplementary activities. Third, we analyse individual livelihoods with specific attention to the role of risk preferences. Fourth, it is investigated whether involvement in supplementary activities has an impact on the efficiency of the use of labour and land for cereal production. Fifth, the research provides information on the role of supplementary activities in the village distributions of household income.

1.1   Statement of the problem

Over the last three decades, farm household diversification into supplementary activities has come firmly on the agenda for research on and development of rural livelihoods (Reardon *et al.*, 1988; Ellis, 2000b). Several studies conclude that involvement in supplementary activities is positively related to farm productivity and contributes to poverty alleviation (Woldehanna, 2000; Lanjouw and Lanjouw, 2001; van den Berg, 2001; Ellis and Mdoe, 2003). Yet, by insufficiently identifying factual economic opportunities in the non-farm sectors, the same studies do not explain the persistent nature of poverty in low-income developing countries and fall short in making specific policy recommendations. Household activity diversification is widespread in rural sub-Saharan African but it has not generated the expected economic growth of the local economy.

More recent research on development and poverty points to the specific social and economic situation in less-favoured areas (Ruben *et al.*, 2004). Increasingly, attention is devoted to broader research themes such as the rate of return to public investment, the relation between public and private investment, and interactions between local, national and international development (Kuyvenhoven *et al.*, 2004; Oskam *et al.*, 2004; Barrett and Swallow, 2003). While economic returns to investments in less-favoured areas appear to be relatively low, it has been shown that investments in certain less-favoured areas contribute more to poverty alleviation and ecological sustainability than investments in more-favoured areas (Fan and Chan-Kang, 2004).

However, it is difficult to support local economies where there are limited opportunities for income generation. This dilemma is also noted by Francis (2002) in a study on South African livelihoods: "The combination of national unemployment and a dearth of locally generated livelihoods make support for the generation of more livelihoods locally critically important". In similar vein, Oskam *et al.* (2004) observe that current and expected future conditions do not attract private and public investments towards less-favoured areas. On the contrary, there is evidence that much capital, especially expertise, leaks away from areas that critically needs such capital (Easterly, 2001).

1.2   Village, household and individual livelihoods

Various review studies on rural economies illustrate remarkable similarities in the size and nature of rural livelihoods in Latin America (Reardon *et al.*, 2001), Africa (Reardon, 1997), and Asia (Alauddin and Tisdell, 1995; Meindertsma, 1997). For countries in Africa as well as in Latin America, income from sources other than own-farm crop and animal husbandry constitute an average share of about 40% of total income (Reardon, 1997; Delgado and

Siamwalla, 1999; Reardon *et al.*, 2001). Livelihood diversification is further illustrated in empirical research into economic choices by rural households in developing countries (Davies, 1996; Tellegen, 1997; Bryceson, 1999; Ellis, 2000a).

Village studies confirm that the non-farm sector has a higher growth-multiplier effect on the village economy compared to the farm sector (Taylor *et al.*, 1996; Delgado *et al.*, 1998). However, the current importance of supplementary activities does not warrant a comparative economic advantage vis-à-vis farming. Despite the relative importance of the non-farm sector little is known about the opportunities to further expand the activities that currently constitute this sector (Haggblade *et al.*, 1989; Corral and Reardon, 2001). On the contrary, supplementary activities are frequently operated under conditions of excess capacity and thus have little room for expansion (Lewis and Thorbecke, 1996). Excess capacity occurs when available means of production are abundant and have the potential to generate a supply of goods largely exceeding demand.

The household analytical framework allows for jointly analysing production and consumption decisions and for addressing intra-household interdependencies (Haddad *et al.*, 1997; Fafchamps, 1998; Quisumbing *et al.*, 2001; Lawrence *et al.*, 1999). Bio-economic modelling studies that include supplementary activities find contrasting evidence of negative and positive effects of supplementary activities on farm husbandry, respectively, in Ethiopia (Holden *et al.*, 2004) and in Indonesia (Meindertsma, 1997). Modelling of livelihood strategies in Malawi shows that women would benefit more from investment in agriculture (fertilisers) than in non-farm sectors (Gladwin *et al.*, 2001). Several studies, however, mention that the household concept encompasses too much social heterogeneity to adequately analyse actual livelihood processes (Ellis, 2000b; Bouahom *et al.*, 2004; Niehof, 2004).

Other studies focus on the individual entrepreneur and the economic activity in question and pay less attention to the position of individuals in household livelihoods (Tellegen, 1997; Scott, 1995). Some detailed analysis of individual behaviour is found in research in agriculture (de Groote and Coulibaly, 1998); education (Shapiro and Tambashe, 2001); and health (Adams *et al.*, 2002). From an individual's perspective a household is a transitory organisation (Adams *et al.*, 2002; Bouahom *et al.*, 2004). Individuals participate in a household depending on age, gender and other characteristics. Whether people contribute to household activities or develop individual activities depends on history and culture on the one hand and on immediate functionality on the other.

The present study separately assesses individual and household livelihoods. This approach recognises that decision-processes as described by unitary and collective household models

occur simultaneously and alternately (Quisumbing and Maluccio, 2003; Fafchamps, 1998). I consider three reasons to complement analysis of village and household economies with better information on individual livelihoods.

First, analogous to the growth-versus-equity debate one could argue that income generation by whosoever is eventually beneficial to all household members. In the short run, economic opportunities accruing to household members that are already better off will have a higher marginal return to household labour resources. This may lead to a better social position of a household and to a shift in domestic budget patterns. Those who earn well are more likely to contribute to large expenditures for schooling, clothing and health care.

Second, no matter how precisely intra-household allocation mechanisms are investigated, one remains dependent on assumptions regarding motives and satisfaction of individual members (Kooreman and Wunderink, 1997). We elaborate contrasting evidence from the literature on intra-household income pooling and consumption sharing (e.g. (Lawrence *et al.*, 1999; Quisumbing and Maluccio, 2003; Fafchamps, 1998)).

Third, analysis of the household organisation of livelihoods should anticipate the formulation of effective policy instruments that can narrow the gap between the actual and the desired situation (Rooy, 1997; LNV, 1996; Brons, 1998). With respect to the latter issue one may question whether ensuing policy interventions actually use the detailed information on livelihoods, can practically handle the complexity of household livelihood, and can adequately deal with complex social relations.

1.3   Research objectives

The general objective is to better understand the potential of farm supplementary activities in rural economies that are characterised by economic stagnation.[1] To balance the research focus on the individual entrepreneur and the economic activity in question on the one hand and attention to household livelihood on the other, we specify five objectives for this study. First, with respect to opportunities for supplementary activities the study provides insight into the character of actual economically viable farm supplementary activities. Second, concerning involvement in supplementary activities, the study sheds light on individual incentives to develop farm supplementary activities. Conversely, knowledge about who are engaged in

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[1] For convenience, the term 'farm supplementary' activities, or in short 'supplementary' activities, is used for all economic activities that provide revenues supplementary to traditional crop and animal revenues generated on the household farm. If we compare economic sectors, we use the general term of non-farm sectors for all kinds of farm supplementary activities.

supplementary activities provides insight into possible entry barriers that impede others from generating supplementary income. Third, an assessment of income diversification at individual level devotes special attention to attitudes to risk, which are considered the most dominant determinant of diversification. Fourth, we analyse the effects of involvement in supplementary activities on production efficiency and input use in crop husbandry. The fifth contribution consists of income decomposition along the household income spectrum. This provides information on whether, at household level, supplementary activities contribute to poverty alleviation.

A sequence of research questions aims at clarifying the above mentioned issues. We choose to deal with each question in separate chapters to provide detailed information on several aspects of local livelihoods. The following research questions elaborate the objectives of this research:

1. What are the characteristics of existing farm supplementary activities?
2. What are the factors that determine whether people participate in supplementary activities?
3. How do supplementary activities contribute to individual livelihoods?
4. What is the effect of diversification towards supplementary activities on crop husbandry?
5. What income level do different portfolios generate and which activities are developed by the poorest population strata?

1.4   Research area and methods

To investigate the reasons why non-farm sectors insufficiently catalyse rural economic growth we selected Burkina Faso; a land-locked sub-Saharan country with a relatively high population density (map and country statistics in Appendix 1.1). The arid and semi-arid regions in Burkina Faso are categorised as less-favoured areas that do not attract much private investments due to current and expected absence of a cost-effective environment (Kuyvenhoven *et al.*, 2004; Oskam *et al.*, 2004). A distinguishing feature of a large part of sub-Saharan Africa, and in particular the Sudano-Sahel region, is the absence of a large urban and semi-urban population that could stimulate economic growth by absorbing surplus labour from rural areas and increasing demand for agricultural products (Tiffen, 2003).

Burkina Faso ranks among the poorest countries, it is third from the bottom on the 2003 country list of Human Development Indices (UNDP, 2004). The dominantly rural economy in Burkina Faso has achieved a rather poor economic performance over the last decades. Although per capita food production has increased, real income has declined between 1990 and 1999 (20% reduction, similar to Mali and Ivory Coast). With 51% of the rural population being

labelled as poor, the incidence of poverty is among the highest in West Africa (World Bank, 2004a). In 1999, less than 20 % of the rural population had access to adequate sanitation facilities. In the agricultural production sector, the use rate of about 7 kg per ha of chemical inputs for crop cultivation is one of lowest in West Africa. Actual crop yields are still low compared to potential yields. The main cereals, maize, rice, sorghum, and millet, attain yields that are 15-40% of potential yields for these crops (IFAD, 2001). The rural non-farm economic sectors consist mainly of activities that give relatively low returns to labour. Among the major constraints are the underdevelopment of nearly all markets for inputs, outputs, and services. Consequently, investment occurs only at a low and inefficient level, and risks and transaction costs are high (IFAD, 2001).

The data for this study is based on fieldwork in five villages in Burkina Faso that are different with respect to agricultural resource endowment and infrastructure conditions.[2] These two factors are generally considered to be the main determinants of opportunities for supplementary activities. Dependent on the population size of the villages, 17-31 households in each village were randomly selected. The households together consisted of 733 persons of whom we interviewed about 400 respondents. When people were not available fellow household members were asked about the economic activities of the absent household members.[3]

The data concern an inventory of inputs and outputs of economic activities. The interviews started with an inventory of all household members taking note of their position within the household and of their economic activities, including individual land and livestock ownership and involvement in supplementary activities. Subsequent interviews were individually held with those who were responsible for an economic activity and who were present during the research periods. Because of the many activities that were covered by the interviews, we relied on several probing questions in order to efficiently obtain the relevant information. In this respect a series of questions about input and output quantities concerned household physical assets (land, livestock, and equipment), crop husbandry (labour, variable inputs, crop produce), livestock husbandry (expenditures, take-off and losses), and supplementary activities (input, output, turnover rates, and investments) (Appendix 1.1).[4]

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[2] The villages are actually four formal administrative units (cf Chapter 2). One of the villages consists of two wards that are markedly different with respect to choice of activities.

[3] The interviews were repeated once with an interval of a year and thus covered two consecutive years starting with the wet season in May 2000. In the analysis I use two-year average data. This reduces the effect of year-specific factors, which are considered to be important in farming in semi-arid areas.

[4] The interviews were repeated during the second year with some adjustments for logistical reasons.

The relation between household and individual characteristics is elaborated in the respective chapters. We first analyse individual opportunities for and access to economic activities and the extent of individual income diversification. Next, the analysis of crop husbandry includes several household characteristics because most management responsibilities are at the level of the head of the household. Finally, total income composition is a typical household feature and analysis of income and consumption allocation mechanisms is beyond the scope of this study.

The methodological choice to analyse the complete household portfolio of economic activities implies some limitations. The relatively small sample insufficiently includes heterogeneity with respect to exogenous factors such as climate, infrastructure, ethnicity, and markets. Livelihood conditions will be different in villages near urban centres or near specific economic activities (mining, plantation, etc.). In contrast to the absence of heterogeneity with respect to exogenous factors, actual management of farm and supplementary activities is characterised by great heterogeneity. The small sample of this study concerns many activities and may therefore yield data that are less precise than actually desired.

1.5   Thesis outline

Before turning to the research questions as specified, the next chapter defines relevant concepts, presents the setting in which this research has been carried out, and provides descriptive statistics. The fairly detailed information on local livelihoods is the basis for the subsequent chapters. Farming and supplementary activities are characterised by a diffuse technological and institutional base. Further analysis of institutions and income distribution cannot be much more precise than the nature of the underlying core economic activities. This dilemma commonly receives little attention in livelihood research.

Chapter 3 concerns the first research question and contains an analysis of the supplementary activities which were observed, yielding insight into the problem of excess capacity in the non-farm sector. It compares rural farm supplementary activities regarding institutional and technological features. This analysis has a descriptive nature and serves to illustrate the diversity of the non-farm sector. We argue that institutional and technological developments are important factors for exploiting local comparative advantage. Supplementary revenues constitute a large share of total income, yet in their current form they do not seem to warrant further local economic growth.

Chapter 4 addresses the second research question concerning actual individual involvement in supplementary activities. It provides information on the characteristics of individuals that stimulate people to develop supplementary activities. Determinants of participation in

supplementary activities are assessed, with allowance for local opportunities for supplementary activities. We assess the effect of household conditions such as resource endowment and individual characteristics such as status, capability, and preference on involvement in supplementary activities.

Chapter 5 deals with the third research question and concerns the relationship between the composition of individual income and risk preferences. The chapter analyses whether individuals specialise or diversify their economic activities. Individual economic diversification may be a rational choice to avoid income risks but could lead to reduction of income by forgoing potential advantages through specialisation.

Chapter 6, and the fourth research question, concerns the issue whether, at the household level, involvement in supplementary activities affects crop husbandry, specifically productivity of labour and land, crop production efficiency and farm-input ratios. If it is the case that diversification takes place across seasons and between individual household members, then farm and supplementary activities may simply co-exist. Consequently, diversification may be, less than is generally thought, a deliberate choice to improve specific activities.

Chapter 7, dealing with the fifth research question, relates to the share of supplementary income in total income, and in particular addresses the issue of income distribution and poverty alleviation. It addresses the question whether households with low farm income benefit sufficiently from opportunities for supplementary activities. Along the wealth spectrum, we decompose income sources by farm and non-farm sector activities.

The last chapter discusses the research findings and outlines some policy implications. It emphasises the importance of focusing on institutional and technological development in order to allow households to exploit comparative advantages. Current diversification patterns reflected a complex household organisation in the context of a meagre economic base. We find no typical portfolios of activities for different income strata. Farm supplementary activities contributed less than generally assumed to poverty alleviation in less-favoured rural areas. The primary motive of activity diversification was the search for income rather than the deliberate composition of a diversified portfolio of activities. The divergence of this finding compared to common perception on local livelihoods is attributed to the set–up of this research. We combine information on individual livelihoods with information on village-wide income distributions. The first type of information is commonly found in case studies while the second type of information is usually presented in broader studies with large samples. Local case studies as well as region-wide studies may lead to overestimating the role of supplementary activities with respect to their impact on village-level income distribution.

Chapter 2

Household and individual livelihoods in local economies

By describing the diversity of rural livelihoods, this chapter provides the research setting, and identifies the relevant unit of social and economic analysis. We combine analyses that focus on households, individuals, and activities, and thus do not strictly rely on the household as principal unit of analysis. The analytical framework for a combined analysis of household and individual livelihoods is elaborated in the next section.

The subsequent sections provide a detailed description of the major economic activities at village, household, individual and activity level. A description of village conditions sets the context of distinct comparative advantage regarding infrastructure and agricultural resource endowment. Household-level data provide information on income composition by categories of income from cropping (on average 63 percent of total income), livestock (11 percent) and supplementary activities (25 percent). In addition, income decomposition by crop and by gender is given. About 70 percent of total income accrued to the household head, 15 percent to dependent men, and 15 percent to women.[1] On average about 90 percent of income streams from crop and animal husbandry accrued to the household head. This figure will be different in other cultural settings or when migration is important (Negash and Niehof, 2004; Bryceson, 2002).

Crop and animal husbandry and supplementary activities were characterised by low levels of use of external inputs and limited technical innovation. Economic activities are highly versatile in that people adjusted activity scale and marketing arrangements according to the day-to-day situation. Marketing of output occurred by various mostly informal transactions with a mix of cash payments, credits and gifts.

The last section elaborates the implications of such a diverse context for research and development policies. The organisation of the present research recognises the need to analyse livelihood as a system consisting of interdependent elements, but also seeks to include sufficient detail on specific activities and livelihoods at the level of the individual and the household.

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[1] These figures are based on the assumption that indicated ownership of fields and animals implies that related income streams and value of production accrue to the owner. Assumptions with respect to intra-household income pooling are further discussed in Chapter 5.

2.1 Analysis of household and individual livelihoods

Livelihood is defined as the process of acquiring a living from different kinds of entitlements to multiple streams of benefits. Entitlement refers to the possibility to develop an economic activity or a claim that provides any direct benefit such as remittances or formal and informal allowances (Sen, 1992; Ellis, 2000). An activity is a particular use of a combination of various assets (Barrett *et al.*, 2001). In turn, an asset is defined as a component of the required capability to undertake an activity. This definition emphasises that assets comprise more than just physical capital such as land or livestock. Also other assets are recognised to be important for income generation, such as formal or informal education, a clientele, a traders' network, and goodwill. These assets are commonly labelled as social and human capital (Toulmin, 1992; Davies, 1996). A single asset is, in most cases, insufficient to develop economic activities. Assets function in relation to other assets.

In this study I analyse direct income streams as being the most visible result of livelihood (Ellis, 2000). Supplementary income is defined as the benefits from all activities other than own-farm crop and animal husbandry.[2] I rely on this expression instead of the commonly used labels of off-farm and non-farm activities. The label of off- and non-farm activities merges criteria derived from three general methods of economic classification (Barrett and Reardon, 2000). The first criterion is based on a traditional economic sector classification, namely that these activities concern secondary or tertiary activities such as processing of raw materials, artisan work, trade or services. The second criterion is based on the physical place of the activities namely outside the farmstead. This may be within the village but may also concern migratory revenues. The third criterion of classification relates to the entitlement to the benefits of the activity and distinguishes wage-labour from self-employment. Thus, off-farm and non-farm activities are all activities other than crop and animal production on the household farm, or in short: supplementary activities.

Individual involvement in supplementary activities takes place in the context of a village and household environment (Figure 1.1). The numbers in the figure refer to related research questions, as specified in Chapter 1. The short introductions below are elaborated in the subsequent chapters.

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[2] Livelihood diversification is interpreted from the perspective of an increasing share of supplementary income compared to household farm income.

Figure 2.1
Individual livelihoods in household and village context
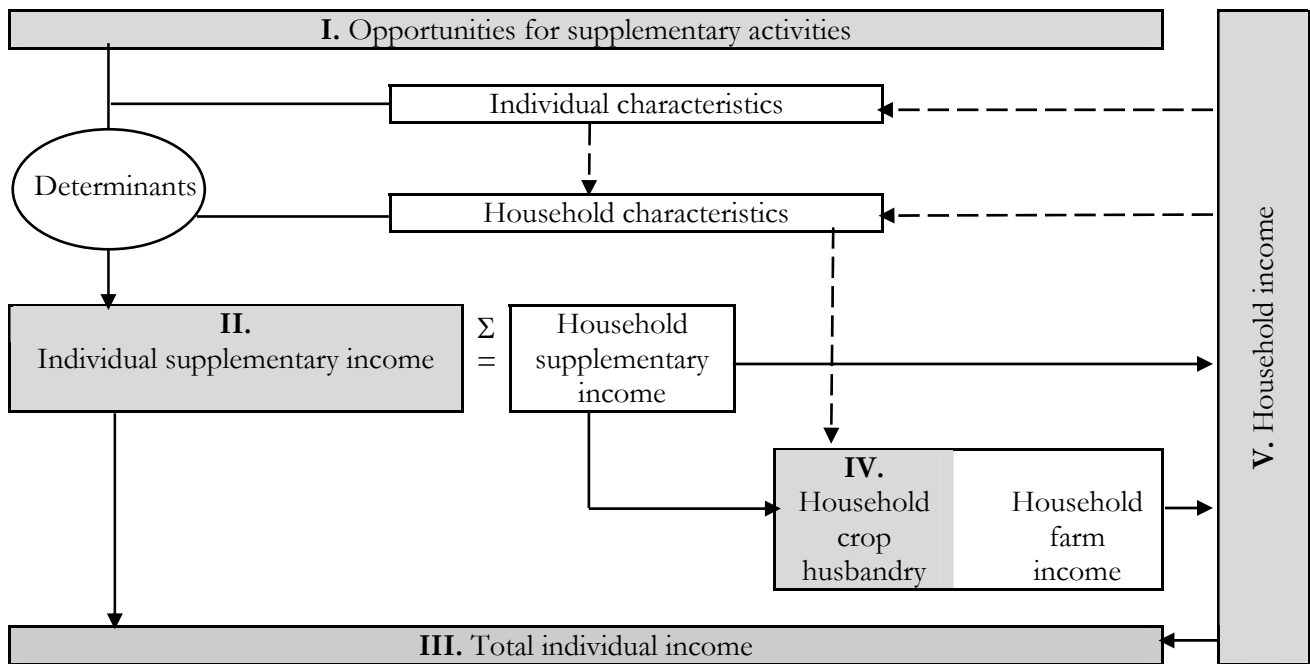
Notes: Bold arrows indicate a relationship between explanatory and dependent variables. Dotted lines point to recursive effects that are not a subject of this study.

First, involvement depends on actual opportunities for supplementary activities. Local opportunities determine, as exogenous factors, individual involvement in supplementary activities. A descriptive analysis of the nature and extent of supplementary activities should give insight into the problem of excess capacity for many supplementary activities. Opportunities for supplementary activities depend on present comparative advantage and on the dynamics of technological and institutional development.

Second, individual and household characteristics affect participation in supplementary activities. Some additional assumptions are required to interpret these determinants as exogenous factors. In contrast to farming, which is essentially a household endeavour, supplementary activities are mainly individual undertakings. Also when people work together in supplementary activities, it is common that costs are incurred by and benefits accrue to individuals. Individuals can generate personal income by supplementary activities without giving up household farm income. Conversely, I do not account for second-level effects between individual supplementary income, household expenditures, and farm husbandry.

Third, the individual nature of supplementary activities calls for a closer look at individual diversification behaviour. While the second research question concerns determinants of

individual involvement in supplementary activities, the third research question relates to individual diversification behaviour. Because diversification is commonly associated with risk behaviour, an assessment of attitude to risk has been made. Multiple measures of risk aversion provide insight into how personal differences shape individual livelihoods.

Fourth, household supplementary income may alter crop productivity, production efficiency and input demand. It is the aggregate household supplementary income rather than individual income that brings about this effect. Since aggregate household supplementary income is the result of a random composition of the household, it can be used as an independent variable to explain crop husbandry characteristics.

Fifth, aggregated household supplementary income is closely related to farm income due to labour and capital substitution effects. Therefore income decomposition relies on descriptive analyses and does not seek to identify causality relations between farm and supplementary income. The focus is on coherence between farm and supplementary income components, income distribution and poverty incidence.

The following sections provide a description of the research setting. It shows that livelihood is a matter of a household as well as an individual enterprise and it assesses technical and institutional features of prevalent economic activities.

2.2   The village environment

Agricultural resource endowment and infrastructure determined the choice of the villages for this research. We selected three villages with relatively favourable agricultural endowments and two villages with poor agricultural endowments. Within agricultural endowment zones accessible and isolated villages were selected (cf. map in Appendix 1.1).

Three villages are located at about 200 km south west of *Ouagadougou*, the capital of Burkina Faso in the *Province* des *Bale*.[3] These villages are characterised by relatively favourable conditions for crop and animal husbandry. The average annual rainfall in this zone is about 1100 mm and drought risks are relatively limited. Soil quality is reasonable and land availability is good compared to other regions in Burkina Faso.

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[3] These villages have participated in a research programme executed by International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in the early 80s (Reardon *et al.*, 1988, 1992; Savadogo *et al.*, 1994). Administratively there are two villages but one village consists of two markedly different wards. In one ward, households belonging to the ethnic group of the *Bwa* reside, in the other ward, families of the ethnic group of the *Dagari Dioula*. The latter were less involved in cotton production and much more in supplementary activities. Because of this noticeable difference the two wards are distinguished in further analyses.

Two villages (both are actually wards belonging to the village of *Koho*) in the southern zone are located at 5-7 km from the main road from *Ouagadougou* to *Bobo-Diallasso* and are serviced by frequent public transport connections to urban centres. Several regional markets are located at distances of 5-15 km. The villages are categorised as agriculturally resource-rich and accessible (RA1 and RA2). The other research village (*Sayero*) in the agriculturally resource-rich zone is located at about 25 km from the main road. Here also, regional markets are available at 5-15 km yet travelling time to these markets is longer compared to the situation in *Koho*. Land quality is similar to the village of *Koho* and land availability is slightly better. This village is categorised as agriculturally resource-rich and isolated (RI). In both villages herder families (from the ethnic group of the *Fulbe*) exploit the surrounding pastures, which have relatively favourable conditions in terms of space and fodder quality.[4]

The other two villages of research are located at a distance of 100 km north of *Ouagadougou* and about 20-25 km from *Kaya*, the capital of the *Province du Sanmentenga*.[5] Average annual rainfall is about 600 mm and there is, compared to the resource-rich villages, more variability of rainfall with respect to the onset of the rainy season, the occurrence and length of dry spells during the season, and total rainfall. Soils are of poor quality and the upland fields are heavily degraded. One village (*Sidogo*) in this zone is located at about 5 km from the main road from *Ouagadougou* to *Kaya*. There is an important regional market (*Korsimoro*) along this road, at a distance of 7 km from *Sidogo*. This village is characterised by a complete occupation of the arable land in the village area. There are no herder families resident in *Sidogo*. *Sidogo* is categorised as agriculturally resource-poor and accessible (PA). The other village (*Tagalla*) in the agriculturally resource-poor zone is at a distance of about 25 km from *Kaya*. It is accessible first via a relatively good non-asphalt road and then via 7 km of tracks and pathways. Land availability is better than in *Sidogo*, yet also in this village most of the land is occupied and soils are heavily degraded. There are some *Fulbe* herder families resident in this village. *Tagalla* is categorised as agriculturally resource-poor and isolated (PI).

Comparative advantage in agricultural resource endowment and infrastructure is illustrated in Figure 2.2. The axes in Figure 2.2 are not scaled because at this level there is no precise measurement of endowment or infrastructure. Current total household income, as observed in

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[4] Herder families were not included in the research sample; therefore no comparative conclusions can be drawn about the relative importance of animal husbandry by these families.

[5] These two villages were involved in a research programme that has been carried out by Wageningen University and the University of Ouagadougou in the 1990s (Stroosnijder and van Rheenen, 2001).

Figure 2.2

Position of research villages with respect to comparative advantages
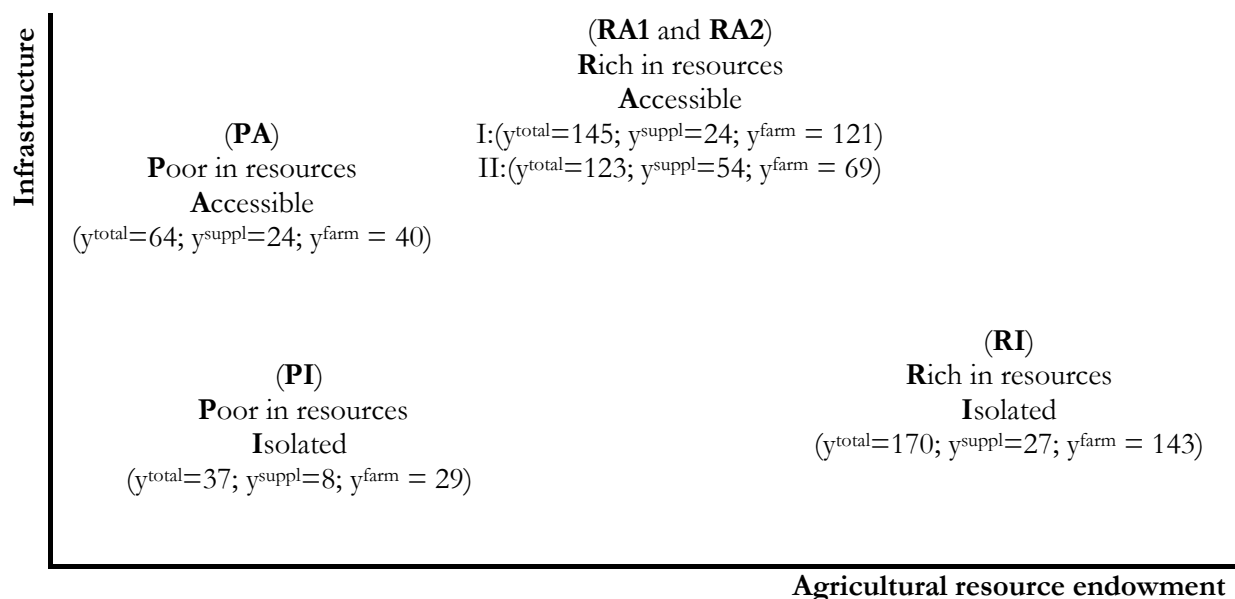
Note: The axes have no scale because comparative advantages cannot be precisely measured. Between brackets the annual total, supplementary, and farm income (y^{total}, y^{suppl}, and y^{farm}) per adult equivalent (FCFA 1,000) in the villages (average of two consecutive years, based on field data). From here on the respective village acronyms will be used in the tables: RA(1 and 2) = rich in resources, accessible; RI = rich in resources, isolated; PA = poor in resources, accessible; PI = poor in resources, isolated.

the research sample, serves as a proxy to position the villages in the graph of comparative advantage.

2.3   Household livelihoods

This section illustrates the differences between the five village economies with figures on household income composition and information on time allocation. In the resource-rich villages, in particular among cotton growers, total income was considerably higher compared to the resource-poor villages (Table 2.1). Crop revenues, constituting on average 63 percent of total income, differed considerably across the villages. Households in the *Dagari Dioula* ward in the resource-rich accessible (RA2) village compensated the lack of crop revenues by supplementary income. The resource-poor isolated village lagged behind in supplementary income. Livestock revenues were on the average almost equally important across villages, only the resource-poor isolated village lagged behind in this respect.

Table 2.1

Household income composition by village

Village	RA1 (n=17)			RA2 (n=20)			RI (n=31)			PA (n=30)			PI (n=23)			All (n=121)		
	avg	cv	med	avg	cv	med	avg	cv	med	avg	cv	med	avg	cv	med	avg	cv	med
Income (FCFA 1000 per adult equivalent) by income category																		
Total income	145	65	88	123	64	85	171	43	100	64	67	92	37	58	101	103	79	77
Total supplementary income	24	131	65	54	105	59	27	63	93	25	143	54	8	155	46	28	135	64
Crop income	106	62	95	54	37	92	126	46	97	27	57	77	22	55	93	62	91	69
Livestock income	14	135	24	14	108	52	17	83	90	12	121	39	7	99	78	13	113	54
Supplementary income by gender (FCFA 1000 per adult equivalent) by income category																		
Women	12	81	70	18	60	100	13	83	70	6	117	52	3	127	62	10	101	68
Men	12	228	28	36	148	51	14	128	47	18	181	39	5	239	22	17	194	30
Livestock income details (FCFA 1000 per adult equivalent) by income category																		
Net sales + herd growth	11	148	21	1	>>	52	12	93	76	7	178	23	4	171	35	7	228	42
Cash flow	2	>>	0	3	394	18	-2	-549	0	10	139	56	3	116	72	4	325	34
Percentage of total net revenues by income category (total = 100)																		
Total supplementary income		14			46			15			37			22			25	
women / men		7 / 7			14 / 32			9 / 6			8 / 29			8 / 14			9 / 16	
Crop income		78			43			75			47			61			63	
Livestock income		8			12			10			15			16			11	
Percentage of net crop revenues by crop (total = 100)																		
Sorghum		15			38			19			46			82			27	
Millet		6			12			4			48			16			9	
Maize		4			26			8			1			2			10	
Cotton		69			11			65			np			np			48	
Other crops		6			13			3			5			0			6	

Notes: Income concerns the average income obtained in 2000 and 2001. It is estimated as gross revenue minus costs for inputs and external labour. Figures are rounded at zero decimals. Abbreviations: avg = average; cv = coefficient of variation (>> indicates a cv of > 999%); med = median as a % of average.

For the entire sample, supplementary income constituted slightly more than a quarter of total income. In both accessible villages, supplementary activities generated 46 and 37 percent of total income, respectively, in the resource-rich and resource-poor village. About two thirds of this income accrued to men.

The *Bwa* households in the resource-rich villages (RA1 and RI) obtained almost two third of their net crop revenues from cotton cultivation. In contrast, the *Dagari Dioula* households in the resource-rich accessible village obtained only 11 percent of the crop revenues from cotton cultivation. In response to good cotton yields and high prices in 2000, in the second year the cotton share was higher (about 20 percent) in the latter village. Instead of cultivating cotton, the *Dagari Dioula* households cultivated maize and sorghum. Maize and cotton cultivation provided similar returns to labour. The resource-poor villages differed with respect to the share of millet in total net crop revenues. In the accessible village, where the land constraint is more present, the share of millet was thrice the share in the isolated village. Revenues from other minor crops such as beans, sesame, and local vegetables were probably underreported. Interviews revealed that these crops plus crop residues such as cereal bran might add 5-10 percent to total crop income.

Animal husbandry is generally characterised by low input levels and highly variable revenues. Additionally, animal losses due to death, theft or disappearance were frequently mentioned during the survey. The conditions underlying these events are subject to a high degree of randomness and therefore not included in this survey.

Because livestock revenues are subject to large variability, we use potential income from animal husbandry in the analyses.[1] Potential income is calculated as the change in herd value plus net sales plus the value of animal losses minus expenditures. The ratio actual - potential revenue provides information about livestock productivity rates. Livestock-related net cash flow provides information on short-term income strategies. Take-off rates, the ratio of net sales to herd value, vary from one year to another because of varying investment and cash requirements for other economic activities.

Realised revenues were in both years noticeably lower than potential revenues. The average value of total livestock per household in the resource-rich villages was about twice the herd value of the households in the resource-poor isolated village. A small number of animals were

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[1] This includes both animals in own management and those entrusted to others. Animal prices are considered to be the same in both zones and are based upon recorded animal sales during the survey period.

entrusted to other households. In these cases I assume that herd take-off provides income to the owner while products (milk and manure) provide income to the herder.[2]

Compared to the resource-rich villages, people in the resource-poor villages worked more hours per week in farm and in supplementary activities (Table 2.2). The heavy farm workload is because the agricultural season is about three months shorter in the resource-poor zone. During the dry season people worked longer in order to compensate for the relatively low returns to labour. For example, in the resource-poor isolated village, many men, women and children worked long days, often from 7[am] to 7[pm] in the near-by gold mines.

With an average of 23 hours per week, by far most of the labour time was allocated to supplementary activities during the dry season. During the wet season men allocated about 3 hours per week and women about 6 hours per week to supplementary activities. Supplementary activities were complementary to agriculture in most cases. In the resource-rich isolated village men allocated less time to supplementary activities during the dry season compared to the other villages. Better resource endowment combined with a weak infrastructure reduced the need and willingness to engage in supplementary activities. This seems to be more valid for men than for women. The relatively large involvement in supplementary activities by men in the resource-rich accessible village (RA2) can be explained by a diversity of relatively good opportunities.

Table 2.2
Labour time by type of activities, agricultural season, gender, and village

Village			Supplementary activities						Farm activities					
			RA1	RA2	RI	PA	PI	All	RA1	RA2	RI	PA	PI	All
n	men		32	67	66	71	64	300	32	67	66	71	64	300
n	women		44	74	91	114	90	413	44	74	91	114	90	413
Dry season (hours per week)														
Men	avg		12	38	8	24	27	23	9	3	3	6	0	4
	se		4	3	2	3	3	2	3	2	1	2	0	1
Women	avg		5	22	18	30	36	24	1	0	0	5	0	2
	se		1	3	2	3	3	1	1	0	0	2	0	0
Wet season (hours per week)														
Men	avg		1	5	2	3	2	3	36	36	45	51	48	44
	se		1	2	1	1	1	1	4	2	2	2	3	1
Women	avg		5	9	7	2	5	6	42	17	26	46	37	34
	se		1	1	1	1	1	1	4	2	2	2	2	1

Notes: The data concern an estimation of the situation in the first year of research (2000). Respondents were asked about the rhythm of their economic activities (days, weeks, and seasons). Based on this information activity involvement is estimated in hrs per week. Abbreviations: avg = average; se = standard error of mean.

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[2] An owner who entrusts animals to others usually also takes care of most of the expenditures for veterinary care and feed. In some cases the herder receives additional payment in the form of offspring, gifts or cash. To simplify the interviews not all transaction details were asked for.

2.4 Individual livelihoods

An African household constitutes a highly diverse farm organisation. The households in our sample consisted of 1 to 40 persons, no two households in the sample had a similar composition and individuals had different positions, interests and capabilities. The scope of this research is limited to only three statuses within the household, namely the household head, dependent or subordinate male members, and female members.

Almost 60 percent of the men and 90 percent of the women generated income by supplementary activities. The majority combined supplementary activities with crop or animal husbandry (Table 2.3). About 30-40 percent of both men and women were involved in animal husbandry. Very few persons other than the head acquired livestock revenues of more than FCFA 7,500 per year (about Euro 10-15). Women frequently combined supplementary activities with animal husbandry. For example, pigs were fed with residues from beer brewing.

The largest share (70 percent) of total income accrued to the head of the household. For both crop as well as livestock revenues the head of the household received more than ten times the revenues of other members. Other men and women shared on average 30 percent of total income, equally shared between genders.

Over the entire sample, 27 percent of total income was generated by supplementary activities. For both men and women, other than the head of the household, respectively 74 and 68 percent of total individual income came from supplementary activities. These figures illustrate that supplementary activities fitted into individual strategies to become more independent of one's household.

Dependent men composed the group with on the average the youngest respondents while conversely the household heads were the eldest on average. Dependent men had received most education. A few young men had obtained 7 or more years of education. Yet, the majority of respondents had received less than 3 years of education. Men had on the average fewer children because the sample encompassed more unmarried men than women.

Farm income opportunities are represented by crop labour productivity and livestock return rates. Women achieved importantly lower crop labour productivity than men while livestock return rates were similar across individual position. Only a few dependent men and women used external labour for their primary production activities (Table 2.3).

Table 2.3

Activity combinations by position in household

	Head (n=121)	Other men (n=190)	Women (n=422)	All (n=733)
Individual income (FCFA 1000 per year)				
Total income (% with individual income)	398 (100)	55 (59)	24 (88)	94 (83)
Total income if income > 0 (cv)	398 (105)	93 (181)	27 (115)	114 (218)
Portfolio combinations (%)				
Supplementary income only	1	24	38	28
+ livestock + crop	62	11	14	21
+ livestock	6	3	23	15
+ crop	0	3	7	5
Crop only	0	1	1	1
Livestock only	1	16	3	6
Crop and livestock only	31	2	1	6
No economic activities	0	41	12	17
	Σ= 100	Σ= 100	Σ= 100	Σ= 100
Individual income shares (%)				
Crop	75	20	29	60
Livestock	16	6	3	13
Supplementary	9	74	68	27
	Σ= 100	Σ= 100	Σ= 100	Σ= 100
Percentage of sector income accruing to				
Total	70	15	15	Σ= 100
Crop	88	5	7	Σ= 100
Livestock	89	6	4	Σ= 100
Supplementary	22	41	37	Σ= 100

Other individual characteristics	avg	cv	avg	cv	avg	cv	avg	cv
Age in years	51	25	28	46	37	43	37	43
Years of education	0.9	200	1.6	163	0.4	350	0.8	238
Number of spouses	1.9	53	0.5	140	1.7	82	1.4	93
Children <7 years	2.5	84	0.8	213	1.1	109	1.2	142
Children 7- 15 years	2	95	0.2	400	0.7	157	0.8	163
Crop labour productivity [1]	131	61	199	90	51	106	129	71
Livestock productivity [2]	67	51	57	40	58	71	66	52
% external labour	11	136	2	450	3	300	4	275

Notes: Income estimates concern the average income obtained in 2000 and 2001. [1] average field productivity (net margin) in FCA per hour (one year); [2] average of ratio realised income / potential income (one year). Abbreviations: avg = average; cv = coefficient of variation.

2.5 The crop income base

Four crops constituted the largest share of the cultivated area, namely sorghum, millet, maize, and cotton. On average the *Bwa* households in the resource-rich isolated village (RI) and in one resource-rich accessible village (RA1) cultivated the largest acreage: respectively 1.56 and 1.80 ha per adult equivalent. In the other villages, households cultivated less then 1 ha per adult equivalent. Land distribution was most unequal among the cotton growers in the resource-rich villages. The households least endowed with land (lowest 10 percentile) cultivated less than 30 percent of the average. The best land-endowed families (highest 10 percentile) cultivated more than 170 percent of the average. In the other villages land ownership was more equally distributed.

Production technologies were characterised by low technological levels and limited technical innovation. Cost output ratios provide insight into the production structure (Table 2.4). Variable expenditures (fertiliser, insecticides, and hired labour) summed up to less than 5 percent of the gross margin (gross revenues minus variable expenditures) in the resource-poor villages and about 25 percent in the resource-rich villages. The costs of animal traction, family

Table 2.4

Crop husbandry in average figures at household level by village

Village	RA1 (n=17)		RA2 (n=20)		RI (n=31)		PI (n=30)		PR (n=23)	
	avg	cv	avg	cv	avg	cv	avg	cv	avg	cv
Expenditures FCFA per FCFA 100 gross revenue output										
Fertiliser	18	222	4	200	13	162	4	250	1	>>
Insecticides	7	100	0		6	200	0		0	
External inputs	25	172	4	225	20	155	4	250	1	>>
External labour	6	117	2	300	5	180	0		0	
Variable expenditures	30	150	6	183	24	154	4	250	1	>>
Animal drawn equipment	2	250	1	200	3	100	2	150	1	200
Family labour (estimates)	18	172	13	154	14	229	66	88	90	100
Variable costs	50	142	20	130	42	155	72	83	92	100
Land (estimates)	38	166	31	106	37	119	25	72	32	100
Total costs	88	144	50	110	79	130	97	76	124	90
Other production factors										
Cultivated area (0.01 ha per adult equivalent)	156	43	82	37	180	42	84	42	96	39
Land use (sq. m. per FCFA 1,000 net margin)	153	165	124	106	148	119	254	72	316	102
Sorghum yield equivalent (kg / ha)	817		1008		845		492		396	
Labour use (hrs per FCFA 1,000 net margin)	9	156	6	150	8	200	26	88	36	100
Income equivalent (FCFA per day)	889		1008		845		492		396	
Organic matter (local units per FCFA output)	23	300	20	535	26	315	48	221	38	389

Notes: Data concern first year of research. Abbreviations: avg = average; cv = coefficient of variance (with >> indicating larger than 999%).

Table 2.5

Diversity of crop management and field characteristics

	Resource-rich					Resource-poor			
	Sorghum (n=167)	Millet (n=67)	Maize (n=87)	Cotton (n=112)	All (n=442)	Sorghum (n=196)	Millet (n=88)	Maize (n=33)	All (n=317)
Percentage of observations with									
Chemical fertiliser	9	2	51	97	47	7	21	0	12
Organic matter	5	7	19	29	16	27	29	100	29
Animal traction	66	59	76	90	75	35	46	0	38
Insecticides	0	0	0	98	39	0	0	0	0
Soil preparation	27	13	45	78	47	44	56	40	48
Weeding	96	98	94	96	96	100	100	100	100
Ridging	70	67	79	81	75	3	4	0	3
Loamy soil	4	11	3	9	7	64	27	0	50
Sandy soil	92	85	88	88	89	28	63	20	40
Gravel soil	0	0	0	0	0	8	10	80	10
Other soil	4	4	9	2	4	0	0	0	0
Basin	n.a.	n.a.	n.a.	n.a.	n.a.	16	10	0	14
Slope	n.a.	n.a.	n.a.	n.a.	n.a.	78	85	100	80
Upper plateau	n.a.	n.a.	n.a.	n.a.	n.a.	6	6	0	6
Percentage of cultivated area with									
Chemical fertiliser	6	1	44	82	32	7	15	0	8
Organic matter	4	7	25	19	12	28	22	85	32
Animal traction	48	39	56	65	53	25	34	18	27
Insecticides	0	0	0	92	23	0	0	0	0
soil preparation	20	16	33	48	29	35	47	83	43
Weeding	94	97	90	91	93	100	100	100	100
Ridging	57	53	73	75	64	2	4	0	3
Loamy soil	4	9	3	6	5	55	26	0	42
Sandy soil	87	84	87	85	86	31	61	25	38
Gravel soil	0	0	0	0	0	14	13	75	19
Other soil	8	7	10	9	9	0	0	0	0
Basin	n.a.	n.a.	n.a.	n.a.	n.a.	15	8	0	12
Slope	n.a.	n.a.	n.a.	n.a.	n.a.	82	83	100	84
Upper plateau	n.a.	n.a.	n.a.	n.a.	n.a.	3	8	0	4

Notes: data concern first year of research. n.a. is not available

labour and land are unsophisticated estimates and differed by zone for methodological reasons.[3]

Except for cotton and maize cultivation in the agriculturally resource-rich zone, the use of external inputs was limited to about 7-15 percent of the cultivated area (Table 2.5). The use of organic matter, commonly produced on the own farm, was more important. In the resource-poor villages, one third of the cultivated area, mainly maize fields, received organic matter while in the resource-rich villages organic matter was applied to only 12 percent of the cultivated area. Insecticides were used almost exclusively in cotton cultivation. Soil preparation before sowing was done on half of the fields. In the resource-poor villages this share was about equal across crops while in the resource-rich villages soil preparation efforts were allocated mainly to the cotton fields. Virtually all fields were weeded at least once and mostly twice or thrice. In contrast, ridging, usually combined with weeding, was only done in the resource-rich villages. Heterogeneity of soil type was much larger in the resource-poor compared to the resource-rich villages.

2.6   The supplementary income base

Average annual individual supplementary revenue was about FCFA 27,000 for the entire sample. All respondents included, the average income of men was about twice the income of women (Table 2.6). For those involved in supplementary activities men obtained more than thrice the revenue of women. The proportion of respondents involved in supplementary activities is in line with findings in similar regions: 52 percent of the men and 82 percent of the women had at least one supplementary income source. The resource-poor isolated village lagged behind in supplementary revenues for men and women. The resource-poor accessible village stood out especially because women obtained a much lower income than men did.

The survey yielded more than 50 different supplementary activities (Appendix 2.1). The following subsections describe the activities by categories of primary production, processing, and artisan work and trade. First, the use of primary raw materials and the near-absence of any kind of transformation define the primary sector activities. The second category of

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[3] For data on labour input, a one-season recall survey in the north and a two-weekly visit survey in the south were carried out. For the resource-rich village labour input was expressed in hours while for the resource-poor villages per-day estimates were used. Since both estimates are prone to an important lack of precision, the answers should be interpreted as proxies for actual labour input. Therefore, labour input cannot be compared between both zones and, if relevant, in the analysis standardised values for labour input (percentage of the zone specific average) were used. For land costs, an estimate of FCFA 10,000 per ha is taken for the resource-poor villages and FCFA 25,000 for the resource-rich villages.

Table 2.6

Total individual supplementary income by village

	Men						Women					
Village	RA1	RA2	RI	PA	PI	All	RA1	RA2	RI	PA	PI	All
Total supplementary income entire sample (FCFA 1,000 per year)												
n	35	73	67	71	65	311	47	77	92	115	91	422
avg	26	68	31	43	11	38	20	32	21	9	5	16
se	18	21	11	13	5	7	3	4	2	2	1	1
If supplementary income > 0 (FCFA 1,000 per year)												
n	20	44	33	43	21	63	40	62	85	98	63	348
avg	45	112	62	72	35	73	24	40	22	11	7	20
se	31	33	22	20	14	12	4	5	2	2	1	1
In percentage of all respondents by income class (FCFA 1000 per year)												
none	43	40	51	39	68	48	15	19	8	15	31	18
<-2.5				3		1				5	1	2
-2.5-2.5	9	1	7	6	6	5	2	4	9	26	18	14
2.5-15	26	11	16	13	11	14	38	10	39	31	41	32
15-30	14	14	6	13	9	11	15	26	15	5	5	12
30-45	6	10	7	8	2	7	26	9	18	15	4	14
45-65		3	1	1	2	2	2	26	5	2		7
65-100		4	4	7		4		3	5	1		2
>100	3	18	6	10	3	9	2	3				1

Notes: The data concern the average of two years. Abbreviations: avg = average; se = standard error of mean.

supplementary income sources consists of processing activities and includes the activities that generate added value to primary products by transformation. The third category, artisan work and trade of food and non-food products, is in fact too diverse to be labelled as a single category. This category includes the generally better remunerative activities that rely on skill, networking, and to some extent on capital ownership.

Primary sector supplementary activities

Regarding the number of people involved, the first activity in the primary sector was gold mining. Gold mining was a dry-season activity observed virtually only in the resource-poor isolated village. In this village it was by far the most dominant activity during the dry season. Almost 50 percent of the adults in the resource-poor isolated village and a few persons from the resource-poor accessible village were involved in it. In addition, many children usually accompanied their parents to the mines. More than twice as many women as men were involved in gold mining, yet women generated only about 50 percent of the total revenues from gold digging. For women this activity can be regarded as a poverty refuge activity because less

than 15 percent of the sample obtained more than FCFA 15,000 per year. A minority of 8 persons, 6 men and 2 women, obtained an annual revenue larger than FCFA 30,000 per year.

The possibility of gaining a relatively large sum was probably the reason that quite a number of people still remained involved in this activity. Gold mining was an activity that was prone to high physical risks, unhealthy working conditions and large variability of income streams within the season as well as between seasons. For example, in 2002, the importance of gold mining diminished considerably because of severe personal accidents in the previous year. Those who had worked in the gold mines in early 2002 had very low revenues.

In terms of total revenues, the second category of primary sector activities concerned various activities such as hunting, fishing, gathering activities, hire of oxen by men, and farm wage-labour by women. These activities were only observed in the agriculturally resource-rich villages. There were no important differences between both resource-rich villages. Only 14 men (about 5-10 percent of the respondents) were involved in any of these activities. Less than 4 persons obtained revenues larger than FCFA 15,000 per year. Gathering of endogenous medicines and hiring of oxen were relatively more remunerative than other primary sector activities. Also, important income was generated by hunting, apiculture and fishing. Most of these activities were highly prone to the chance of the day and it was therefore not possible to obtain precise productivity estimations.

The third primary sector activity was horticulture.[4] A considerable potential for horticulture existed in both villages with good infrastructure, while there was a limited potential in both isolated villages. About 4 percent of the respondents (29 persons; 23 men and 6 women) were involved in horticulture. The total net revenues were only in 6 cases larger than FCFA 30,000 per year and in 5 cases (2 men and 3 women) the losses were larger than FCFA 2,500 per year. Large losses as well as profits occurred more often in the resource-poor village than they do in the resource-rich villages.

The resource-poor accessible village has two areas with irrigated horticulture. There is a small basin in which during the rainy season water is collected that can be used to grow various vegetables in the course of the dry season. By digging some shallow wells, growers extended the period for growing vegetables. In addition, some respondents cultivated vegetables in a large watershed at a distance of about 10 km from the village. Groups applied irrigation by using motor pumps. In the latter watershed farmers grew almost exclusively onions.

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[4] We consider horticulture a supplementary activity because relatively few persons were involved in this activity and crop husbandry was considerably different from the management of traditional crops such as millet, sorghum, maize, and cotton.

In the resource-rich accessible village, farmers grew vegetables on small plots (200-1000 square metres) along a small river. Only one farmer in the village, who was not included in the sample, possessed a motor pump, the others dug shallow wells (2-3 m depth) and watered the crop with baskets. A wide variety of crops including tomato, cabbage, tobacco, onions, celery, and sweet potato was grown. During the rainy season these plots were used to grow early maturing maize. The horticultural activities continued until the onset of the rainy season but diminished in the course of the dry season.

In the isolated villages, resource-poor as well as resource-rich, the potential for horticulture was much smaller. Only a few small horticultural plots were located at a considerable distance from the village.

Processing and food preparation

Processing activities included, in order of importance across the research villages, brewing of sorghum beer, production of various intermediate products and sheanut butter, preparation of various food and non-food products, and cotton spinning. Distilling spirits, and producing bricks, charcoal and ammunition were typical activities for men (21 men in our sample).

Women were involved in processing of food and non-food products. Among women we observed a rather similar pattern of scale of activity across the different activities. About 75 percent of the women generated annual revenues of less than FCFA 15,000 by these activities. In particular in the agriculturally resource-poor villages the activities of women took place on a limited scale.

Men participated in activities such as milling, distilling spirits, butchering, and brick making. Only the activities of milling and distilling spirits had been expanded to relatively large-scale activities. These two activities generated important revenues to a few men. Butchering was done irregularly depending on season, special occasions, and availability of slaughter animals. Brick-making was a dry-season activity, done irregularly and on a small scale by a few men.

Turning to the processing activities by women, the preparation of food products (various snacks and drinks) was most frequently observed. The activities concerned small daily turnover rates and were done on a highly regular basis (*e.g.* daily or following the rhythm of market days). Beer brewing involved a larger volume that was produced at once and sold within a few days. It was done in a less regular rhythm ranging from once every 10 days to only once or twice a season. A few women continued brewing beer during the wet season, and Islamic women were not involved in brewing beer. Only a few women significantly expanded preparation and sale of snacks in what could be considered as a small bar or restaurant.

Non-food processing had a similar nature as food preparation except for the fact that the produce was non-perishable, which made the producer more flexible in production and marketing. Sheanut processing included the tasks of collecting, processing and selling. Most women were usually involved in each task. Women collected as well as bought sheanuts for processing, and sold the butter themselves or through intermediaries. Collaboration and transactions between women were usually informally organised (taking turns) or dealt with by monetary transactions (the butter was sold in bulk to be retailed by others).

Cotton spinning generated small revenues and could be considered to be an activity done for lack of other opportunities, to escape from poverty, or motivated by tradition. Some women involved in cotton spinning combined it with contracting men for weaving and dyeing cotton.

Trade and artisan work

The most remunerative examples of trade by men were the exploitation of a retail shop, and trade in livestock and cereals. The most remunerative examples of trade by women were commerce in groundnut, rice and dried fish. Trade activities generated 27 percent of the total supplementary revenues, yet the number of persons benefiting from this activity was limited.

Only 11 men were involved in trade in non-food products, among whom 7 persons had annual revenues of more than FCFA 65,000. In the resource-rich accessible village non-food trade stood out, yet this income accrued to only five men, namely two owners of a retail shop, two traders in over-cloths and blankets, and one commercial vendor of various products.

Trade in food-products showed greater diversity. Although there were slightly more women involved in trading food, on the average women generated only 13 percent of the net revenues by trading. Annual revenues accruing to men were mostly larger than FCFA 30,000 while only a few female traders obtained more than FCFA 15,000 per year. In the isolated resource-poor village the food trade revenues accrued to a single trader.

Artisan work consisted of activities typically carried out by men. Remunerative activities were carpentry, bricklaying, and the exploitation of repair shops. Less remunerative activities were cotton weaving and the making of ropes, basket, and mats. Related revenues were relatively larger in the resource-poor accessible village. In this village, cotton weaving and dyeing during the dry season was an economic activity that was characterised by regular work against a stable (but low) income.

2.6   Research perspectives on rural livelihoods

Farm and supplementary activities both contribute to household and individual livelihoods. Therefore both types of activities should be analysed in relation to each other. This is a common approach in numerous studies that focus on understanding livelihood strategies.

Studies on households, entrepreneurs and villages have yielded insight in the functioning of different categories of assets in local livelihoods (DFID, 2001; Meinzen-Dick *et al.*, 2003; Ellis and Mdoe, 2003; Tellegen, 1997; Scott, 1995). Analysis of broader surveys across regions and countries has led to identification of determinants and effects of rural diversification by engaging in farm and non-farm sectors (Reardon *et al.*, 2001; Reardon, 1997; Ruben and van den Berg, 2001; de Janvry and Sadoulet, 2001). Quantitative studies seek to comprehensively analyse rural livelihoods by integration of economic and physical elements in village modelling (Taylor *et al.*, 1996) and household modelling (Holden *et al.*, 2004; Gladwin *et al.*, 2001; Haddad *et al.*, 1997).

The before-mentioned studies pay limited attention to role of household livelihood diversification in long-term transition processes of "de-agrarisation" (Bryceson, 1996). For example, the advantages of opportunities for occupational specialisation besides diversification should also be considered (Bryceson, 2002). Relatively few studies assess the actual economic potential in developing supplementary activities (examples include (Tellegen, 1997; Scott, 1995; and Chalfin, 2000)). The dearth of the latter type of studies shows that non-farm economic sectors in less-favoured areas attract limited public research investments. In Chapter 1 we similarly noted lack of investment interests from the side of private sectors (Oskam *et al.*, 2004).

Analysis of transition processes, such as de-agrarisation, would facilitate the formulation future-oriented rural policies. However, before entering in diachronic analysis of livelihood transitions, one could ask whether existing farm supplementary activities contain sufficient economic potential. Supplementary activities were essentially individual activities with a weak institutional and technological base. Farming activities were also characterised by a low technical level. Further analysis of the income distribution cannot be much more precise than the diffuse nature of the underlying economic activities.

The organisation of this study recognises the need to analyse livelihood as a system consisting of interdependent elements, but also seeks to include sufficient detail to assess economic viability of supplementary activities. Therefore, we first analyse, at individual level, opportunities for and access to economic activities (Chapters 3 and 4), then review implications for individual livelihoods and diversification (Chapter 5), and finally consider household agricultural resources and income composition (Chapter 6 and 7).

Chapter 3

The economic base of farm supplementary activities

This chapter assesses the type of local economic base provided by supplementary activities. An economic base is defined as "core economic activities that specifically locate or are historically present in a region and exploit a natural comparative advantage" (Haggblade *et al.*, 2002).

   Empirical evidence leads to ambiguous conclusions regarding the role of supplementary activities in constituting an economic base. On the one hand, supplementary activities seem to contain an economic potential. Livelihood studies repeatedly result in policy recommendations to improve the physical and institutional infrastructure that can facilitate growth of the non-farm sector (Ellis and Mdoe, 2003; de Janvry and Sadoulet, 2001; Barrett *et al.*, 2001; Barrett and Reardon, 2000). On the other hand, these and other studies conclude that, despite their importance, supplementary activities are carried out under conditions of excess capacity. Excess capacity occurs when available means of production are abundant and have the potential to generate a supply of goods largely exceeding demand. As a result, the non-farm sector has provided thus far only limited additional growth to the local economy in rural Sub-Saharan Africa (Delgado *et al.*, 1998; Haggblade *et al.*, 1989; Lanjouw and Lanjouw, 2001; Lanjouw, 2001).

   The structure of this chapter is as follows. First, I define the concept of comparative advantage and assess the role of institutions and technology. Second, I elaborate a qualitative assessment of critical success factors for developing farm supplementary activities. Third, I use fieldwork results to analyse typical examples of supplementary activities in the villages of this study.

   The results show that the potential benefits of diversification were smaller than commonly assumed. Prevailing supplementary activities were mostly linked to output of primary sector activities and had a limited growth potential. The local supplementary economy thus far has contributed little to structural transformation towards a non-agricultural economic base. Promoting diversification based on prevailing supplementary activities does not seem to offer a local economically feasible income alternative.

3.1 Exploiting comparative advantage by institutions and technology

To assess the nature of the non-farm economic base we focus on supply characteristics of supplementary activities without paying attention to demand characteristics. Supply characteristics of supplementary activities refer to the nature and size of supplementary activities (de Janvry and Sadoulet, 2001). As in other studies, the description of supply characteristics is based on an assessment of existing economic activities in village economies. Demand characteristics, on the other hand, refer to features of those who are actually engaged in supplementary activities.

Supplementary as well as farm activities are actually important when they allow individuals and households to exploit comparative advantage with respect to producing, transporting and selling goods and services (Haggblade *et al.*, 2002). Comparative advantage is determined by resources, access to markets, and population density (Pender *et al.*, 1999). Concisely formulated there are two core resources, namely man-made and resource capital (Pender, 1998). Man-made capital refers to the physical infrastructure, which reduces transaction and transportation costs.[1] Resource capital consists of the availability of raw materials or specific climatic conditions that create a favourable revenue-cost ratio in production processes. Infrastructure and resource endowments are to a certain extent substitutable factors in constituting comparative advantage. Better resource endowment is commonly accompanied by better provision of man-made capital (Binswanger *et al.*, 1993).

Processes of specialisation and innovation are required to translate comparative advantage into economic growth and the development of an economic base. Specialisation and innovation are supported through institutional and technological progress (Verschoor, 2000; Pender, 1998; Dorward and *et al.*, 2003). Improvement of institutions brings about a reduction of transaction costs due to better information, regulation, and organisation, thus creating economic opportunities for specialisation and innovation. Improvement of technology implies higher returns to production factors due to changes in production processes, either by organisation (specialisation) or by technical changes (innovation). Production processes thus depend simultaneously on institutional and technical development (Dorward *et al.*, 1998).

Frequently, livelihood studies state that better comparative advantage (infrastructure and resource endowment) brings about a larger economic base of supplementary economic activities (Reardon *et al.*, 2000). The role of institutional and technological processes as a link between comparative advantage and economic activities, however, is often ignored (Dorward *et*

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[1] Man-made capital is interpreted relative to population density and refers to public comparative advantage such as roads, communication, education, and health.

al., 2001; Ellis and Mdoe, 2003). Institutional and technological improvements are linked and can be perceived in a sequential and iterative perspective (Dorward and *et al.*, 2003). To be able to fully assess the economic potential of supplementary activities it is necessary to focus on the entire chain of specific sub-sectors and related markets for products, production factors, and finance (Haggblade *et al.*, 2002). Since this is beyond the scope of this research, we use a descriptive analysis of institutions and technology.

The single most important institution in an economy is the market, which is defined as the entire configuration of transactions between individuals (de Janvry *et al.*, 1995; Ensminger, 1992).[2] The definition of a market includes all formal and informal transaction rules summarised as market institutions and exchange mechanisms (North, 1990; Thorbecke, 1993). In developing countries, markets are characterised by many imperfections with respect to price formation and information symmetry. These imperfections provoke high transaction costs additional to production and transportation costs. Transaction costs further increase due to linkages between markets for products, labour, land, finance and inputs (Fafchamps, 1995). Markets are considered to be missing when it is virtually impossible to observe a market price. In such a case, multiple behavioural determinants affect market relations (Binswanger and McIntire, 1987). In line with the market definition above, markets are actually not missing but largely shaped by institutional arrangements other than plain buying and selling practices.

A concise measure for the technological level of economic activities is labour productivity. There are ample analyses that point to expertise (experience, skills, education, and health) and investment levels as the main labour productivity determinants (Tellegen, 1997; Yunez Naude and Taylor, 2001; Berdegué *et al.*, 2001). Although the above studies relate factor productivity with expertise and investment level, they provide no information on underlying technological factors that could explain increased factor productivity. Therefore, this study assesses supplementary activities on their potential to add value to expertise and investment. In addition, it evaluates how supplementary activities interact with farming activities, in particular with respect to labour allocation.

3.2 Supplementary activities in rural livelihoods

Descriptive livelihood studies provide details on management of supplementary activities mostly in the form of household case studies or aggregate village level descriptions (respectively (Tellegen, 1997) and (Ellis, 2000b)). More analytical studies commonly seek to explain the

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[2] Apart from this definition of a market, the same term is also used to assess quantities of supply and demand of consumption goods and production factors.

aggregate income from supplementary activities and pay less attention to activity-specific technologies and institutions (Reardon, 1997). These studies do not provide a detailed analysis of institutions and technology. Instead, they refer to the rather general comparative advantage of infrastructure and resource endowment as being the main driving force of the development of the non-farm sectors. The actual institutional and technological processes that facilitate exploitation of existing comparative advantage receive less attention (Dorward and *et al.*, 2003).

Institutions and markets

Theoretical and empirical studies describe institutions as typically observed in developing countries. The petty scale of most activities and the use of local inputs generally explain the absence of formal exchange arrangements (Tellegen, 1997). In addition, networks of family and non-family relations usually arrange linkages informally between markets for labour, land, inputs, products, and finance (Woldehanna, 2000). These features shape what has been called "the moral economy", "the economy of affection", (Scott, 1976; Hyden, 1981) or "the cultural economy" (Mazzucato and Niemeijer, 2000). This theoretical concept, however, gives limited insight into the causes of persistent poverty in economies such as those observed in the villages of this research.

An important element of institutions in developing countries is the functioning of the labour market. Wage labour, either paid in kind or cash, is virtually absent in the region of this study (Wouterse and van den Berg, 2004; Reardon, 1997; Haggblade *et al.*, 2002). Absence of formal wage labour in the non-farm sector is due to the near-absence of small and medium enterprises (Haggblade *et al.*, 1989). The few existing small-scale enterprises commonly employ relatives through informal contracts or on an *ad hoc* basis (Woldehanna, 2000; Tellegen, 1997).

Farm wage labour, if available, is generally considered as one of the lowest remunerative supplementary activities, but it constitutes an important way to escape from poverty and to reduce household income risks (van den Berg, 2001). Farm wage labour may also typically take the form of mutual help or is informally arranged with in-kind payment (Mazzucato and Niemeijer, 2000). Absence of wage labour in the farm sector is due to the fact that most households possess their own land, or can borrow land from other households where this is necessary to generate a minimum subsistence income (Binswanger and McIntire, 1987). This attribute of the market in land also explains the virtual absence of regular land transactions.

There is little more than anecdotal information on markets related to sub-sector activities by backward- and forward-linkages. Examples of market chains from producers to consumers are presented by Haggblade *et al.* (2002) but these provide no information on institutional

arrangements within a particular chain. A descriptive study of the supply chain for sheanut products illustrates the importance of multiple, mostly informal, arrangements for transactions on the product market (Chalfin, 2000). The latter study does not report any importance of markets for inputs, labour or finance. The absence of these markets can be considered typical for low-technology non-farm products in low-income countries. Another study describes the complex social and commercial interactions on the market within which sorghum beer-brewers operate (Tellegen, 1997). Beer brewers, exclusively women, operate in a market where social relations determine to a large extent the size of the clientele, the price per unit output, and the share of produce actually paid in cash or sold on credit. In the above-mentioned and other studies it also appears that formal and many types of informal finance transactions are relatively unimportant because the most critical source of finance is accumulation of household liquidity and capital (Webster and Fidler, 1996; Lanjouw and Lanjouw, 2001).

Market size in sub-Saharan African is relatively small compared to other countries. Burkina Faso ranks sixth in terms of least urbanised countries (Tiffen, 2003).[3] Urban and semi-urban centres have remained relatively small and their populations have only limited purchasing power. The agriculture sector is the single most important sector generating exports (mainly cotton and meat). Road infrastructure is confined to connecting the main urban centres and only a limited number of villages are provided with electricity, telecommunications, and piped water.

Burkina Faso is relatively less favourably endowed with agricultural resources. It has a single growing season lasting from three months in the north to seven months in the south. There is a limited potential for irrigation and soils are relatively infertile. Cotton, maize and to some extent rice are the major cash crops. Virtually only the cotton sector is well supported by a backward and forward linked agribusiness. The situation in the cotton sector in Burkina Faso is comparable to for example the cotton sector in Ghana (as described in (Poulton, 1998)). Other crops, such as cereals and groundnuts, are mainly locally processed and marketed.

A particular comparative advantage that combines infrastructure and non-local resource endowment is the opportunity to migrate. At national and regional level, migration within and outside the country is historically important in Burkina Faso (Gervais and Mandé, 2000; Henry *et al.*, 2004). Nevertheless, revenues from migratory activities tend to be small in villages that are not close to urban centres or to other important employment opportunities in mining or industrial sectors (Reardon, 1997; Haggblade *et al.*, 2002). Detailed income studies in eastern

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[3] Only Ethiopia, Malawi, Uganda, Burundi and Rwanda rank higher on the list.

Burkina Faso similarly revealed a negligible share of remittances in total income. (Mazzucato and Niemeijer, 2000). A recent study, in two villages near to the northern villages of this research, reports that remittances contribute three to six percent to total income (Wouterse and van den Berg, 2004). Another study in Tanzania even reports a stream of remittances out of the rural villages (Lanjouw *et al.*, 2001). Evidence that returning migrants use their migration revenues to establish local economic activities remains at the level of anecdote (Mazzucato and Niemeijer, 2000; Breusers, 2001; de Haan *et al.*, 2002). Further analysis of this stimulus to the local economy is beyond the scope of this research because it would require time-series information on individual livelihoods.

Technology

The contribution of local supplementary activities to economic growth depends on productivity of labour and capital when locally employed in this sector *vis-à-vis* alternative allocation of labour and capital in farming or in urban economies (Lanjouw and Lanjouw, 2001). Livelihood studies distinguish high from low labour-productivity supplementary activities and observe that comparative advantage has a different impact on the opportunities and on related labour-productivity for both types of activities.[4] With economic development, more economic opportunities along the whole labour productivity range become available. In addition, labour productivity of low-productivity activities improves together with economic development (Reardon *et al.*, 2000; Lanjouw, 2001; Ferreira and Lanjouw, 2001; Corral and Reardon, 2001).

Higher labour productivity is commonly achieved in activities that require skill or capital (Woldehanna and Oskam, 2001). However, in rural West-Africa, investments mostly concern equipment and tools that turn out to have low costs in terms of depreciation. Enterprises generate income essentially by high turnover rates. The necessary skills are commonly acquired by experience. For most supplementary activities there exists no formal education or formally documented knowledge concerning relevant skills (Haggblade *et al.*, 1989).

Most supplementary activities are complementary to cropping and thus the length of the cropping season has an important influence on the extent of these activities (Reardon, 1997; Ellis, 2000a). Households commonly do not specialise in supplementary activities because

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[4] Precise data on labour input and productivity is commonly lacking for multiple reasons. Many activities are combined with other economic or household activities. People do not fully devote their time to a single activity. Also, in many cases people use time to travel, to negotiate, or simply to wait before actual income is generated. Transactions are characterised by multiple and diverse arrangements. Part of the produce is given away or sold on credit, which in-turn has also multiple appearances. Lastly, revenues from some activities like hunting and gold mining are highly dependent on chance.

employment opportunities are limited. Another reason for households not to specialise in supplementary activities may be because of the wish to maintain a subsistence base in own crop production. Crop production provides an important basis for resilience and is therefore maintained as a base activity (Brons *et al.*, 2004). This portfolio choice constitutes an important constraint for households to take advantage of specialisation in either farm or supplementary activities. Investments can only be effectively used during a part of the year thus limiting the returns to capital.

Summarising this review of structural determinants of the non-farm sectors in rural areas of sub-Saharan Africa, features of institution and technology are listed below (Table 3.1). Livelihood studies point to a weak institutional and technological development in the non-farm sector. Burkina Faso seems to be worse off in this respect. Limited institutional development (no local wage labour, information asymmetries) and a weak technology base result in scanty opportunities for generation of supplementary income.

Table 3.1

Assessment of critical success factors for current supplementary activities

Factors	Assessment
Institutions and markets	
Availability of production factors and support services	
• Labour	• mediocre
• Finance	• mediocre
• Inputs	• unfavourable
Product markets (market size)	
• Local markets	• unfavourable
• Agricultural sector consumption linkages	• unfavourable
• Migratory sector consumption linkages	• unfavourable
• Non-local markets	• absent
Agricultural sector linkages	
• Backward linkages	• absent
• Forward linkages	• absent
Technology	
Factor productivity	
• Investment opportunities	• mediocre
• Skill requirements	• low
Ancillary factors	
• complementary to agricultural activities	• assumed important
• risk control	• assumed important

3.3   Features of supplementary activities

Building on the description of enterprise practices in Chapter 2, this section empirically illustrates the issues related to institutions and technology. This empirical section compares a variety of supplementary activities. Consequently, clustering of similar activities and some generalisation of key determinants is necessary. The analysis provides information on strengths and weaknesses of the non-farm economic sectors and thus on possible entry points for policy support.

Institutional diversity

A striking feature of the non-farm sector activities was the invariably large range of scale of activities in terms of generation of net income. Apparently, within the boundaries determined by culture and gender there were no obvious reasons why a person could not change from one activity to another. People could start developing an activity at a very small scale. Often a person had started a supplementary activity by joining family members in their activities. Subsequently, the frequency and size of activities had changed according to the opportunities. Investment requirements were small or required equipment was borrowed and once the activity was launched investments were gradually expanded and self-financed. Supplementary activities were characterised by irregular and low input use. Horticulture is illustrative for this observation. Seeds, fertilisers and other inputs came from different mostly informal sources. There were no extension services on which growers could rely in the case of pests, diseases or other problems. The marketing of the crops took place via various channels and at various locations such as the farm, the village and on local markets.

For all farm supplementary activities, the general market conditions were determined by the period in the year, by social events, by the weather and related crop revenues. The sale of the produce was usually done at the place of production. Some ambulant vendors assisted in retailing the produce when it concerned highly perishable products (*e.g.* meat, fish) or easy-to-handle products (*e.g.* snacks). Marketing was characterised by a mix of own consumption, sales and gifts. Part of the gifts was meant to attract consumers or it was expected that gifts would be followed by return-gifts by the consumer. In the latter case, these gifts created goodwill but when and how this goodwill would be materialised depended on the kind of kin, the situation, the opportunities, etc. and was therefore difficult to estimate.

Trade activities were highly diverse with respect to nature and size. Many trading activities could be undertaken without the availability of much operating capital: one could have started with low volumes of merchandise and gradually expanded or reduced business. Trading

activities were often financed by the clients either on the supply side or on the demand side: farmers provided the trader with cereals and were paid afterwards, or a bulk trader provided cash to retail traders to obtain produce.

Diversity in activities and revenues

Across categories of supplementary activities and gender, I compare size, distribution and capital requirement. The following overviews include only the respondents who were involved in supplementary activities. The figures thus describe the current composition of specific sectors within the villages.

A few activities stood out because of relatively high net revenues (Table 3.2a and b). There were two men involved in distilling spirits and three in milling enterprises (food processing) in the resource-rich isolated village. In the resource-rich accessible village several traders in retail items, cereals, and livestock acquired the highest supplementary revenues from a single activity. In addition, 5 men in the resource-rich accessible village acquired revenues larger than FCFA 100,000 per year from charcoal production (non-food various processing). In the resource-poor villages nine traders, among who three holders of a repair shop, gained relatively high profits. Also in the resource-poor accessible village the local cotton dyeing industry generated relatively high individual incomes. Aside from the before-mentioned activities with a remarkably high average revenue (village and gender specific), the other activities generated an annual personal revenue between FCFA 4,000 and 40,000.

Activities that stood out by the number of people involved were: production of sheanut butter in the resource-rich accessible village, brewing of sorghum beer in the resource-rich isolated village, cotton spinning in the resource-poor accessible village and gold mining in the resource-poor isolated village. An activity like sheanut processing in the resource-poor isolated village was important in terms of number of people involved but hardly generated supplementary revenues. Revenues were in most cases less than FCFA 5,000 per person per year.

Taking all activities by men and women together, the diversity of supplementary activities was largest in the resource-rich accessible village followed by the resource-rich isolated village. Most supplementary income opportunities were found in trade and processing of a large range of products. In the resource-rich accessible village, it was the infrastructure factor that provided access to regional markets for local products (*e.g.* sheanut butter and charcoal) and for retail of consumption goods. Relatively fewer men than women developed supplementary activities but men obtained considerably higher revenues from these activities. The large diversity of activities operated by men suggests that participation in supplementary activities was driven by

Table 3.2a

Individual annual supplementary income (FCFA 1,000) for men by village and activity

Village	RA		RI		PA		PI		All	
	avg [cv]	se [n]	avg [cv]	se [n]	avg [cv]	se [n]	avg [cv]	se [n]	avg [cv]	se [n]
Men all activities	91 [2]	25 [64]	62 [2]	22 [33]	71 [2]	20 [43]	35 [2]	14 [21]	72 [2]	12 [161]
Primary										
Gold mining					13	[1]	14 [1]	3 [18]	14 [1]	3 [19]
Food various	13 [1]	6 [7]	12 [1]	6 [8]					13 [1]	4 [15]
Horticulture	19 [2]	12 [8]	5 [1]	3 [4]	9 [3]	7 [10]			12 [2]	5 [22]
Non-food various	5 [1]	2 [3]	4	[1]					4 [1]	2 [4]
Processing										
Alcoholic drinks			266 [1]	232 [2]					266 [1]	232 [2]
Food intermediate	56	[1]	256 [1]	149 [3]					206 [1]	117 [4]
Snacks	46 [0]	6 [2]			25	[1]			39 [0]	8 [3]
Non-food various	119 [1]	37 [9]	5 [1]	1 [6]					73 [1]	26 [15]
Trade										
Food	99 [1]	33 [12]	54 [1]	32 [4]	124 [2]	83 [5]	175	[1]	100 [1]	26 [22]
Non-food various	416 [1]	198 [6]	35 [1]	14 [4]	113	[1]	18 [0]	2 [2]	214 [2]	103 [13]
Artisan work										
Various	28 [1]	12 [8]	31 [1]	8 [6]	156 [1]	99 [2]	268	[1]	58 [1]	20 [17]
Cotton dyeing					89 [2]	35 [19]			89 [2]	35 [19]
Cotton weaving	22 [1]	4 [14]			16 [1]	4 [12]	6	[1]	19 [1]	3 [27]
Basket weaving	10 [1]	3 [10]	7 [1]	3 [8]			1	[1]	8 [1]	2 [19]

Notes: The data concern the average of two years. Figures are rounded at zero decimals. Abbreviations: avg = average; cv = coefficient of variation; se = standard error of mean; n = number of persons involved in an activity.

Table 3.2b

Individual annual supplementary income (FCFA 1,000) for women by village and activity

Village	RA		RI		PA		PI		All	
	avg [cv]	se [n]	avg [cv]	se [n]	avg [cv]	se [n]	avg [cv]	se [n]	avg [cv]	se [n]
Women all	34 [1]	3 [102]	22 [1]	2 [85]	10 [2]	2 [98]	7 [1]	1 [63]	19 [1]	1 [348]
Primary										
Gold mining					10 [2]	9 [4]	5 [1]	1 [42]	5 [1]	1 [46]
Food various	3 [0]	1 [5]	1 [0]	0 [18]					2 [1]	0 [23]
Horticulture					-4 [-3]	5 [6]			-4 [-3]	5 [6]
Processing										
Alcoholic drinks	27 [1]	3 [21]	17 [1]	2 [67]	12 [1]	4 [13]	13 [1]	5 [9]	18 [1]	2 [110]
Food intermediate	22 [1]	6 [25]	11 [1]	2 [20]	2 [7]	4 [20]	7 [1]	2 [9]	12 [2]	3 [74]
Sheanut	16 [1]	2 [63]	5 [1]	1 [37]	3 [1]	1 [31]	0 [2]	0 [45]	7 [2]	1 [176]
Snacks	25 [2]	8 [25]	10 [1]	2 [25]	16 [1]	3 [24]	22 [1]	7 [3]	17 [2]	3 [77]
Non-food various	7 [1]	1 [21]							7 [1]	1 [21]
Cotton spinning	0	3	2	2	4 [2]	1 [63]	1	1	4 [2]	1 [69]
Trade										
Food	21 [1]	5 [24]	11 [1]	5 [5]	5 [4]	7 [7]			16 [1]	4 [36]

Notes: The data concern the average of two years. Figures are rounded at zero decimals. Abbreviations: avg = average; cv = coefficient of variation; se = standard error of mean; n = number of persons involved in an activity.

Table 3.3

Distribution of individual annual supplementary income by gender, village and activity

Village	RA			RI			PA			PI			All		
	C n	K se	S se	C n	K se	S se	C n	K se	S se	C n	K se	S se	C n	K se	S se
Men	2 64	19 1	4 0	2 33	10 1	3 0	2 43	8 1	3 0	2 21	9 1	3 1	2 161	23 0	4 0
Gold										1 18	0 1	1 1	1 19	1 1	1 1
Food	1 7	-1 2	1 1	1 8	0 1	1 1							1 15	-1 1	1 1
Horticulture	2 8	6 1	2 1				3 10	0 1	1 1				2 22	7 1	2 0
Non-food	1 9	-2 1	0 1										1 15	-1 1	1 1
Food	1 12	2 1	2 1										1 22	3 1	2 0
Non-food													2 13	4 1	2 1
Various	1 8	0 1	1 1										1 17	4 1	2 1
Cotton dyeing							2 19	7 1	3 1				2 19	7 1	3 1
Cotton weaving	1 14	2 1	1 1				1 12	0 1	1 1				1 27	1 1	1 0
Baskets	1 10	0 1	1 1	1 8	0 1	1 1							1 19	0 1	1 1
Women	1 102	19 0	3 0	1 85	1 1	1 0	2 98	1 0	1 0	1 63	4 1	2 0	1 348	23 0	3 0
Gold										1 42	10 1	2 0	1 46	21 1	4 0
Food				0 18	-1 1	0 1							1 23	0 1	1 0
Alcohol	1 21	-1 1	0 1	1 67	1 1	1 0	1 13	-1 1	0 1	1 9	-1 1	0 1	1 110	0 0	1 0
Food	1 25	7 1	2 0	1 20	-1 1	1 1	7 20	11 1	3 1	1 9	-1 1	1 1	2 74	15 1	3 0
Sheanut	1 63	2 1	2 0	1 37	0 1	1 0	1 31	4 1	2 0	2 45	1 1	1 0	2 176	9 0	3 0
Snacks	2 25	7 1	3 0	1 25	0 1	1 0	1 24	-2 1	0 0				2 77	18 1	4 0
Non-food	1 21	0 1	1 1										1 21	0 1	1 1
Cotton weaving							2 63	7 1	3 0	1			2 69	8 1	3 0
Food	1 24	9 1	3 0										1 36	10 1	3 0

Notes: The data concern the average of two years. Figures are rounded at zero decimals. Abbreviations: C = coefficient of variation; n = number of persons involved in an activity; K = kurtosis; se = standard error; S = skewness.

opportunity in the resource-rich villages. In contrast in the resource-poor villages supplementary activities were more homogenous in nature and to a greater extent operated by women. This suggests that in resource-poor villages necessity was an important reason to develop supplementary activities

Kurtosis and skewness for total supplementary income of men and women were similar for the entire sample (Table 3.3). Kurtosis and skewness provide information on distribution of supplementary activities. Because only few persons were involved in more than one activity the distribution patterns are also illustrative for individual income distribution.

The relatively high kurtosis points to a flat distribution of realised supplementary income while the skewness measure (for men and women respectively 4 and 3) points to the presence of extreme values. Within the villages, the coefficient of variance and the skewness factor was larger for men's activities, which points to a more uneven distribution of income opportunities for men compared to women. Given the lower average of supplementary income for women, extreme incomes for women were also lower compared to extreme incomes of men.

With respect to the defined clusters of activities, both kurtosis and skewness were larger for the activities by women than those for men. This implies that for men overall kurtosis and skewness were high due to the clusters of activities that are omitted in Table 3.3. These activities are distilling spirits and milling. Processing of non-food products has a negative kurtosis, which is explained by the different types of products in this category, namely bricks (low productivity) and charcoal (high productivity). Cotton dyeing had a large skewness because there were two distinct types of cotton dyeing enterprises. The traditional way of dyeing cotton involved low costs for inputs and relatively unskilled labour and provided low returns to labour. Dyeing techniques based on industrial materials involved higher costs and generated high returns to labour. The other clusters of activities with a skewness of around two (horticulture and food trade) included activities that had the potential to generate a large income, yet only a few persons succeeded in expanding these activities.

For women, there were several clusters of activities with a skewness factor of three to four. This is illustrative for the heterogeneity within clusters of activities. Scale of sheanut processing varied essentially due to the differences in sheanut availability in the resource-poor and resource-rich villages. In the resource-poor villages scarcity of sheanut resources impeded further development of this sector. The high skewness factor for food processing is due to different products included in this cluster. A few women processed groundnuts into oil and butter on a considerable scale. In the cluster of preparation of food, snacks and drinks there were a few women who expanded this activity up to the scale of a small restaurant. Some

women combined spinning with sub-contracting weaving and dyeing to others thus generating larger revenues. Concerning trade, a few women obtained relatively large profits, though smaller than those of male traders.

Investment requirements

To obtain a base for comparison of capital intensity, I estimate the turnover rate and the ratio of total revenues to variable costs (Table 3.4). This table aggregates typical men's and women's activities because the figures are scale-independent, and thus gender is not a major factor in explaining differences in capital intensity. The estimation of the turnover rate is based on the frequency of completion of a full cycle of necessary activities from acquisition of raw material to the sale of produce.[1] The capital intensity index is calculated as follows: capital intensity = (expenditures / turnover rate) / profit (with profit = revenues – expenditures).[2] An index of 0.5 indicates that on a year basis FCFA 0.5 is required to generate a profit of FCFA 1. The index is independent of activity scale and does not consider large investments. The aim of this study is to provide an estimation of partial returns to capital rather than calculating comprehensive cost-benefit analyses. Moreover, large investments were relatively rare.

  For most activities the capital requirement index was between 0.10 and 0.30 indicating a required capital of FCFA 2,5000-7,500 to generate a profit of FCFA 25,000 (the recorded average individual supplementary income). This figure indicates the limited capacity of local supplementary activities to absorb capital. Consequently credit markets were also of less importance.

  For most clusters of activities the capital requirements were higher in the resource-poor villages compared to the resource-rich villages. This was due partly to the lower turnover rate in the resource-poor villages (in the case of beer-brewing) and to smaller margins (in the case of trade and horticulture).

  Across the different clusters of activities the capital requirements were as expected. Next to milling and sewing, horticulture had the highest capital requirements. Trade, processing, and artisan work followed in terms of capital requirement. Artisan work relied on skills rather than on investments (carpentry, masonry, and repair-shops). Some activities, like gold mining and farm wage labour, had virtually zero capital requirements.

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[1] In several cases respondents provided information only on annual turnover. We therefore rely on information given a limited number of respondents.
[2] Alternatively expressed as: capital intensity = (% / turnover rate) / (1-%); where % = expenditures / revenues.

Table 3.4

Turnover rate and capital requirement by type of supplementary activities and village

Village	RA			RI			PA			PI		
	tr	rc	ci	tr	rc	ci	tr	rc	ci	tr	rc	ci
Primary												
Horticulture	1	4.3	30	1		0	1	1.3	355	np		
Processing												
Alcoholic drinks	12	2.0	8	26	1.4	9	5	1.6	36	5	1.3	60
Food intermediate	15	1.5	14	29	2.0	3	12	1.1	131	5	1.7	30
Sheanut	29	1.6	6	11	2.2	8				9	1.5	21
Snacks	16	1.2	38	34	1.5	6	9	1.8	15			
Trade												
Food	11	1.3	27	33	1.2	16	12	1.3	30		1.4	
Non-food various	10	1.1	133	38	1.1	27	90	1.2	5		1.1	
Artisan work												
Various	6	20.0	1	6	>>	0	3		0			
Cotton dyeing	np			np			8	2.3	9	np		
Cotton weaving				np			24	3.2	2			
Basket weaving		14.3		12	5.3	2	np					

Notes: The estimations are based on average of two consecutive years. Information in this table is not specified for activities by gender because this is not a determining difference for capital requirements. Activities with zero capital requirements are not included in the table. Figures are rounded at zero decimals. Abbreviations: tr = estimated number of complete production cycles per year with np is not present, rc = revenue - cost ratio; ci = capital intensity or required capital (FCFA) to generate a benefit of FCFA 100: $ci = (100/tr)/(rc-1)$.

The revenue-cost ratio was in most cases smaller than 1.7. For most activities the respondents acquired their inputs via the market. Also for activities like brewing sorghum-beer and processing sheanuts, inputs were bought on the market rather than taken from the household stock. This practice suggests that household members sought to separate family subsistence requirements from farm supplementary activities. The latter activities were carried on independent of farming. This confirms the individual nature of supplementary activities.

3.4   From comparative advantage to institutions and technology

The non-farm economic base was clearly related to comparative advantage with respect to man-made and resource capital (infrastructure and agricultural resources). Infrastructure, providing access to population centres, had a clear impact on the opportunities for supplementary activities. In the accessible villages the revenues from supplementary activities were two to three times higher than in the two isolated villages with comparable agricultural resources. The size of the agricultural sector had an additional positive effect on supplementary income mainly by consumption linkages. Figure 3.1 illustrates how comparative advantage and development of an economic base were related.

A closer look at the nature and size of supplementary activities reveals that, despite local comparative advantage, the non-farm economic base was only to a limited extent supported by institutional and technological development. Supporting markets of labour, finance, and inputs were virtually absent. Very few local entrepreneurs made use of formal market transactions of labour, finance or inputs. This observation is in accordance with other studies but receives

Figure 3.1

Comparative advantage and the non-farm economic base

		RA	RI	PA	PI
Comparative advantages					
	Infrastructure				
	Agricultural resources				
	Other natural resources				
Non-farm economic base					
Access	Percentage of men involved				
	Percentage of women involved				
Level	Level of revenues				
Distribution	Level of extreme income				
	Persons with high income (number)				

Level of comparative advantage and development of economic base is indicated by darkness, the darker the larger the advantage and the higher the concerned indicator for economic base.

limited attention in policy recommendations (Mazzucato and Niemeijer, 2000; Ellis and Freeman, 2004).

Processing of food and non-food was almost entirely directed to the local market. Most artisan products were not tradable over large distances. Simple products such as baskets, local chairs, etc. encountered increased competition from urban manufactures (see also (Delgado *et al.*, 1998)). Some quality artisan products (cotton blankets) benefited from national urban markets but competition from similar modern products was severe (see also (Haggblade *et al.*, 1989)).

Backward linkages enlarging the size of agribusiness sector activities appeared to be limited. For example, inputs for horticulture were available to a very limited extent and related extension services were virtually absent. The comparative advantage of non-agricultural resource capital turned out to be limited in all villages and extremely limited in the resource-poor villages. Consequently, there were few opportunities to further expand the current non-farm sector that relied on natural resources (*e.g.* processing, hunting, and gathering).

With respect to technology factors, one can readily observe that investment and technical innovation had been virtually absent over the last three decades. The technology of supplementary activities was homogenous and rather poorly developed. Preparation of food and drinks, charcoal production, weaving, and other activities still build on traditional technologies from the last decades. Capital requirements were limited and required investments could be gradually accumulated. Returns to labour can be assumed to be low because almost no one specialised in supplementary activities. Most of the supplementary activities took place besides cropping activities either during the dry season or in slack moments during the growing season.

Activities less affected by these constraints, such as horticulture and trade serve as an example for respectively technological and institutional constraints hampering the development of a local economic base. Horticulture is an activity that offered a potential to expand supply. The two accessible villages had an important potential to produce high-value crops, but did not fully exploit these opportunities. Trade revenues constituted about a quarter of all supplementary revenues while only about six percent of the respondents participated in trade. Despite their economic potential, horticulture and trade showed only limited technological and institutional progress.

In sum, despite an importance of about one third of total income and by far the largest share of cash income, there appeared limited room to further develop prevailing supplementary activities. The previous issues are summarised in Figure 3.2. From a perspective of economic

Figure 3.2

Assessment of institutional and technological development by comparative advantage

	RA	RI	PA	PI
Institutions and markets				
Availability of production factors and support services				
Labour	▨	▨	▨	▨
Finance	▩	▩	▩	▨
Inputs				
Product markets				
Local markets				
Agricultural sector consumption linkages	▰	▰	▨	▨
Migratory sector consumption linkages	▨	▨	▨	▨
Non-local markets	▰	▰	█	▨
Agricultural sector linkages				
Backward linkages	▰	▰	▨	▨
Forward linkages				
Technology				
Factor productivity				
Investment opportunities	▰	▨	▨	▨
Use of skills	▨	▨	▨	▨
Ancillary factors				
Complementary to agricultural activities	▰	▰	█	█
Risk reduction	▨	▨	▨	▨

Level of institutional and technological development is indicated by darkness, the darker the more advanced the concerned indicator

growth potential the conclusion by Haggblade *et al.* (2002) in the introduction of this chapter is confirmed. Prevailing supplementary activities have limited growth potential. The local supplementary economy thus far has little contributed to structural transformation towards a non-agricultural economic base. It is probably for this reason that other livelihood studies are starting to re-emphasise the need for agricultural development in rural areas (Reardon *et al.*, 2001; Lanjouw and Lanjouw, 2001; Ellis and Freeman, 2004).

Chapter 4

Involvement in farm supplementary activities

The previous chapter pointed to the meagre economic potential in local non-farm sectors. This chapter analyses involvement in supplementary activities, also referred to as labour supply. To explain involvement in farm-supplementary activities four types of determinants of labour supply will be elaborated. People's involvement in supplementary activities is determined by position within the household, ability, preference and capital endowment. Because allocation of labour to economic activities is mainly an individual decision, I elaborate the motives and factors that drive this choice at the individual level.

The literature review shows that several factors have an ambiguous impact on involvement in supplementary activities. In general, gender, education, access to finance, and land and capital ownership stand out as factors that allow people to develop supplementary activities. Yet, the previous chapter showed that, except for gender, there was no obvious link between these factors and the nature and size of supplementary activities. Therefore, relevant indicators are further elaborated for our empirical work.

The analysis shows that household heads opted for supplementary activities when farm means were insufficient to acquire a living. Male household members other than the household head appeared to have the largest room for manoeuvre to engage in supplementary activities. An important conditioning factor for men was that they were able to escape from contributing to household activities. For women, farm endowments catalysed involvement in supplementary activities.

Individual characteristics, related to ability, preference, and property, appeared to be less important as determinants of participation in non-farm sectors. Apparently there is a difference between involvement in and demand for supplementary activities. Economic opportunities should be available at a wider scale before individual characteristics effectively determine actual involvement in farm supplementary activities.

4.1 Labour supply besides farming

Analysis of labour supply commonly relies on patterns of actual involvement in economic activities. Yet, labour supply refers to the willingness to work and may thus be different from actual involvement in economic activities.[1] The scarcer economic opportunities are, relative to labour supply, the larger is the difference between labour participation and supply. Instead of $y_i^* = f(.)$ where y_i^* is the willingness of person i to develop economic activities we estimate $y_i = f(.)$ where y_i is realised income.

Common labour supply theories refer to actual labour participation without explicitly accounting for the difference between y_i^* and y_i. This difference is relatively large in poor economies, and therefore empirical research on labour supply in less-favoured areas should be interpreted with caution.

This section enumerates four types of labour supply determinants concerning, respectively, individual position within the household, capability, preference, and entitlement. The following section reviews how empirical work has incorporated various determinants of labour supply.

The first category of determinants of labour supply relates to intra-household task division and the position of a person within the household (Low, 1986; Kooreman and Wunderink, 1997). The outcome of this task division is based on economic income opportunities and relative productivity with respect to household tasks. This generally refers to the division of paid labour and household tasks between spouses in a nuclear family. If applied to the diverse organisation of an extended household in Africa some modification is needed. The extended family has multiple members with different relations to the head of the household, for example one or more wives, married and unmarried sons, brothers, daughters, sisters and elderly. Each member has a specific position determining the individual opportunity to develop economic activities and the contribution to household and farm tasks.

The second group of determinants concerns individual productivity or wage explained by one's capability (Low, 1986). Productivity is generally determined by experience and education often approximated with age and years of work experience (Kooreman and Wunderink, 1997; Verbeek, 2000). Health is an additional important determinant of labour productivity, which is rarely included in livelihood surveys. Several ability criteria cannot easily be measured. For example, reputation and attitude might be two major determining factors that determine

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[1] Kanwar (1991) included the number of working days that respondents had been looking for employment in the estimation of labour supply. The effects of the determinants were slightly stronger with increased significance. However, where labour markets are absent, it is not useful to ask respondents on how many they had been looking for employment.

whether a person successfully engages in a certain activity. Intuitively, the factors of health, reputation, and attitude will be more important in a fragile economy compared to economies with a more secure institutional base.

The third type of labour supply determinants concerns the relationship between preference and labour supply. Total labour supply will decrease when productivity or wage increases (Ellis, 1993). This is explained by an increase of the marginal utility of leisure parallel to a wage increase. In the latter case, a part of the income increase is used to consume more leisure. In this reasoning preference refers to the marginal utility of leisure. Conversely, people's preferences may reveal utility of effort for certain activities and thus increase the willingness to develop them. Preference patterns are thus based on marginal utility of leisure as well as effort, resulting in an ambiguous effect of preference on labour supply.

The last group of labour supply determinants is actually a specification of the above-mentioned determinants. Instead of focusing on supply of labour from a worker's point of view, an enterprise perspective is taken by including endowment levels (Kanwar, 1991). Endowment is ownership of physical capital (land, livestock, equipment, or stock) or other entitlements (clientele, social position, etc.). The most important endowment properties are household level farm and family resources. Measurement of individual endowment is prone to the methodological problems of intra-household analysis. Therefore further analysis focuses on household endowment. Endowment for supplementary activities (*e.g.* social position, clientele and investment) is also important but difficult to measure.

The division of labour time into farm and supplementary activities requires precision of determinants of labour supply. Because supplementary activities are engaged in individually, farm productivity takes the same role of an opportunity cost as leisure in the total labour supply model. Thus when farm productivity is high, households will be less inclined to supply labour to the non-farm sector. However, when farm and non-farm labour productivity are positively related by for example managerial qualities, households with high farm revenues have also access to high-productive supplementary activities and will thus develop these activities. The ability characteristics have a similar effect on farm and non-farm labour productivity and the actual choice for either of the activities is not *a priori* determined.

Similarly, farm endowments are generally considered to have an ambiguous effect. On the one hand, better-endowed farmers achieve higher farm labour productivity and thus are less inclined to develop supplementary activities. On the other hand, farm asset endowment may also improve access to non-farm employment opportunities by means of networks or collateral for credit.

Figure 4.1

Determinants of individual involvement in supplementary activities

Individual	Household
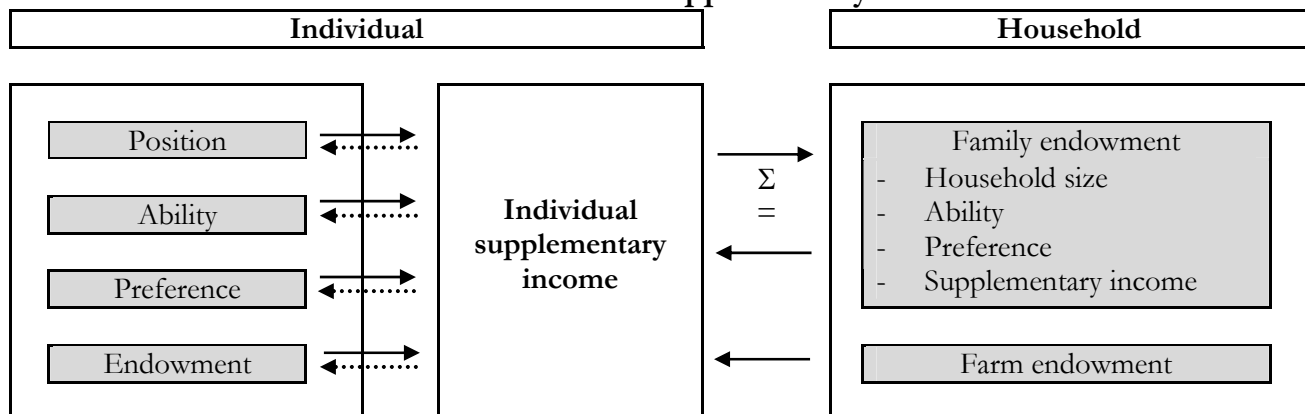
Bold arrows indicate a relationship between explanatory and dependent variables. Lines without an arrow head indicate coherent variables without a clear cause-effect relation. Dotted lines point to possible recursive effects that are not subject of this study. Recursive elements point to how individuals acquire a position, develop abilities and preferences, and accumulate endowment when they are involved in supplementary activities.

Taking the four categories of determinants together, individual income generation is a function of the individual's position, capacity, preference, and endowment (Figure 4.1). A focus on individual involvement in supplementary activities avoids the common problems of endogeneity of explanatory variables. Individuals have opportunities (*e.g.* time) to develop supplementary activities by co-ordinating household tasks with other members. Total household endowment or income is to a large extent the result of an accidental composition of the household and can therefore be used as an explanatory variable for individual supplementary income.

4.2   Determinants of involvement in farm supplementary activities

This section reviews empirical findings mainly qualitatively. Qualitative assessment is appropriate because due to the absence of local and regional wage-labour, the area of this study is different from regions in other studies. Also, econometric models as well as underlying research samples used in livelihood studies are too diverse to provide a meaningful quantitative comparison of determinants of supplementary income.

Gender roles in household organisation

African households constitute highly diverse farm organisations. Yet there is little attention to the individual position of its members. Research on the income position of individual household members that takes into account the specific intra-household position is relatively

scarce. Most of the reviewed studies are conducted at level of the household as being the administratively most convenient unit of analysis. This implicitly assumes that the head of the household is responsible for organising household tasks, income, and consumption pooling (Quisumbing and Maluccio, 2003). Intra-household division of work, income and goods is a culturally sensitive theme and young adults may be unwilling in the presence of other household members to reveal their interests (Breusers, 1998; de Bruijn and van Dijk, 1995). The intra-household position of individuals can change within a relative short time-span. Family cycle factors or opportunistic reasons determine the moment that children or brothers of the household head constitute their own household.

Individual position is dominantly determined by gender, which receives ample attention in livelihood literature (Tellegen, 1997; Ellis, 1993). Obvious gender disparities are the different proportion of men versus women who are involved in supplementary activities and the different nature of activities in which they are involved. In various rural areas in developing countries, about 50 percent of the male and 85 percent of the female population is involved in supplementary activities (Reardon, 1997; Barrett and Reardon, 2000). These figures are somewhat lower in regions with relatively good agricultural potential such as Latin America (Reardon *et al.*, 2001) or African countries such as Ivory Coast and Rwanda (Delgado and Siamwalla, 1999). Men are involved in activities with higher productivity as was also confirmed in the previous chapter (Quisumbing *et al.*, 1995). Women face more and larger institutional constraints on developing supplementary activities (Tellegen, 1997).

Ability through expertise and availability

Individual capability attributes that facilitate involvement in supplementary activities are commonly based on experience, which is informally acquired and activity specific. A commonly taken proxy for expertise is age, with an age-squared factor because of diminishing productivity when people get older (Verbeek, 2000; Lanjouw, 2001). Additionally, education is taken as an indicator of the general capability of individuals to generate supplementary income (Elbers and Lanjouw, 2001). Yet, education may be a less appropriate determinant of capability. Virtually no local supplementary activities require formal education while on the other hand education level is extremely low in sub-Saharan Africa (Tellegen, 1997). On the contrary, education can show a spurious negative effect on supplementary income. The younger men who are best educated have less opportunity to develop supplementary activities because of their subordinate position within the household. They are often considered too young to start their own enterprise.

Besides education and expertise, health is frequently mentioned as one of the major factors determining the ability to develop economic activities (Smith *et al.*, 2001, 2000). Also in this study, many respondents mentioned that they abandoned their activities for reasons of personal health or family conditions (health of family members). Yet these background risk factors are virtually absent in the literature (*e.g.*(Barrett *et al.*, 2001; Tellegen, 1997; Ellis, 2000)).

Attitude parameters, such as optimism, confidence, etc., are rarely found in the diversification literature. One study into non-farm earnings included individual trust scores (Lanjouw *et al.*, 2001). A trust score indicated how people perceive trustworthiness of others. This indicator appeared to affect the probability of obtaining non-farm earnings and its level. Trust in informal leaders and traders from outside the village negatively affected non-farm earnings while trust in government officials had a positive effect. It can be learned from this study that attitude or trust should be measured with a similar point of reference. Otherwise trust scores may tell more about the local environment than about personal characteristics.

An indirect capability attribute is availability. Individual responsibility for small children or for the elderly within a household may reduce people's capacity to generate supplementary income. When children grow older they assist in supplementary activities and thus improve one's capability to generate additional income. Typical teenagers' activities consist of simple work such as retailing, packing, guarding, and other tasks.

Opportunity costs of leisure and farm activities

Preference attributes are related to perceived advantages of supplementary activities compared with farm activities. These may concern returns to labour or capital, risk, or any other attribute of the activity in question. First, labour productivities in farm and supplementary activities are linked by capability and thus individuals compare both activities within the scope of own possibilities. High farm labour productivity points to a better capability to generate supplementary activities. Moreover, when people withdraw labour resources from own-farm production, they increase the ratio of non-labour to labour production factors thus increasing labour productivity. Hence, there will be a positive relation between farm labour productivity and involvement in supplementary activities, once controlled for total cultivated area.

Instead of aiming at higher returns to labour, supplementary income can be sought in order to obtain immediate cash revenues (Ellis, 2000; Reardon, 1997). Because of immediate cash needs households may choose not to carry out certain crop management activities and thus forego farm revenues at the end of the cropping season. In most cases these activities such as wage labour and wood gathering provide low returns to labour. When farmers do not manage to

fully carry out necessary crop management tasks they will obtain lower returns to farm production factors. This so-called survival strategy can be recognised in the fact that own production factors, in particular land, are left idle or become less productive. Where households follow a successful survival strategy they adjust farm factor ratios so that farm labour productivity will increase. Households which remain less successful in this strategy will develop little involvement in supplementary activities and accordingly will not adjust farm production factor ratios. In both cases, with or without success, one expects to find a positive correlation between farm labour productivity and involvement in supplementary activities.

Risk preferences may also influence activity choice (Kanwar, 1991; van den Berg, 2001). Aside from the motive to optimally exploit available labour and capital in the course of the season, households additionally may seek to reduce income risks. Households participate in supplementary activities when their base activity, crop cultivation, is considered to be too risky. Therefore they develop supplementary activities of which risks are expected to be zero or negatively correlated with crop revenue risks. This provides arguments to analyse the relationship between activity diversification and risk attitude. Yet, because risk aversion is inversely related to wealth, it is not possible to establish a causal relationship between risk attitude and supplementary income. Therefore the elaboration of risk behavioural arguments is postponed to Chapter 5 on individual income composition.

Endowment influence on portfolio composition

Farm and family endowment is elaborated in many studies as a determinant of individual supplementary incomes (Woldehanna, 2000; van den Berg, 2001). Yet, the actual interaction with supplementary income receives less attention. Typical combinations of farm and supplementary activities as they appear in livelihood literature are: i) a relatively high farm income combined with important supplementary income usually from high labour productivity activities; ii) specialisation in farm income alone; and iii) low farm-income plus self-employment. Specialisation in farming requires endowment with a relatively secure income source such as rice (Ivory Coast) or cotton (cotton regions in Burkina Faso) (Delgado and Siamwalla, 1999).

Other household or family resources influence involvement in supplementary activities. Individuals have the opportunity to fall back on household resources and therefore have a greater opportunity to specialise in supplementary activities (Smith and Chavas, 1999). In general terms, the more members a household has the more flexibly it may allocate time to supplementary activities. Individual specialisation is found in artisan work such as a exploiting a

repair shop, tailoring, and other activities (Tellegen, 1997) or in trade for which travelling is required. More members within a household may thus have a positive effect on involvement in supplementary activities. Participation in supplementary activities by other household members may be a stimulus as well as a constraint for others to develop supplementary activities. Frequently household members work together in supplementary activities, but it may also happen that farm labour demand increases when one member diverts towards supplementary activities.

An additional household characteristic is the ratio of absent versus present members. Migration of household members has a diverse and often ambiguous impact on the farm household activity portfolio. Migration may be a substitute for local supplementary activities (de Haan *et al.*, 2002; Francis and Hoddinott, 1993). Subsequently, remittances by non-resident members may stimulate participation in supplementary activities because of a better liquidity and thus an increased capacity to invest. Conversely, remittances can be seen as an easy income source that discourages participation in low-productivity activities.

Elaboration of the method of estimation

An appropriate econometric method to predict involvement in supplementary activities is the Tobit estimation procedure. This procedure excludes the cases with zero supplementary income. The few respondents that made losses with supplementary activities are not included in the sample (1.5 percent of the male and 3.5 percent of the female respondents). Because losses are commonly due to other factors than included in the estimation (illness, production failure, etc.) these cases do not provide information on what actually drives people to develop supplementary activities.

The dependent variable is total individual annual supplementary income. It is, at this level, not useful to further distinguish different types of supplementary activities because the research is on the choice between farm and supplementary activities. For reasons elaborated in the previous chapter, total revenues instead of labour supply and labour productivity were recorded.[2] This has no consequence for the direction of the effects of ability and endowment on supplementary income, it only weakens the relationship due to the possible income effect (Ellis, 1993). Under conditions of poverty I estimate the income effects of leisure to be limited and thus expect that an increase in productivity will stimulate people to allocate more labour to supplementary activities.

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[2] Also labour supply theories frequently interchange total earnings with earnings per unit of labour as the dependent variable in labour supply models (Verbeek, 2000).

The estimations concern three positions within the household: the head of the household, other male, and female members.[3] Further specification of an individual's position within the household would be desirable but was not feasible within the scope of this research. When individual data are not available only household data is used, and in other cases household data is simply a mathematical aggregate of individual data (Appendix 4.1).

Ability characteristics are recorded at individual level and to the extent possible aggregated to household level. However, in the case of age, the average age of all household members has a limited meaning because various household compositions may give a similar average age. Only households consisting mainly of very old members are distinguished by a relatively high average age. Often these households no longer develop important economic activities and therefore this variable is maintained as an explanatory variable. Farm labour demand has not been recorded at an individual level. To compensate for this shortcoming I include the time devoted to farm labour averaged over the household members. The number of spouses is recorded for nuclear household subgroups within the farm household. At the household level this variable is implicitly taken into account as the male-female ratio being is one of the preference variables. Finally, for women the order of entry into their nuclear household subgroup is recorded.[4]

Individual preference attributes are not included in the explanatory variable list because comparative advantages cannot be measured when an individual has no own farm activities. Thus only household level productivity indicators are included. Farm endowment is measured as crop acreage and livestock ownership for individuals as well as households.

4.3   Village, household and individual effects on supplementary income

This section discusses village, individual, and household determinants of participation in supplementary activities. This closely follows the order of the labour supply determinants in the previous sections, but some modifications take into account interaction and overlap between variables. Position of people within the household is taken into account by comparison across the three different estimations. The village environment, as a major determining factor, is discussed first. Next individual traits of ability are discussed. Lastly, the role of individual and household endowment is evaluated. Household endowment consists of the aggregate of individual characteristics. Table 4.1 reports the estimations.

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[3] The share in total village income was respectively 6, 11 and 10 percent for household heads, dependent men, and women.

[4] Single women score zero on this variable, which implicitly puts them at the beginning of an ordered variable.

Table 4.1

Tobit estimations of determinants of supplementary income by individual position

Village dummies	**Head** (n=121)		**Men** (n=187)		**Women** (n=405)	
	Coeff.	z-val.	Coeff.	z-val.	Coeff.	z-val.
Resource-rich accessible (1)	-54.071	-1.640 *	-130.945	-1.536	-2.347	-0.394
Resource-rich isolated	-87.557	-2.940 ***	-141.237	-1.741 *	-6.044	-1.235
Resource-poor accessible	-116.270	-3.129 ***	-58.013	-0.599	-7.950	-1.236
Resource-poor isolated	-135.552	-3.672 ***	-229.362	-2.217 **	-13.245	-2.117 **
Individual features						
Ability						
Age (year)	-4.623	-0.971	13.697	2.544 **	0.736	1.481
Age squared (year)	0.014	0.327	-0.116	-2.190 **	-0.013	-2.180 **
Education (year)	-11.759	-1.793 *	11.043	1.376	-1.734	-1.556
Children <7 (number)	-6.153	-0.830	32.655	1.998 **	-0.190	-0.142
Children 7-16 (number)	4.330	0.531	-1.455	-0.052	1.535	1.029
Use of external labour (% of total)	n.a.		2.394	1.290	0.174	1.176
Wives (number)	5.867	0.396	-20.461	-0.488	2.851	1.767 *
Order of entry	n.a.		n.a.		0.347	0.176
Endowment						
Land ownership (ha)	n.a.		-4.078	-0.124	2.605	0.882
Livestock assets (FCFA)	n.a.		-0.247	-0.371	0.557	1.026
Household features						
Endowment						
Arable land (ha per adult equiv.)	-0.877	-2.800 ***	0.726	0.739	0.013	0.239
Livestock assets (FCFA /ae)	-0.270	-0.396	-3.959	-1.865 *	0.281	2.531 **
Household size (number)	-7.096	-1.850 *	-4.041	-0.626	-0.244	-0.593
Ratio absent / present	0.163	1.397	-0.086	-0.198	-0.020	-0.835
Suppl. inc. oth. members (FCFA/ae)	-0.283	-0.789	-0.791	-0.876	0.050	1.013
Preference						
Crop labour productivity (%[1])	-2.385	-5.775 ***	1.086	1.574	-0.058	-1.328
Net crop margin (FCFA per ha)	1.433	8.163 ***	0.478	0.334	0.237	2.817 ***
Percentage female in household	0.838	0.949	5.045	2.356 **	-0.268	-2.054 **
Ability						
Average age (year)	9.294	1.054	-11.889	-0.500	0.240	0.170
Average age squared (year)	-0.111	-1.044	0.082	0.277	0.002	0.115
Education of men (year)	0.095	1.245	-0.199	-1.171	0.012	1.211
Education of women (year)	-0.046	-0.529	0.250	0.944	-0.007	-0.311
Children <6 (number)	0.065	0.217	-0.111	-0.147	-0.008	-0.189
Children 7-16 (number)	0.256	0.688	-1.110	-1.307	0.073	1.555
Farm labour demand (%[1])	0.583	2.378 **	1.077	1.349	-0.096	-2.048 **
Use of external labour (% of total)	-0.233	-0.266	0.064	0.027	0.035	0.217
Other						
Constant	75.330	0.438	-368.939	-0.810	7.091	0.254
Error distribution scale	69.863	12.605 ***	172.648	11.532 ***	22.706	25.228 ***
Statistics						
Adj. R-squared / avg log likelihood	0.658 /	-4.051	0.290 /	-2.893	0.229 /	-3.841
Left censored observations	38		112		74	

Notes: *, **, and *** indicate significance at the 0.10, 0.05 and 0.01 levels, respectively. n.a. =not applicable. The H0 of a normal distribution of the error term is accepted at 1% significance level. Abbreviations: ae = adult equivalent; %[1] = percentage of zone average.

Village influence

In the Islamic ward in the resource-rich accessible village, supplementary activities provided a significantly higher income compared to the other villages (cf. Chapter 2). In this ward about 90 percent of the heads of the households were involved in supplementary activities. Five of the ten household heads with the highest supplementary revenue resided this village. The household heads in other villages were less involved in supplementary activities. In the resource-poor isolated village, only 52 percent of the household heads obtained supplementary income.

For dependent men and women, the village effect was much less pronounced. Only the resource-poor isolated village stood out in terms of low involvement in supplementary activities by men and women. As illustrated in the previous chapter this village was marked by the near-absence of any opportunity to develop supplementary activities. In this village a few persons were involved in trade or repair, there was too little raw material available to process food or non-food products, and the clientele for local snacks and drinks was limited. The nearby gold mines provided only a meagre income during the two years of study.

Lack of infrastructure had a greater effect on supplementary income generation by men than it has on supplementary activities by women. A few men acquired relatively large supplementary revenues and the majority of men were only to a limited extent involved in supplementary activities. Women, on the other hand, were involved in supplementary activities at a much broader but lower level. Low-productivity activities relied less on local economic development and thus women tended to benefit less directly from infra-structural and agricultural development.

Individual ability and endowment

Individual ability and endowment worked out differently across positions within the household. For household heads, age did not have an effect on supplementary income level. In most cases the head of the household was older than 45 years and thus it was expected that the pattern of experience acquisition at a younger age would not appear in the regression results. For dependent men and to a lesser extent for women, the results confirm the hypothesised pattern of supplementary activities initially increasing and then decreasing with age. A closer look at the data reveals that the youngest men (from 16 – 20 years) did not obtain supplementary income. Women developed supplementary activities up to a rather old age.

Education level had a negative effect on supplementary income for the household head. Better education may be linked to status and thus increased demand for leisure. As already

mentioned, education levels as well as requirements for prevailing activities were particularly low. Therefore, not much weight should be attached to this negative effect.

Men with young nuclear families, with more young children, often had better opportunities to develop supplementary activities. For women, the number of own children did not affect supplementary income. Presence of co-spouses positively affected the generation of supplementary income because there were more possibilities for co-operation within the household, and task division facilitated developing supplementary activities by women.

Individual farmland and livestock endowment did not influence involvement in supplementary activities, except for the household head (thus referring to household land endowment).[5] Individual land ownership was more important in villages with less supplementary income.[6] Within villages, land ownership did not further influence involvement in supplementary activities. Household heads controlled about 90 percent of the livestock assets. Women possessed on average 4 percent of livestock assets: 6-7 percent in the isolated villages and 2-4 percent in the accessible villages.

The household as principal endowment

Farmland endowment decreased the level of supplementary income only in the case of the household head. As discussed in chapter 2, household heads benefited most from household farm resources. Therefore they had within the household the largest interest in exploiting available land. Better land availability was thus an incentive for the household head to allocate attention to farm activities. Livestock ownership had a negative effect on supplementary income for men while it had a positive impact on supplementary income for women. Men may have been more often responsible for keeping livestock and thus had less time to develop supplementary activities. For women, livestock revenues positively contributed to alternative income opportunities mainly because of a wealth effect. Wealthier households had a better position in non-farm economic sectors. Furthermore, brewing of sorghum beer, an important supplementary activity, was commonly combined with fattening pigs, which were fed with the residues from the brewing process.

The larger the household the less supplementary income was obtained by the head of the household. As with farmland availability, in a relatively larger household it was in his interests

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[5] The expression individual ownership refers to the managerial responsibility of individuals for fields or livestock.
[6] In the cotton-growers ward, in the resource-rich accessible village (RA1) about 27 percent of the farmland was owned by women. In the resource-poor isolated village, women cultivated 17 percent of the farmland.

to focus on farm rather than on supplementary activities. The ratio of absent to present members had no impact on supplementary activities. Apparently, as hypothesised in the first chapter, migratory activities were developed independent of household organisation and neither remittances nor better networks provided improved access to supplementary activities. Revenues from supplementary activities of other household members had no impact on supplementary income of co-members. There was no competition effect such that households would allow only a few individuals to develop supplementary activities. Nor was there a synergistic effect that involvement of some members in supplementary activities would increase participation by others.

Higher crop labour productivity on household fields had for household heads a negative impact on supplementary income while there was no effect for men and women. For the head of the household, this confirms the hypotheses that he made a clear choice between farm and supplementary activities. Higher crop yields positively affected preference of the household head for agriculture compared to supplementary activities. Dependent men and women operated supplementary activities rather independently from farm results. For women, productivity in cropping went to some extent along with productivity in farm supplementary activities. Finally, the female to male ratio had a positive impact on supplementary income for men while a negative, albeit small, impact for women. In the case of men, this may have been a wealth effect. In the sample, there were a few wealthy traders with a more than average number of spouses.

The factors of availability at household level had minor influence on supplementary income level. The ratio of teenagers per adult in the household positively (although with a low significance level) affected female supplementary income. Teenagers helped other household members with various tasks. Household crop labour demand (working days adult equivalent) had a negative effect on supplementary revenues only for women. Household labour demand for crop production activities competed for labour in supplementary activities by women. In contrast, men seemed to have more opportunities to operate supplementary activities in a household environment focused on crop production.

4.4   Involvement in versus demand for supplementary activities

It turns out to be easier to enumerate factors that determine labour supply than to empirically verify related effects. Insufficient empirical validation is essentially caused by the difference between effectuated labour supply and actual demand for income opportunities. Virtually all livelihood studies, descriptive as well as analytical, are based on actual labour supply.

Information on actual labour supply is sufficient for descriptive case studies that do not seek to consistently compare different labour supply determinants (Tellegen, 1997; Scott, 1995; Mazzucato and Niemeijer, 2000). Studies that encompass larger databases on wider regions also refer to actual labour supply determinants in less-favoured areas in their general conclusions. Infrastructure, education, and synergy between farm and supplementary activities are the evident focal points of ensuing recommendations (Reardon, 1997; Reardon *et al.*, 2001; Ellis and Mdoe, 2003).

The present research matches labour supply determinants with actual labour supply while maintaining village-specific information, which is commonly found only in case studies. There were important differences according to the position of an individual within the household. The remarkable differences according to three positions (head, dependent men, and women) suggest that it will be necessary to specify future analyses in much greater detail according to intra-household position.

The dominant opinion about the role of supplementary activities in farm household livelihood was valid for the heads of the household. They made a clear choice between farm and supplementary activities. When farm and family resources were sufficiently available the household head gave priority to farming activities. From his perspective, diversification was mainly driven by necessity in case farm means were insufficient to acquire a living. Dependent men had a relatively large room for manoeuvre to generate supplementary income. As illustrated in the previous chapter, a few men chose for highly remunerative activities that required many and long days of absence. Women were more dependent on household circumstances than men but in an opposite direction compared to the head of the household. Household farm-resources catalysed rather than impeded involvement in supplementary activities. Because women's supplementary activities were often complementary to farming, individual members launched supplementary activities taking advantage of prevailing farm and family resources.

Actual labour supply was likely to be much lower than the demand for becoming involved in farm supplementary activities. Consequently, individual characteristics related to status, ability, and preference, did not appear as major determinants of actual involvement in farm supplementary activities and thus provided insufficient direction for enhancing the economic base of farm supplementary activities. Attention should be given to broader poverty dynamics (Barrett and Swallow, 2003; Verschoor, 2000) and also to the specific conditions prevailing in less-favoured areas (Kuyvenhoven *et al.*, 2004).

Chapter 5

Individual livelihoods, diversification and risk attitude

The individual nature of supplementary activities calls for a critical examination of personal diversification behaviour. While Chapter 3 discussed determinants of individual involvement in supplementary activities, this chapter assesses individual diversification behaviour. Because diversification is frequently associated with risk behaviour, a simple assessment of risk attitude has been carried out to obtain insight into personal differences that shape individual livelihoods.

The literature offers scanty and inconclusive results concerning the relationships between risk attitude, income level and activity diversification. Concepts related to risk and risk perception are in themselves ambiguously and endogenously related. In the context of developing countries theory on risk behaviour is much more advanced than empirical work (Fafchamps, 2003).

Despite the theoretical argument that risk aversion is a major determinant of activity diversification, the relationship has not been empirically verified. Moreover, earlier empirical studies on intra-household income distribution and individual livelihood diversification devote limited attention to the status of members within the household.

In this chapter, I elaborate an empirical measure of risk attitude and investment choice. Responses to a simple heads-or-tales game provided proxy information on risk attitude. We used a real game situation with a limited number of stake-gain combinations to elicit risk attitudes. In addition, to analyse whether investment decisions are influenced by the person to whom income opportunities accrue, we asked respondents how they would allocate hypothetical extra income.

We found that women were more risk averse compared to men and risk aversion first decreases and then increases with age. Better accessibility consistently led to less risk aversion. Individuals, men more than women, tended to specialise rather than diversify in economic activities. Risk aversion had a small negative impact on diversification: less risk-averse people generated more supplementary revenues. Risk aversion had little effect on individual investment choices.

5.1 Household diversification and individual risk preference

Combined assessment of income allocation, diversification behaviour and risk attitude at household and at individual level encounters an important theoretical constraint. Risk attitude is an individual characteristic and cannot be attributed to the household. Moreover, individual income measures critically depend on assumptions with respect to intra-household income pooling and consumption allocation. Elaborated data on intra-household sharing mechanisms are seldom available.

This section reviews some of the theoretical and empirical studies on intra-household income pooling and consumption sharing. The unitary household approaches are appropriate for analysing most farming decisions made by household heads. In the villages of this study such a focus is justified because two thirds of the income streams accrue to the head of the household (cf. Chapter 2). Unitary household models, however, are not appropriate for taking into account individual interests and motives of household members (Quisumbing and Maluccio, 2003).

Household versus individual decision making

The unitary household approach simplifies decision arguments by assuming that each household member has equal preferences. Issues regarding motivation of household members to work in household activities or to stay within the household are commonly not dealt with explicitly. Numerous studies develop non-unitary household models but provide scanty empirical evidence on preference heterogeneity (Quisumbing and Maluccio, 2003; Smith and Chavas, 1997; Quisumbing *et al.*, 1995).

Livelihood research that includes individual perspectives is mostly focused on gender differences (Meinzen-Dick *et al.*, 1997). More detailed intra-household analysis is found in research in sectors such as agriculture (de Groote and Coulibaly, 1998); education (Shapiro and Tambashe, 2001); and health (Adams *et al.*, 2002). Various studies on supplementary income referred to in the previous chapters of this thesis also analyse individual livelihoods, but do not disentangle intra-household allocation mechanisms (Tellegen, 1997; Ruben and van den Berg, 2001).

For two villages in Burkina Faso, Mazzucato and Niemeijer (2002) analyse individual livelihoods of 35 persons including 10 household heads. They show how each person was widely involved in the cultural economy, defined as an integration of market principles and social interaction. About 55% of total income accrued to the household heads. Van Dijk *et al.* (2004) show several examples of how individual economic choices affected the livelihood of

the own household as well as of other households related by family ties. This is but one example of the fact that household boundaries are highly diffuse.

The above mentioned studies do not elaborate household income pooling mechanisms and do not seek to consistently compare individual income effects. We emphasise the individual nature of supplementary activities and consider crop husbandry an individually managed activity, which is mainly managed by the household head. Previous chapters analysed household income without attention to intra-household distribution implications. The present chapter assesses individual livelihood in the context of the household economy. This approach does not reject the importance of household livelihoods, but suggests that decisions are often better understood from the viewpoint of the individual (Bouahom *et al.*, 2004).

Risk attitude and diversification

Diversification of economic activities is generally considered to be a deliberate strategy to reduce or to manage risks. Consequently, one expects that risk preferences influence the degree of activity diversification of a household or an individual. Various studies have tried to assess risk preferences and to relate these to activity choice. Risk aversion *ex ante* drives diversification while *ex post* one expects less risk aversion for people with higher incomes. Causality between risk aversion and income takes both directions. A high income makes it possible for people to afford to be less risk aversive, and *vice versa* less risk aversive people are willing to take more risks. The subsequent high income is generally considered to be a reward for risk-taking.

Other studies have examined whether actual diversification sufficiently reduced income variability or whether inherent activity risks affect management decisions. Most of the empirical evidence concerns the household portfolio of economic activities and takes the perspective of the household head, while only a few studies are available on individual income composition. Empirical evidence on the link between individual income diversification and risk preference is also scarce (Fafchamps, 1998; 2003).

Studies on household portfolio composition provide ample evidence that diversification reduces income variability, though probably insufficiently to fully eliminate downside income risks for the poorest income strata (Carter, 1997; Anderson, 2001).[1] Bio-economic modelling of farm enterprises in respectively Mali and Burkina Faso also showed that poorer households have insufficient means to raise their income to a secure subsistence level (Kruseman, 2000; Maatman, 2000; Stroosnijder and van Rheenen, 2001). External risk factors (prices, markets,

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[1] Downside risks are the risks that households fall irreversibly into lower income levels.

finance) as well as internal activity-specific risk factors are clearly present in crop husbandry (Huijsman, 1986; van den Berg, 2001). Yet, in the latter studies risk preferences appear to weakly influence crop husbandry decisions.

Repeated efforts have been made to empirically assess risk preferences. Resulting risk aversion measures mostly appeared unresponsive to income and wealth in regression analyses (Binswanger, 1981, 1982; Huijsman, 1986; Zimmerman and Carter, 2003; Mosley and Verschoor, 2004).[2] In contrast, Wik (1998) found decreasing risk aversion for wealthier farmers in a study in Zambia.

Risk aversion is assumed to be the most prevalent risk attitude among poor farmers (Hardaker et al., 1997). It has an ambiguous effect on diversification behaviour because of the endogenous wealth effect on risk attitude: the wealthier the less risk averse.[3] Risk aversion stimulates diversification of economic activities because diversification supposedly brings about risk reduction. In addition, poorer people, considered to be more risk aversive, are commonly obliged to diversify because their scarce endowments do not allow them to generate sufficient income by farming alone.

Risk aversion may also impede people to diversify their portfolio of economic activities. Developing supplementary activities requires the ability to make investments and to deal with different actors in each sector. Thus diversification itself brings about new risks. Risk aversive people will seek to avoid these risks. Moreover, involvement in supplementary activities is commonly considered to increase income and thus to reduce risk aversion. The consequent negative correlation between risk aversion and supplementary income stems from the causal effect from wealth on risk aversion instead of the reverse causality from risk aversion to supplementary income. However, causality, in the sense of Granger causality, can only be established by extensive time series data.

Intra-household allocation of income

Individual income from supplementary activities has an impact on the household budget. Turner (2000) assesses adjustments of domestic budgets due to changes with respect to intra-household ownership division of livestock. Since a severe drought occurred in Niger in 1984, household heads have lost wealth, and thus authority, relative to women and male subordinates

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[2] Included countries were India (Binswanger), The Philippines (Huijsman), and Uganda, Ethiopia and India (Mosley and Verschoor). The study of Zimmerman and Carter concerned a simulation of risk behaviour.
[3] In the following we discuss risk aversion. This is more convenient than discussing risk preferences in general terms, but does not exclude the possibility that some persons may also like risk.

(Turner, 2000). Supplementary income likely has the same wealth redistribution effect as livestock ownership in the Niger study.

Actual and self-perceived contributions to the household budget do not necessarily correspond. Gladwin *et al.* (2001) assess the possibilities of multiple livelihood strategies for improving household food security. They point to the important role of informal income-generating activities, by men as well as women, to generate sufficient liquidity for making cropping-related expenditures. Their focus is on women's capacity to generate farm and supplementary income, yet they recognise that the implications on domestic budgeting further depend on the local context (culture, history, social position). In another study in southern Burkina Faso, it appeared that women who took charge of a relatively large share of household expenditures maintained that they 'only helped' their husbands in household livelihood (Thorsen, 2002).

The effect of individual income opportunities on household and individual consumption decisions depends on intra-household co-operation and bargaining. Quisumbing and Maluccio (2003) provide (preliminary) evidence that the more assets women own, the more expenditures are allocated to education and children's clothing. Similarly, Goldstein (1999) shows that risk sharing is more likely to be effectuated between women across different households rather than between members within the same household. Both studies recommend research and policy to become much more oriented towards individuals.

Smith and Chavas (1997, 1999) also show, for West-African rural households, that the impacts of price policy depend on individual reaction, instead of household response, to price changes. In contrast, Lawrence *et al.* (1999) argue, for West-Africa, that household co-operation contains enough bargaining elements to assure that men's income opportunities (*e.g.* due to technological innovation) are also beneficial for women. Finally, a study among *Bwa* and *Mossi* households reveals that intra-household analyses insufficiently explains gender division of activities and probably also income-asset relationships (Kevane and Wydick, 2001).

Whereas the above-mentioned studies rely on elaborated theories concerning risk behaviour and intra-household allocation processes, we aim at an empirical assessment of risk preferences. A quantitative assessment of the link between diversification and risk preference, albeit in an explorative manner, can be helpful to better understand whether risk attitudes actually drive income diversification.

5.2   Risk preference, diversification and investment choice

This section elaborates indicators for risk attitude, investment choice and individual income that are appropriate in the context of low-income rural village economies. The previous section illustrated that causes and effects of risk aversion are characterised by endogeneity and ambiguity. Mosley and Verschoor (2004) underscore that risk attitude is both a determinant of and determined by one's livelihood. In the following we focus on the relationship between risk aversion and diversification, and do not aim at explaining cognitive and cultural complex concepts surrounding risk perception and attitude (Slovic, 2000; Vose, 2000).

With two core questions, respectively, about risky choices and investment preference this chapter makes an empirical contribution to research into individual livelihoods. The first question considers a heads-or-tails lottery with real outcomes. The second question was about what respondents would actually do with the money they could possibly win. These two questions are derived from theories about risk behaviour and intra-household consumption allocation. The required individual income estimations rely on assumptions with respect to intra-household income pooling.

Risk attitude refers to the willingness and ability to deal with risk, the capacity to make investments, and one's income and utility level. In the following I elaborate a simple, intuitively plausible measure of risk aversion (in line with Mosley and Verschoor (2004)).

Most risk behaviour theories are based on the *von-Neumann-Morgenstern expected utility function* and on the *Bernoulli utility function*. The first assigns utility to an entire probability distribution of consumption or income levels. The latter is defined on certain amounts of money. *Bernoulli risk aversion* is essentially explained by the fact that at any place on the consumption-utility curve the utility gain from an extra consumption (or income) unit is smaller than the utility loss of consuming (or obtaining) one unit less (Mas - Colell *et al.*, 1995).

In empirical assessments of risk attitudes the effect of marginal decreasing utility of increasing income and the attitude towards lotteries are inherently linked (Smidts, 1990). For a given utility curve, risk attitude is determined by the ratio of income loss to income gain as the possible outcome of the tossing of a coin. Willingness to participate in such a lottery indicates that the utility loss for respectively losing one unit of income equals the utility gain of a subsequent number of income units. In other words, the utility value of the last received unit of income can be expressed in the number of units of income that would subsequently be needed to achieve an equal increase of utility.

A classical coin tossing experiment empirically approximates the comparison of utility loss and gain. To explain this I take a simple utility function:

$$U = \ln(y) \tag{5.1}$$

A loss of the stake leads to a utility decrease of:

$$\Delta U = \ln(y) - \ln(y - stake) \tag{5.2}$$

Similarly, a net gain gives a utility increase of:

$$\Delta U = \ln(y + gain) - \ln(y) \tag{5.3}$$

Any stake-gain combination for which equation (5.2) equals (5.3), or in words for which the utility decrease of a loss equals the utility increase of a gain, gives a unique utility-income (U, y) combination.[4] Hence, when individuals state the minimal net gain that they should possibly win to be willing to participate in the heads-or-tails lottery, they implicitly indicate their degree of risk aversion, utility and income level.

The experiment was conducted as follows (see also Appendix 5.1). Respondents were presented with four different cards. Each card presented four different stake-gain combinations with an increasing stake from FCFA 0 to 300. From card one to four the gains at each stake level were increasing. Coin tossing determined the outcome of the bet and a dice determined the card that was going to be played. Respondents received a small sum (FCFA 200), equal to the daily wage for cotton harvesting. They could refuse to participate and also add their own money to increase the stake up to FCFA 300. In any case respondents used their own money in the game. The small amount they received at the beginning of the interview was theirs.

Relative responses, compared to other respondents, are more important than absolute answers. Utility itself does not have an absolute scale, so the conversion from income to utility is merely arbitrary. Research on risk behaviour shows that risk attitudes differ according to the level of gains and losses. Our experiment was therefore simple, concerned a realistic game with relatively low stakes, and contained some triangulation questions (Binswanger, 1982; Wik, 1998).

This risk attitude assessment has some advantages, which are particularly valid in the context of a low-income economy. Respondents answered to realistic, real game questions and did not have to think about nuances in for example stating a certainty equivalent. A simplified heads-or-tails experiment with a small monetary stake has a universal neutral value and avoids the nuisance of details and the complexity of different interpretation of scaling words between persons, languages and cultures. The use of just a small amount of money coincides with the concept of marginal utility, which is usually a linear approximation of a small segment of the utility function. By initially giving a small sum of money to respondents as an incentive to

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[4] This relies on the assumption of the possibility of interpersonal utility comparison, which is evidently overly simplified but facilitates interpretation.

participate in the lottery we use the psychology of the instant and thus avoid hyperbolic behaviour leading to unobserved differences between choice intention and realisation (Harris and Laibson, 2001). All respondents were put in the same position; they received a small sum; and immediately had to decide what to do with it in a real game situation.

Additional to the lottery, a question about hypothetical expenditures provided information on to what extent people are inclined to invest. The question concerned a hypothetical possibility to spend FCFA 1,000 and FCFA 10,000. The first sum could be gained in the best outcome of the lottery and served as a step-up to the second sum. A sum of FCA 10,000 is certainly non-negligible relative to annual profits of most supplementary activities (see Chapter 3). Answers are categorised in terms of consumption goods (mostly food) and investments (mostly small ruminants or trade goods).

Lastly, an individual income measure is needed. To avoid the complexity of individual income evaluation I take four income measures that represent different income pooling mechanisms. The first measure of total individual income assumes that individuals do not pool at all. In this measure most of the farming income accrues to the head of the household. The second measure is supplementary income plus per adult equivalent household income. This measure represents the situation that household members benefit from being a member of a household but do not contribute to household income. The third measure is total household income per adult equivalent. It assumes that household members share equally all household and individual income. The last measure only considers supplementary income and makes no assumption about income pooling.

5.3   Risk aversion in economic sectors with excess capacity

Risk aversion is discussed in relation to, respectively, income, diversification, and propensity to investment. We focus on the partial role of risk aversion without assuming causality directions. Prior to the analyses the experimental results are described and exogenous determinants of risk aversion are assessed.

Experimental results

In general, respondents positively understood the experiment. Almost all respondents (98%) were already willing to bet FCFA 50 at the lowest possible gain with an expected outcome value of zero. This reflects positive evaluation of the lottery as well as some politeness in not refusing to participate. At a stake level of FCFA 100 and 200 the answers to the lottery provided sufficient variation. Tossing with a stake of FCFA 300 yielded little variation in responses.

About 78% were not willing to use additional money of their own.[5] There was little difference in lottery participation between the resource-poor and the resource-rich villages. Across different positions within the household, risk aversion appeared to be on average similar.[6]

Risk aversion differed considerably between different accessibility conditions. Men as well as women were more risk aversive in the isolated villages in both zones compared to the accessible villages (30.7 versus 27.1, significantly different at 1%-level).[7] Comparison between gender groups within villages does not consistently confirm this conclusion. Only men in the cotton growers' ward in resource-rich accessible village (RA1) consistently stood out by low risk aversion (Table 5.1). Over the entire sample men were less risk averse compared to women (27.9 versus 29.3, significantly different at 10%-level).

To assess exogenous determinants of risk aversion, responses to four different lotteries are

Table 5.1

Differences between villages and gender in risk aversion

					Men					Women				
		Avg	se	n	RA1	RA2	RI	PA	PI	RA1	RA2	RI	PA	PI
Men	RA1	23.4	1.3	22	■	**	***	**	***	**	**	***	***	***
	RA2	27.8	1.5	35	**	■						**		**
	RI	30.4	1.5	41	***		■	**			**			
	PA	26.7	0.9	47	**		**	■	**			***		***
	PI	29.8	1.2	32	***			**	■		**			
Women	RA1	27.3	1.3	16	**					■		**		**
	RA2	26.7	0.9	36	**		**		**		■	***		***
	RI	31.3	1.2	45	***	**		***		**	***	■	**	
	PA	28.6	0.9	51	***							**	■	**
	PI	31.2	0.9	36	***	**		***		**	***		**	■

Notes: *, **, and *** indicate significant differences of the average at the 0.10, 0.05 and 0.01 levels, respectively. Overall average: 28.6 with standard error of mean 0.4. The significance of difference in risk aversion between men and women in the same village is indicated in the grey cells. The data concern 361 respondents. This sample is smaller than in the other chapters because, unlike the questions related to economic activities, we needed the presence of the person in question. Abbreviations: avg = average; se = standard error of mean.

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[5] In theory there should be no difference between stakes of less or more than FCFA 200 (up to FCFA 300). However, apparently the respondents valued the money they had just received to play the lottery less than the money that was already in their pocket. The question at which minimum gain level they would be willing to bet FCFA 300 yielded answers ranging from FCFA 1250 to 5000. In terms of the utility-income framework (equation 6.1), these levels were relatively much higher than the gain that was offered in the lottery. For this reason these answers are not further used in the analysis.

[6] Included categories are head, wife, married men, married son, unmarried son, single men, married daughters, married women, and single women

[7] The risk aversion indicator takes the value of 10 for being least risk averse and 50 for being most risk averse.

used as dependent variables in an ordered probit model (Table 5.2). For reasons explained above the first lottery (with a stake of FCFA 50) provided insufficient variation in answers. Therefore the answers are not used in a separate estimation but only included in the estimation of average risk aversion measure.

The coefficients together are significantly different from zero (probability > 99%). The Pseudo-R^2 and the adjusted R^2 in the OLS are low, suggesting that the explanatory variables explain only a small part of the variability in risk aversion. The coefficients that are significantly different from zero have a consistent sign in the four estimations (ML-ordered probit and OLS). Women were more risk averse than men. The coefficients for age and age-squared are significantly different form zero confirming an expected *u*-shaped age-risk aversion curve.

Respondents in the resource-poor villages were slightly more risk averse compared to people in the resource-rich villages. Infrastructure had a much larger effect than resource endowment: the better the infrastructure, the lower the risk aversion. Education level had no impact on risk aversion. This may be due to the fact that only formal education is taken into account. Because only very few adults had received formal education, this variable probably had too little variation in the sample. Household size appeared not to be related to risk aversion, which may indicate that risk attitudes were shaped independently from the household environment.

Table 5.2

Determinants of risk aversion; regression results

Stake (FCFA)	Ordered probit						OLS	
	100		200		300		Average score	
Intercept							33.351	10.133 ***
Gender (1=female)	0.080	0.639	0.174	1.414	0.813	5.064 ***	1.613	2.041 **
Age (years)	-0.020	-0.851	-0.045	-1.871 *	-0.072	-2.154 **	-0.211	-1.443
Age squared (years)	0.000	0.831	0.001	2.192 **	0.001	2.435 **	0.003	1.725 *
Resource endowment (1=good)	-0.102	-0.847	-0.272	-2.299 **	0.054	0.364	-0.431	-0.568
Infrastructure (1=good)	-0.498	-4.131 ***	-0.461	-3.835 ***	-0.493	-3.121 ***	-3.663	-4.828 ***
Education (years)	0.016	0.447	0.022	0.612	0.053	1.102	0.131	0.570
Household size (number)	0.015	0.842	-0.009	-0.499	-0.016	-0.737	0.002	0.021
Coeffcients of limit points (1)	-0.716	-1.364	-2.600	-4.742 ***	-3.645	-4.750 ***		
(2)	0.237	0.454	-1.942	-3.590 ***	-3.293	-4.362 ***		
(3)	0.602	1.149	-1.297	-2.413 **	-2.468	-3.324 ***		
(4)	0.707	1.348	-0.898	-1.672 *	-1.964	-2.658 ***		
Akaike info criterion	2.503		2.855		1.466		6.772	
LR statistic	20.354		28.691		45.087		4.571	
Probability (LR stat)	0.005		0.000		0.000		0.000	
Schwarz criterion	2.621		2.973		1.584		6.858	

Notes: n = 361. Dependent variable in ordered probit = 1 … 5 indicating increasing risk aversion. Dependent variable in OLS is average of responses to the four lotteries. *, **, and *** indicate significance at the 0.10, 0.05 and 0.01 levels, respectively.

Risk aversion and income

Over the entire sample, risk aversion was negatively correlated with each different income measure (Table 5.3): the higher the income, the less risk averse.[8] This pattern was most clear for household heads and women and could not be confirmed for dependent men. Assessment of the correlation between income and risk aversion within the villages and across the positions in the household provides a different image. The relation between risk aversion and income found in the entire sample was also apparent for women in the resource-rich villages and for men in the isolated villages (resource-poor and resource-rich). The same pattern, however, could not be identified for the resource-poor villages and not for male dependent members in any village.

  These observations suggest that risk aversion was to a large extent determined by local conditions of accessibility and resources endowment. Within the villages the relation between income and risk preference was less pronounced. This indicates that the relation between income and risk aversion as it appeared from the entire sample may reflect specific local conditions (*e.g.* culture) rather than the generally hypothesised effects of wealth on risk aversion.

Table 5.3

Correlation between income and risk aversion by village and position

	All	RA1	RA2	RI	PA	PI
Head	(n=112)	(n=17)	(n=17)	(n=29)	(n=29)	(n=20)
Total individual income	-0.252 ***	-0.033	-0.335	-0.452 **	0.017	-0.523 **
Individual suppl. plus household income	-0.249 ***	-0.021	-0.353	-0.450 **	0.044	-0.526 **
Household income	-0.218 **	-0.103	-0.412	-0.479 ***	0.166	-0.139
Supplementary income	-0.124	0.146	-0.292	-0.163	0.060	-0.243
Men	(n=65)	(n=5)	(n=18)	(n=12)	(n=18)	(n=12)
Total individual income	-0.146	-0.185	-0.219	-0.227	0.014	-0.377
Individual suppl. plus household income	-0.128	-0.178	-0.168	-0.373	0.065	-0.280
Household income	-0.050	-0.114	0.039	-0.448	0.204	0.192
Supplementary income	-0.222 *	-0.268	-0.374	-0.298	0.003	-0.133
Women	(n=184)	(n=16)	(n=36)	(n=45)	(n=51)	(n=36)
Total individual income	-0.184 **	0.088	-0.311 *	-0.172	-0.075	-0.026
Individual suppl. plus household income	-0.237 ***	-0.553 **	-0.387 **	-0.298 **	-0.077	0.049
Household income	-0.218 ***	-0.662 ***	-0.350 **	-0.297 **	-0.066	0.026
Supplementary income	-0.198 ***	0.138	-0.339 **	-0.200	-0.092	0.013

Notes: Correlation coefficients for entire sample are: -0.19***; -0.21***; -0.18***; and -0.17*** for respectively total individual income, supplementary income plus household income, household income and supplementary income. *, **, and *** indicate significance at the 0.10, 0.05 and 0.01 levels, respectively.

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[8] Income measures are explained in the previous section: 1: no income pooling; 2: sharing in household income and individually holding supplementary income; 3: full income pooling and sharing; and 4: only supplementary income is taken into account.

Risk aversion and activity diversification

To examine the actual relationship between risk aversion and activity diversification, we compare income composition by category of risk aversion and position within the household.[9] This is presented for the second income measure, namely individual supplementary income plus household income as if it were equally shared among the members. This measure assumes that members can individually use their own income while still taking advantage of household income.[10] For the income measure of total individual income, the share of farm supplementary income was constant across classes of risk aversion. This measure does not reveal whether individuals diversify by increasing individual income relative to total household income. The income measure of household income per adult equivalent cannot reflect individual diversification behaviour.

  Less risk-averse people obtained a larger share of their income form supplementary activities (Figure 5.1). This observation essentially concerned dependent men and to a lesser extent household heads and women. Less risk-averse people diversified more because they obtained a

Figure 5.1

Share of supplementary income by class of risk aversion and position in household

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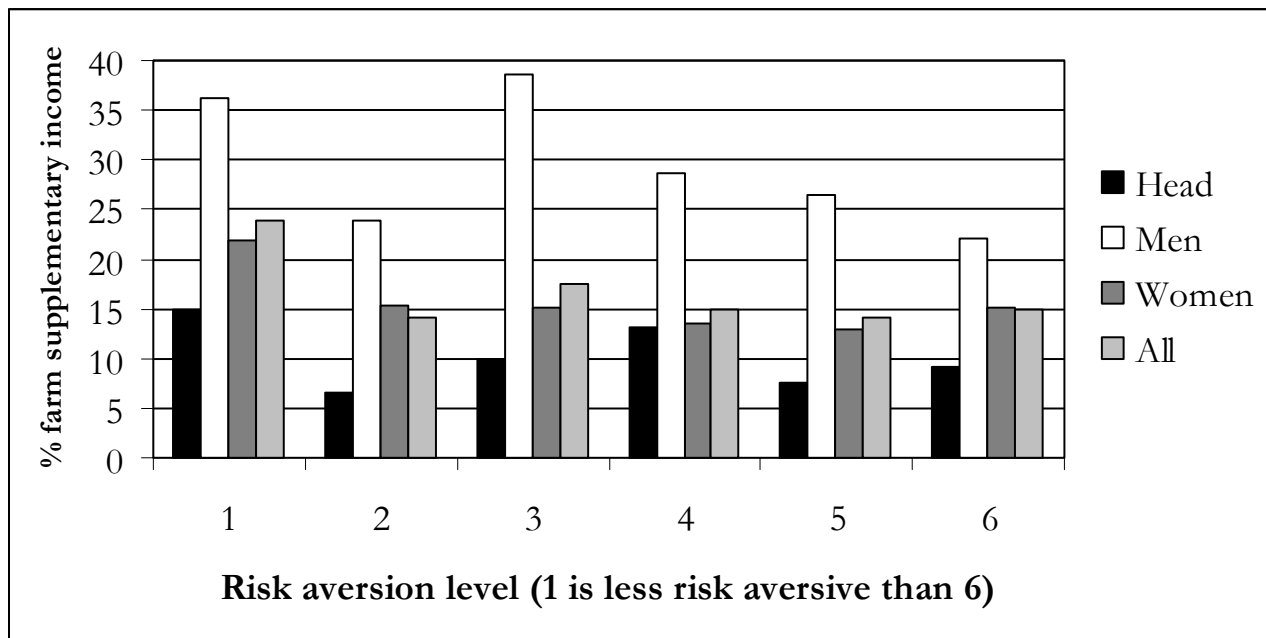
[9] Diversification in this context means a large share of supplementary income. Thus when total individual income consists of a large share of supplementary income, as is the case essentially for men, what we call diversification is in fact specialisation into supplementary activities.

[10] The latter assumption is not realistic for the position of the household head. This income measure can be used to compare persons within the same position but does not enable us to compare individuals with different positions.

a higher income through engaging in supplementary activities. Also less risk-averse people may have diversified because they were willing to take the risks of developing new activities. Bivariate correlation analysis by village and by individual position did not confirm this inverse relationship between risk aversion and diversification. As expected, the underlying mechanisms of risk aversion and diversification behaviour may consist of avoidance of income risks by diversifying as well as taking risks by engaging in supplementary incomes.

Individual activity diversification was mostly limited to two or three activities. Women frequently developed one to three supplementary activities especially in the resource-rich villages. Men involved in supplementary activities commonly had a single supplementary activity generating more than 90% of total supplementary income. In the resource-rich accessible village (RA1), some men had a more important second supplementary activity. However, in this village supplementary income was relatively less important.

Investment choice and risk aversion

The propensity to invest or consume the hypothetical extra income was largest in the resource-poor accessible village (70% of the respondents would invest, compared to 40-55% in the other villages). The relatively large sum of FCFA 10,000 was more likely to be used for investments (62%) than the small sum of FCFA 1,000 (43%). Between those willing to invest and others willing to consume an extra income there were no differences in risk aversion.

Table 5.4 provides information on the personal characteristics that predispose people to allocate income to investments.[11] A higher income, for households as well as individuals, led to a greater readiness to make investments. Household heads were slightly more inclined to invest compared to other men and women. The head of the household commonly had more room for manoeuvre to invest, but there was no difference in willingness to invest between subordinate men and women.

Strikingly, people in the resource-poor villages were more inclined to allocate income to investment goods. This may have two reasons. First, there was simply less opportunity for spending money in the poorer northern zone and therefore people saved their money in a near-liquid asset like small ruminants. Second, in the more risk-prone resource-poor villages, people were more eager to set their money aside in order to have a buffer to cope with adverse income conditions. Education and household size had no effect on the propensity to invest. As illustrated in Chapter 3, starting supplementary activities did not require important skills.

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[11] Finally the risk aversion coefficient (average minimum gain level in the four lotteries) appeared not to be significantly different from zero and could therefore be excluded in the estimation.

Table 5.4

Probit estimation of propensity to invest

Dependent variable is reply to the question: How would you spend …	0 = investments; 1 = consumption goods;			
	… FCFA 10,000?		… and FCFA 1,000?	
	Coeff.	z-value	Coeff.	z-value
Intercept	1.998	1.691 *	1.399	1.182
Supplementary income (ln FCFA)	0.149	1.283	0.049	0.407
Crop income (ln FCFA)	-0.509	-2.314 **	-0.383	-1.796 *
Livestock assets (ln FCFA)	-0.059	-0.505	-0.075	-0.625
Head of household (=1)	0.072	0.243	-0.516	-1.741 *
Other male members (=1)	0.055	0.156	-0.563	-1.541
Age (years)	-0.030	-0.652	-0.016	-0.328
Age squared (years)	0.000	0.798	0.000	0.529
Resource-rich (=1)	1.039	2.154 **	0.633	1.345
Accessible (=1)	-0.708	-2.000 **	-1.159	-3.028 ***
Resource-rich and accessible (=1)	0.897	1.840 **	0.848	1.702 *
Education (years)	-0.060	-0.822	-0.041	-0.570
Log likelihood	-213.513		-210.027	
Observations with dependent variable =1	192		129	

Notes: n = 361; *, **, and *** indicate significance at the 0.10, 0.05 and 0.01 levels, respectively.

5.4 A paradox of small daily and large background risks

This chapter emphasises that risk aversion is a personal trait and should therefore be matched with individual diversification and investment behaviour. However, research on rural development thus far has devoted limited attention to individual livelihoods.

Risk aversion is frequently referred to in livelihood studies as an important but ambiguous determinant for investment and diversification behaviour. Measurement and interpretation of risk aversion is more advanced in theoretical work than it appears from related empirical evidence. Because of the subjective element in the perception of and the response to risk, elicitation of risk attitudes has frequently led to inconclusive results.

The empirical risk measure presented in this chapter confirms common wisdom about gender and age as exogenous determinants of risk aversion. Women were more risk averse compared to men and risk aversion first decreased and then increased with age. In addition, better accessibility consistently led to less risk aversion. Risk and income appeared to be related to a limited extent. Local conditions strongly determined the link between risk attitude and income, and thus will probably influence also risk perception.

Against expectations, risk aversion had a limited effect on individual diversification and investment choices. This finding emerges from a combined analysis of risk aversion and individual livelihood diversification, which I did not find in comparable studies. Individuals,

men more than women, tended to specialise rather than diversify in economic activities. This important configuration of livelihoods implies that individuals behaved rationally with respect to the principle of economic advantage through specialisation. If risk aversion had an impact on diversification, this seemed to be a negative impact: less risk-averse people showed greater involvement in supplementary activities.

In the perspective of prevailing economic conditions in less-favoured areas, it is not surprising that empirical identification of risk perception and attitude has been less successful (Pannell *et al.*, 1997). Economic activities are carried out in a diffuse institutional and technological context and thus there are many other factors besides risk that shape patterns of livelihoods (Anderson, 2001). Less-favoured areas are characterised by inter-linkages between markets for products, finance, insurance and labour; between production and consumption decisions; and between background risks (health and drought) and activity-specific risks (Ruben *et al.*, 2004).

The assessment of risk attitude in the present study sheds light on the paradox between small daily risks and large structural background risks. Daily activity-specific risks are probably overshadowed by diverse and relatively large background risks related to social security and climate (Smith *et al.*, 2000; Fafchamps, 2003; Ellis, 2000). Consequently, it is difficult to probe on risks that can to some extent be controlled by the management of the activity. Compared to the readiness to invest, local opportunities for investments with economic potential were scanty. As elaborated in chapter 3, the present excess capacity in non-farm sectors implied that prevailing economic activities produced largely sufficient goods to meet local demand. Consequently, people showed a large tendency to invest if there were economically feasible activities.

Chapter 6

Supplementary income and crop husbandry

Involvement in supplementary activities brings about changes in crop husbandry. Households adjust production factor proportions, in particular the land to labour ratio, and apply more or less external inputs per labour unit. In addition, timing and quality of farm work may change due to involvement in supplementary activities. Farmers may also adopt different production technologies.

This chapter evaluates the impact of involvement in supplementary activities on crop productivity, production efficiency, input demand and technology choice. This assessment combines livelihood analysis with an estimation of a production frontier for millet and sorghum. First, I refer to the sustainable livelihoods framework to illustrate the link between farm and supplementary activities. Subsequently, I elaborate how non-physical variables (*e.g.* supplementary income) are incorporated in estimations of crop production and production frontiers. The literature review in section 6.2 presents examples of positive and negative effects of involvement in supplementary activities on crop husbandry.

The analysis shows that in a resource-poor environment, households with more supplementary revenues used labour and land for crop production more efficiently. Also, livestock asset ownership showed a positive relationship with crop production efficiency in a resource-poor environment. In contrast, in the resource-rich villages, supplementary and livestock assets were not directly related to efficiency of factor use.

Supplementary income did not appear to be a determinant of use of external inputs for crop husbandry in the resource-rich nor in the resource-poor zone. In the resource-rich villages, hired labour was the single input that was more important for households having more supplementary income. Other inputs such as mechanisation and organic matter were more important for households who own more livestock assets. Also in the resource-poor villages, the use of fertiliser and oxen traction increased when households had more livestock assets.

The concluding section suggests that policy and extension support to farm and supplementary activities should not aim at diversification of activities within the household. Diversification took place across agricultural seasons and between individual household members. This resulted in a co-existence of economic activities for which the underlying motives focused on income generation rather than that they reflected an intention to improve either activity.

6.1   Household livelihood, cropping efficiency and input demand

Asset endowment and crop production efficiency are brought together in the thesis on the paradox of being poor in income but efficient in crop cultivation (Schultz, 1964). However, the scope of Schultz's thesis is more limited than it is generally referred to (Sherlund *et al.*, 2002). Efficiency, as used in Schultz's thesis, relates to allocative efficiency of a specific technology with a given set of inputs. The poor-but-efficient hypothesis refers to farmers who efficiently use labour and land in traditional crop production technologies. It does not concern the question which factors enable farmers to innovate towards better production technologies.

Schultz (1964) poses the question why subsistence agriculture continues to exist also in communities that are relatively non-isolated and where people evidently are hard working and eager to improve livelihoods. One could argue that, at household level, the more households are involved in supplementary activities the better potential they have to become more efficient in crop production. In the poor-but-efficient hypothesis livelihood analysis and efficiency assessment come together and therefore further precision of poverty and efficiency is required.

Because poverty and efficiency are concepts that encompass many aspects, we use rather narrow proxy definitions of both terms. Poverty, in this chapter, refers specifically to access to supplementary activities and to ownership of livestock, both constituting a part of the household asset base. Efficiency refers to measures of technical efficiency estimated by the use of direct production functions and to input demand as an indicator for the capability of households to shift to new production technologies.

With respect to the description of the livelihood asset base, I refer to the framework for analysing sustainable livelihoods as it has been developed by the U.K. Department for International Development (DFID, 2001; Meinzen-Dick *et al.*, 2003). Concerning crop production efficiency assessment I follow common econometric methodology to assess productivity, efficiency and input demand.

The effect of supplementary income on crop husbandry is part of the farm livelihood complex. This chapter focuses on the question whether involvement in supplementary activities has an effect on efficiency of use of labour and land in crop production and on input demand. Input demand effects may concern large investments (*e.g.* animal traction) as well as variable expenditures for crop production (*e.g.* labour and fertilisers).

The asset pentagon

Poverty as used in the poor-but-efficient hypothesis refers to the household asset base. In the sustainable livelihoods framework this base consists of a pentagon of distinct but related assets: human, natural, social, physical and financial capital. The pentagon analogy indicates that assets have distinct functions but their role in generating income depends inextricably on other assets. Financial, social and human capitals determine access for rural households to natural resource and man-made capital (see Chapter 3).

Supplementary activities contribute importantly to income generation and thus reinforce the household economic base. Reinforcement of the household economic base implies more room for manoeuvre to adjust proportions of factor use and to choose production technologies. A better economic base is consequently expected to lead to more efficient crop production. Likewise, livestock assets are included in the analyses of this chapter.[1]

In addition to the effects of asset ownership, the same factors that facilitate involvement in supplementary activities also positively affect farming activities for reasons of simultaneity. People with the capability to develop supplementary activities may also be better equipped to manage the crops. Moreover, when labour is hired with supplementary income, timing of crop management may improve. In some cases a negative impact of involvement in supplementary activities on crop management may occur. Competition for labour or divergence of the interests of the farmer can result in reduced quality of crop management.

Crop production at the frontier

To empirically evaluate the links between supplementary activities and crop production, I use a common quantitative analytical framework to assess productivity, efficiency and input demand (Coelli *et al.*, 1998; Coelli, 1995). Estimations of the production function and frontier (eq. 6.1) represent technical relationships between input and output conditional upon the production environment and technology. The production function represents an average firm technology, while the frontier estimation reflects the best possible output given a set of inputs. Frontier estimations are commonly combined with a prediction of inefficiency (eq. 6.2).

The equations 6.1 and 6.2 reflect that for some variables (z^l) a choice needs to be made whether to use them to predict the frontier or the inefficiency term. Input related variables, like soil quality, are commonly used to predict the frontier while labour related variables, like

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[1] As described in Chapter 2, the potential annual revenues that can be expected from the average livestock represent livestock assets.

Equation 6.1

Frontier estimation $q_{ij} = \sum_{k=1...n}^{1} \beta^k x_{ij}^k + \sum_{l=1...m}^{1} \alpha^l z_{ij}^l + (v_{ij} - u_{ij})$

This is estimated for $i = 1...n$ plots of $j = 1...n$ farm households.

q_{ij} is the logarithm of the output value.

x^k are $k = 1...n$ types of inputs (variable inputs in logarithm).

z^l are $l = 1...m$ additional variables that determine the production frontier.

β^k and α^l are unknown parameters.

v_{ij} is the error term, assumed to be iid. $N(0, \sigma_{v^2})$ and independent of

u_{ij} , which is a non-negative term for technical inefficiency in production and is assumed to be independently distributed as truncations at zero of the $N(m_{ij}, \sigma_{u^2})$ distribution.[2]

Equation 6.2

Inefficiency prediction $m_{ij} = \sum_{l=m...n}^{m} \delta^l z_{ij}^l$

where z^l are $l = m...n$ variables that influence crop production efficiency

and δ^l is a vector of parameters to be estimated.

management quality, are used to explain inefficiency. The arbitrariness of this choice is represented by the z^l variables indicating that several variables can be used in predicting the frontier $(l < m)$ as well as the inefficiency term $(l > m)$ (Ali and Byerlee, 1991).

We use three groups of explanatory variables in the estimation procedures: i) the technology itself, namely the use of land, labour, external inputs, and oxen traction; ii) plot and environment conditions such as soil quality and rainfall; and iii) variables that are not related to crop inputs or to field conditions. The latter group of variables include education, age, supplementary income, and livestock assets.

Productivity and efficiency assessment should be confined to relatively homogenous production technologies (Ali and Byerlee, 1991). In the following, I analyse the production parameters for sorghum and millet production. These crops are cultivated under traditional

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[2] Below we elaborate the frontier estimation with the specification of the error term $(v_{ij} - u_{ij}) = (e_{ij})$ where (e_{ij}) is the error term of the production function in Appendix 6.1. The equations are log-linear forms of standard Cobb-Douglas functions. Other functional forms like translog and quadratic estimation did not give a better statistical fit.

crop management practices for which farmers use little external inputs. It has been demonstrated that in traditional agriculture environmental information commonly adds little to the explanatory power of a production function (Savadogo *et al.*, 1994; Adégbidi *et al.*, 2000).[3]

Crop husbandry input use

Input demand is commonly estimated in relation to profit maximisation objectives as a function of output prices (p^q), input prices (p^x) and wages (w) conditional upon household characteristics (z_j^l) (eq.6.3a; (Sadoulet and De Janvry, 1995)). In separate and reduced form, input demand is a function of endogenous prices and household characteristics. Household characteristics commonly function as proxies for endogenous prices thus reducing equation 6.3a into equation 6.3b.

Equation 6.3a

Input demand: $x_j^n = f(p^q, p^x, w, z_j^h)$

  x_j^n are n type of inputs (at household level for $j = 1...n$ households).

  p^q are output prices.

  p^x are input prices.

  w represent wages.

  z_j^l indicate $l = 1..n$ household characteristics for $j = 1...n$ households.

Equation 6.3b

Approximated input demand: $x_j^n = f(z_j^l)$

  Household supplementary income may have an effect on the dependent variables and on some explanatory variables such as education and cultivated area. This implies that supplementary income may be an endogenous variable and the estimation would be biased. This bias would imply that the actual relationship is smaller compared to the outcome of the estimation. Thus, in case the results would point to a positive relationship between productivity and efficiency there should be a correction for possible overestimation. In case no significant effects are identified the problem of endogeneity is less present (Wooldridge, 2000).

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[3] Estimation of the production function of maize and cotton proved to be problematic because the production technology is more complex. For cotton cultivation the effect of application of fertilisers and insecticides depends strongly on timing related to the date of sowing and to weather conditions. Other crops like maize, rice and groundnuts are cultivated on relatively small plots and various crop management practices interact (*e.g.* staggered harvesting, use of organic matter, nitrogen fixation, etc.).

6.2 Supplementary income and crop husbandry

This section reviews empirical studies that focus on non-physical determinants of productivity, efficiency, and input demand. Studies on crop production recognise the impact of non-physical factors but only a few studies incorporate these in empirical production function estimates. In most cases, input demand estimations concern aggregate input demand and do not specify input types.

Supplementary income and efficiency in crop production

In a study on rice cultivation in Ivory Coast, technical efficiency in appeared to be positively as well as negatively affected by supplementary income streams (Barrett *et al.*, 2004). Probably, a negative effect stemmed from less interest of the cultivator and less time because supplementary activities competed for available time. This effect may have been partially compensated by a positive effect of better accessibility to external inputs and hired labour. In an earlier study the same authors found higher technical efficiency on farms specialised in rice cultivation and for farmers who had attained lower education levels (Sherlund *et al.*, 2002).

In rice cultivation in Bangladesh the percentage of supplementary income in total income appeared to have a consistent negative effect on efficiency (Coelli *et al.*, 2002). Involvement in supplementary activities appeared to reduce farmers' attention to crop cultivation. These findings with respect to the effect of supplementary income contrast with results from a study in Ethiopia where farm as well as non-farm diversification contributed to higher crop productivity (Woldehanna, 2000). The contrast between both studies can be explained by conditions of comparative advantage in the respective regions of study. The study in Bangladesh concerned input-intensive rice cultivation in an accessible area. The study in Ethiopia was about rain-fed agriculture in more isolated areas by farmers who were frequently involved in supplementary activities.[4]

In Lesotho, farm households with remittances in their income portfolio appeared to produce technically more efficiently (Mochebelele and Winter-Nelson, 2000). Remittances appeared to be the most important determinant of efficiency differences.

Other non-physical variables that have been used in the estimation of a production function include information on rainfall (Chavas *et al.*, 1991) and riskiness of the activity in question (van den Berg, 2001). It has been demonstrated, also for agriculture in Burkina Faso, that plots managed by men showed higher productivity compared to plots managed by women (Udry *et*

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[4] Both studies use income shares as explanatory variables and thus provide information on the effect of asset composition rather than asset size on crop husbandry.

al., 1995). Controlled for input level, however, gender had no significant impact on marginal productivity. Udry *et al.* (1995) estimate that plot yield would increase by 11% if supplementary income doubled. His study was based on data from villages with similar conditions as in this research. One could argue that an 11% increase of relatively low yields is a minor consequence of a doubling of supplementary income.

Portfolio decomposition studies provide less information on possible effects of supplementary income on crop productivity and efficiency. Barrett *et al.* (2001) report that households that have insufficient agricultural resources typically rely on low-productivity agricultural activities. Recursive links between income components and productivity complicate these analyses. Diversification and specialisation appear feasible livelihood options for high- as well as low-income strata.

Supplementary income and use of inputs for cropping

Various studies provide examples of significant investments of farm supplementary earnings in agricultural production, for example in Kenya (Collier and Lal, 1986; Zaal and Oostendorp, 2002; Tiffen, 2003), Honduras (Ruben and van den Berg, 2001), India (Walker and Ryan, 1990), and Indonesia (Nibbering, 1991; Meindertsma, 1997). With supplementary activities households have a better liquidity position enabling them to buy farm inputs or to hire labour. Households are assumed to be better able to take risks when they have an income stream which is not positively correlated with crop revenues. Supplementary revenues may serve as collateral for credit thus giving access to finance markets (Collier and Lal, 1986; Woldehanna, 2000).

Input demand estimations in other studies, however, illustrate ambiguous effects of supplementary income on agriculture expenditure levels. Expenditures for crop production are determined by many factors, yet often in opposite directions. For example, Savadogo *et al.* (1994) found, against expectations, a negative effect of accessibility on the probability that a household would invest in animal traction equipment. In the study by Savadogo *et al.* (1994) the three resource-rich villages of this research were also included. Apparently, reasons of history, village culture and organisation have been more important reasons than the proximity of the asphalt road for some households to specialise in cotton cultivation.

Another example concerns the allocation of supplementary income to labour and fertiliser use in crop production in India (van den Berg, 2001). In this study risk perception and production variability appeared to cause counter-intuitive effects of supplementary income on input demand. Farmers considered fertiliser use to be risk-reducing (variability). Supplementary income improved the capacity to deal with risk and thus farmers with more supplementary

income were less inclined to use fertilisers. They felt less need to reduce crop production risks. The same study also shows that labour use in crop production did not vary consistently across supplementary income levels. On the one hand, more supplementary income led to a greater capacity to deal with risk and thus farmers used more labour in crop production. On the other hand, time competition effects led farmers to reduce labour input in crop production.

Concerning the effect of supplementary income on specific inputs some hypotheses are postulated. Empirical research mostly does not concern this level of detail. The relationship between the use of organic matter and supplementary revenues depends on the time horizon. In the long run households may invest supplementary revenues in cattle and thus increase capacity to produce organic matter. In the short run, labour constraints may impede households from holding cattle and producing and transporting organic matter. Crop choice and technology adjustment is also ambiguously dependent on involvement in supplementary activities. A farmer may choose to cultivate crops that are less labour- and input- intensive because supplementary activities receive priority. Conversely, alleviation of cash constraints may encourage cultivation of more labour- and input-intensive crops by creating access to hired labour and external inputs.

6.3   The effect of supplementary income on crop husbandry

This section evaluates productivity and efficiency in crop production and input demand across conditions of resource endowment and accessibility. The estimations are specified by resource endowment: resource-poor versus resource-rich. Thus related inefficiency measures concern zone specific production frontiers.

Cereal versus cotton cultivation

The villages showed remarkable differences in factor use per unit gross margin of output (Table 6.1). With background information on village income level some preliminary conclusions can be drawn about typical village development dynamics. Households may have been technically less productive in one activity but overall economically better off (Pender *et al.*, 1999).

Table 6.1

Input use intensity by crop and village

Village	RA1		RA2		RI		PA		PI	
	avg	sd	avg	sd	avg	sd	avg	sd	avg	sd
Sorghum	(n=49)		(n=27)		(n=77)		(n=59)		(n=111)	
Square metre per FCFA net margin	35	30	14	10	20	14	22	13	32	27
Hours per FCFA 1000 net margin	20	17	7	6	10	11	33	25	45	35
Millet	(n=19)		(n=16)		(n=23)		(n=47)		(n=26)	
Square metre per FCFA net margin	31	14	16	14	22	25	28	19	29	29
Hours per FCFA 1000 net margin	27	11	10	10	10	9	32	21	42	37
Cotton	(n=16)		(n=4)		(n=86)					
Square metre per FCFA net margin	8	4	9	1	12	5				
Hours per FCFA 1000 net margin	7	4	8	2	9	6				

Notes: Abbreviations: avg = average; sd = standard deviation; net margin = gross revenues minus costs for external inputs. Labour intensity cannot be compared across the resource endowment. In the resource-rich villages, labour use has been recorded in hours once every two weeks. In the resource-poor villages labour use has been estimated in number of days at the end of the growing season. Consequently, labour use in the resource-poor zone appears to be much higher compared to the resource-rich zone.

Cultivated area per unit of gross margin output was similar in both resource-poor villages with on average slightly better productivity in the accessible village. In the resource-rich accessible village with an orientation towards cotton cultivation (RA1), households used on average more than twice as much labour and land per gross margin cereal output value (FCFA) compared to the other two resource-rich villages. For cotton cultivation, factor use per unit gross margin output was equal in both resource-rich accessible villages. The *Bwa* households in the resource-rich isolated village used slightly more labour and land per unit output for producing cotton.[5]

To explore whether productivity indicators on millet and sorghum plots can provide information about the productivity on cotton and maize plots, I compare crop yield and returns to labour on different plots of the same farm. A similar analysis for rain-fed agriculture in Cameroon, performed by de Steenhuijsen Piters (1995), shows large variations in crop yields on the same farm.

Returns to labour largely vary across crops within and between households (Figure 6.1). In each village, less than half of the households had a return to labour on millet and cotton fields within the plus to minus ten-percent range of return to labour on sorghum plots. Over the entire spectrum of return to labour on sorghum fields, there were households not cultivating

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[5] These households obtained 68% of crop income from cotton cultivation and more than 70% of total income from crop income.

Figure 6.1

Intra-household comparison of crop returns to labour: sorghum versus cotton and millet
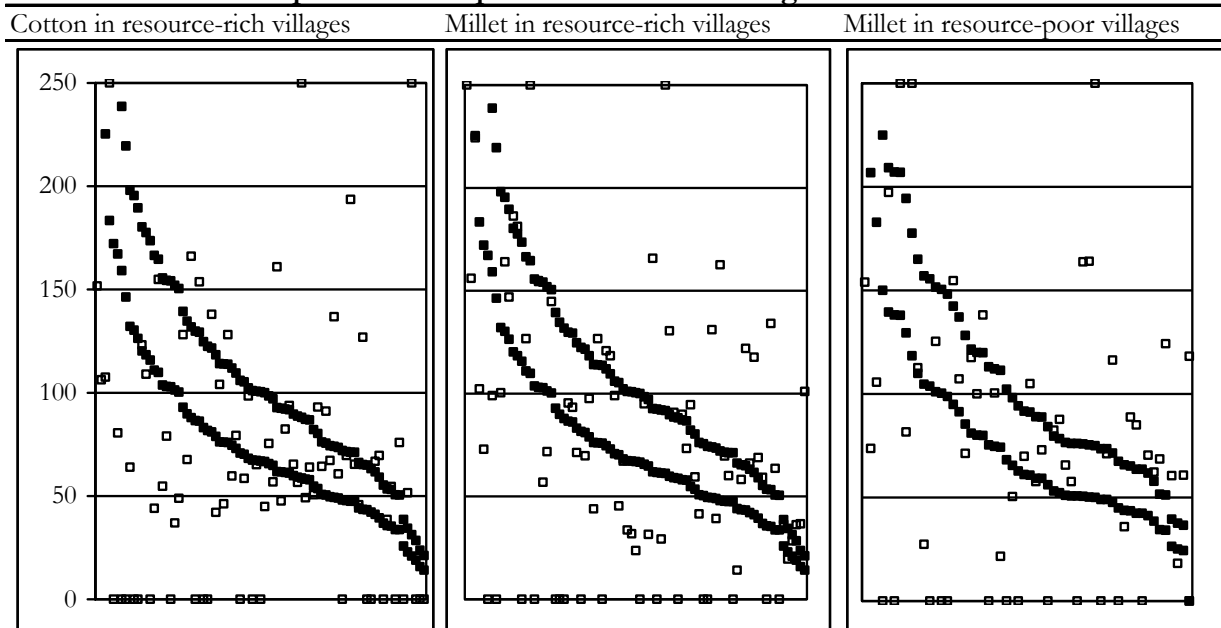
Cotton in resource-rich villages	Millet in resource-rich villages	Millet in resource-poor villages

Dots on the same vertical line represent the average of 1-3 plots of the same household.

The closed dots depict a + / - 10% range of realised returns to labour of sorghum.

The open dots represent returns to labour for respectively cotton and millet (zero is no observation).

Vertical: % of zone average	Horizontal: household observations

Figure 6.2

Intra-household comparison of crop yields: sorghum versus cotton and millet
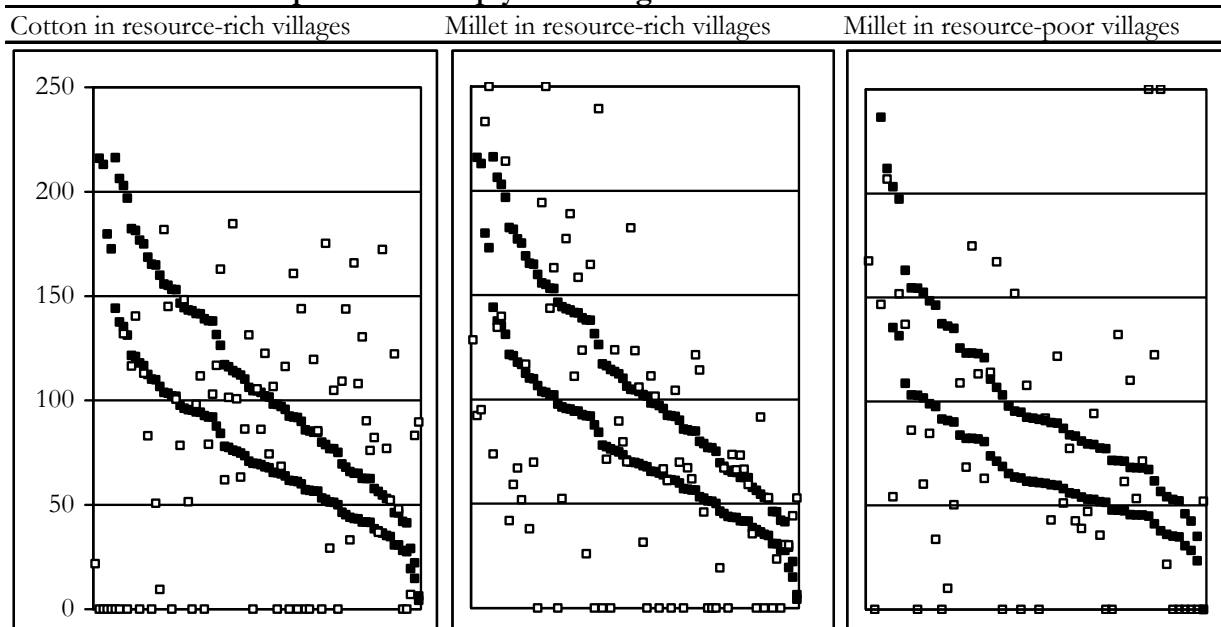
Cotton in resource-rich villages	Millet in resource-rich villages	Millet in resource-poor villages

Dots on the same vertical line represent the average of 1-3 plots of the same household.

The closed dots depict a + / - 10% range of realised crop yield of sorghum.

The open dots represent crop yield for respectively cotton and millet (zero is no observation).

Vertical: % of zone average	Horizontal: household observations

millet (zero-observations). Thus, returns to labour for sorghum did not influence the decision to specialise in sorghum cultivation or to choose for other crops.

High productivity in cereal production does not warrant the same productivity in cotton cultivation. Cotton yields tended to be higher for the farmers with low sorghum yields (Figure 6.2). These were farmers, in the resource-rich isolated village, who specialised in cotton production. Farmers in the resource-rich accessible village with high sorghum yields (>150% of zone average) had only a small area cultivated with cotton.

On the same farm in the resource-rich villages, millet plots had a yield level rather similar to the sorghum plots. The deviation from sorghum yield became larger with increasing yield. Better soils caused greater within-household yield variation. On the same farm in the resource-poor villages, millet yields did not show much consistency with sorghum yields. It may be that households with low sorghum yields either had high millet yields (specialisation towards millet) or did not cultivate millet (some of the poorer households).

Crop productivity and efficiency of labour and land use

As expected for traditional crop production technologies, land and labour determined the largest part of the production frontier (Table 6.2).[6] In the resource-poor villages, land and labour had similar effects on the frontier for sorghum and for millet production. In the resource-rich villages the marginal effects of land and labour use were different across crops. Millet cultivation is labour-extensive and thus provided a higher marginal labour productivity compared to sorghum cultivation. The higher marginal productivity of land in sorghum cultivation may have been due the residual effects of fertiliser use on cotton fields prior to the year that sorghum was cultivated on these plots.

Application of fertiliser and organic matter had no significant effect on productivity. In the case of cereal cultivation this was expected because of the limited number of fields that received these inputs (cf. Chapter 2). Other technical variables appeared to have limited effects on crop output. In the resource-poor villages white sorghum performed slightly better than red sorghum and bean intercropping increased crop yield (taken as the harvest value of cereals and beans together). Women tended to attain lower marginal productivity for sorghum in the resource-poor villages, and for millet cultivation in the resource-rich villages (Appendix 6.1).

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[6] Because many households cultivated only a single plot of both crops, we used a cross sectional estimation of the pooled data. The estimation of the production function is presented in Appendix 6.1. The production function differs from the frontier estimation in that it includes some non-physical variables (*i.e.* status within the household, supplementary income, and livestock assets). These variables are linked to the frontier estimation by using them as variables explaining technical inefficiency.

Table 6.2
Frontier and ineffciency estimation by crop and resource endowment

	Resource-rich				Resource-poor			
	Sorghum (n=155)		Millet (n=58)		Sorghum (n=171)		Millet (n=73)	
Frontier estimation	coefficient	z-val.	coefficient	z-val.	coefficient	z-val.	coefficient	z-val.
Inputs								
Land (ln FCFA)	0.827	7.26 ***	0.313	1.55	0.346	4.57 ***	0.432	4.41 ***
Labour (ln FCFA)	0.229	1.95 *	0.726	4.53 ***	0.362	5.09 ***	0.277	2.51 **
Fertiliser (ln FCFA)	-0.033	-0.97	n.a.		0.006	0.28	-0.064	-3.53 ***
Organic matter (ln local units)	0.015	0.55	-0.053	-2.43 **	-0.002	-0.22	-0.002	-0.16
Technical and environment								
Animal traction (proxy)	-0.022	-1.03	0.060	1.88 *	0.002	0.11	0.024	1.40
Red sorghum (=1)	n.a.		n.a.		-0.138	-1.17	n.a.	
Been intercropped (=1)	n.a.		n.a.		0.103	0.83	0.222	1.69 *
Accessibility (=1)	0.012	0.08	0.058	0.25	0.119	1.11	0.226	1.59
Distance to homestead (ln mtr)	-0.082	-1.27	-0.297	-2.07 **	-0.025	-0.62	0.066	0.91
Intercept	2.181	3.60 ***	3.189	3.24 ***	4.034	7.57 ***	3.529	3.48 ***
Inefficiency explanation								
Individual characteristics								
Age (year)	0.036	0.45	1.157	1.83 *	0.056	0.86	0.163	1.70 *
Age squared(year)	0.000	-0.18	-0.012	-1.83 *	0.000	-0.85	-0.002	-1.76 *
Education (year)	-0.121	-1.19	0.151	0.46	0.092	0.47	0.530	1.93 *
Number of children (number)	0.010	0.16	-0.916	-1.81 *	0.156	1.83 *	-0.086	-0.69
Owner: Women (=1)	1.082	1.97 **	1.714	1.24	0.704	1.34	0.938	1.08
Owner: Dependent men (=1)	2.915	2.74 ***	10.468	2.11 **	-0.655	-0.80	-0.981	-0.93
Household characteristics								
Cultivated area (ha/ae)	-0.001	-0.25	0.034	1.71 *	0.004	0.97	0.017	1.48
Household size (number)	-0.031	-0.50	-0.369	-1.33	0.091	1.11	0.050	0.33
Ratio absent / present	0.001	0.34	-0.006	-1.01	0.004	0.97	0.012	1.59
Suppl. income (FCFA / ae)	-0.004	-0.62	0.024	1.21	-0.025	-2.42 **	-0.021	-1.92 *
Livestock assets (FCFA /ae)	0.010	0.84	-0.020	-0.50	-0.139	-2.17 **	-0.113	-1.97 **
Intercept	-1.831	-0.93	-27.680	-1.87 *	-3.059	-1.38	-5.601	-1.83 **
Sigma_v (se)	0.539	0.09	0.577	0.07	0.411	0.05	0.267	0.06
Wald chi2(9)	368		129		212		111	
Prob > chi2	0.00		0.00		0.00		0.00	
Log likelihood	-176		-57		-143		-53	
Predicted efficiency (%)	avg	sd [n]	avg	sd [n]	avg	sd [n]	avg	sd [n]
Village								
Accessible (RA1)	49	16 [50]	67	19 [19]				
Accessible (RA2 and PA)	66	17 [28]	97	3 [16]	71	19 [59]	64	25 [47]
Isolated (RI and PI)	58	19 [77]	70	25 [23]	64	19 [112]	57	24 [26]

Notes: The dependent variable is the log value of crop output (FCFA). Animal traction consists of an estimation of the costs for plowing, weeding and ridging. *, **, and *** indicate significance at the 0.10, 0.05 and 0.01 levels, respectively. Abbreviations: n.a. = not applicable; avg = average, sd = standard deviation; ae = adult equivalent.

Households in the resource-poor villages with more supplementary and livestock income were more efficient in use of land and labour in cereal cultivation.[7] In the resource-rich villages, supplementary income and livestock assets did not have an effect on efficiency and productivity.

Other non-physical variables had a limited contribution to explaining inefficiency. The individual traits that mattered are gender and the number of dependent children for whom the principal cultivator is responsible. Yet, the effects were not the same across crops and resource endowment.

The last rows in Table 6.3 show that technical efficiency, relative to the local production frontier, did not consistently depend on resource endowment and accessibility. Only the households in the resource-rich villages, oriented towards cotton cultivation, were significantly less technically efficient in sorghum production compared to the other villages. Households in the two resource-poor villages were technically as efficient as the households in two most efficient resource-rich villages. Households in both villages produced on average about 60-70 percent of frontier production level.

Technical efficiency on millet and sorghum plots were weakly correlated (r= 0.3, significance level of 0.10). For most households the technical efficiency on millet plots lied within the range

Figure 6.3
Intra-household comparison of technical efficiency for millet and sorghum
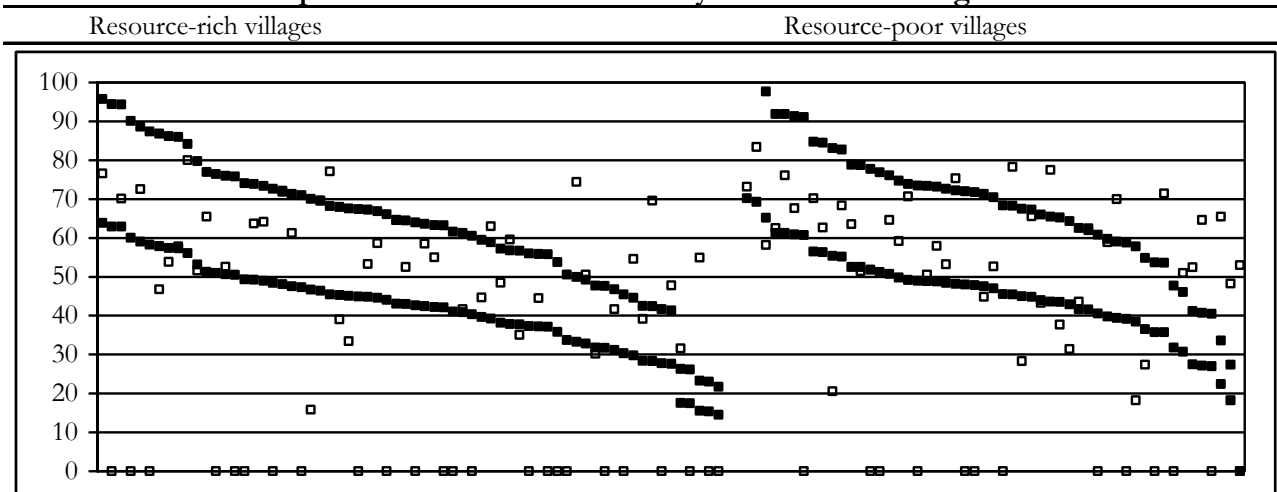
Dots on the same vertical line represent the average of 1-3 plots of the same household.
The closed dots depict a + / - 10% range of realised technical efficiency for sorghum production.
The open dots represent technical efficiency for millet production (zero is no observation).

Vertical: technical effciency (%)   Horizontal: household observations

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[7] The interaction terms (land times supplementary income) and (labour times supplementary income) did not improve the estimation and are not presented.

of 10% below or above the technical efficiency on sorghum plots (Figure 6.3). Farmers with low production efficiency on sorghum plots, tended to produce millet more efficiently. These households probably cultivated on poorer soils, which are less suitable for sorghum cultivation and more appropriate for millet.

Determinants of input use

Input demand did not show a clear pattern along the spectrum of supplementary income levels. This has been tested by cross tabulation and graphical inspection. In the resource-poor villages, households with average levels of supplementary income used relatively more organic matter compared to households with limited or large supplementary income. Households without supplementary income lacked access to organic matter and households with more supplementary income may have been less interested in using organic matter.

Supplementary income had a significant impact on demand for hired labour only in the resource-rich villages (Table 6.3). The largest demand for hired labour was for the cotton harvest and occurred at the end of the growing season. At this time crop income was limited and thus supplementary income was important for households to be able to hire labour. In addition, households involved in supplementary activities had less time for crop cultivation and thus needed to hire labour for necessary crop activities. Supplementary income had no significant effect on input demand in the resource-poor villages.

Table 6.3
Summary of supplementary income effects on input demand by resource-endowment

	Villages	Resource-rich (n-68)		Resource-poor (n=53)	
Input type	Income source	Livestock assets	Supplementary income	Livestock assets	Supplementary income
Household labour	coef.	-0.40	-0.41	-4.52	-0.50
(in hours)	z-val	-0.4	-1.0	-1.3	-0.5
Hired labour	coef.	0.06	0.49 **		
(in hours)	z-val	0.1	2.6		
Fertilisers	coef.	2.58	1.56	8.85 **	-1.63
(in 1000 FCFA)	z-val	0.5	0.9	2.2	-0.5
Oxen traction	coef.	1.38 **	-0.17	1.64 ***	0.17
(index)	z-val	2.3	-0.9	2.5	0.9
Organic matter	coef.	0.59 ***	0.08	0.01	-0.02
(in local units)	z-val	2.6	1.0	0.1	-0.6
Crop index	coef.	0.37	0.32	-0.04	0.10
(avg. z-value of net margin)	z-val	0.4	0.9	-0.1	1.2
Cotton share	coef.	0.04	0.07		
(percentage)	z-val	0.2	1.0		

Notes: Coeffcients concern household level estimates. The coefficients are taken from the full Tobit demand estimations in Appendix 6.2. n.a. = not applicable. *, **, and *** indicate significance at the 0.10, 0.05 and 0.01 levels, respectively.

In the resource-rich villages cultivated area was the main determinant of demand for household labour, hired labour, fertilisers and animal traction (Appendix 6.2). Farmers with more land used also slightly more organic matter and cultivated more high value crops (maize and cotton).

Demand for hired labour was additionally explained by household size (the larger the less external labour) and by age pattern (households in which the age of the members averages toward village average demanded more external labour). Livestock revenues had an evident positive effect on the use of oxen traction and organic matter in the resource-rich villages. Finally, farmers in one resource-rich accessible village, the non-Islamic ward (RA2), were less likely to choose cotton cultivation.

For the resource-poor villages the input demand equations had a low statistical fit (Appendix 6.2). The effect of cultivated area on input use was significantly different from zero only for household labour and oxen traction. Livestock asset ownership positively affected fertiliser use in the resource-poor villages. The latter is because livestock activities provided sufficient liquidity to buy fertilisers.

6.4   Coexistence of activities rather than diversification

Under resource-poor conditions, factor productivity and technical efficiency of crop production were higher for households with larger supplementary revenues. Yet, supplementary revenues did not have an effect on input demand. Only livestock ownership showed the expected positive effect on oxen traction and had a small positive effect on fertiliser demand. In contrast, under agricultural resource-rich conditions, supplementary income levels did not show an impact on crop productivity and production efficiency. Supplementary revenues had a positive impact only on expenditures for hired labour. Livestock assets showed the expected positive effect only for use of oxen traction and organic matter.

These findings have implications for the interpretation of the asset pentagon as presented by the sustainable livelihoods framework. Due to links between different types of household capitals (natural, physical, social, financial and human) support to the non-farm sector is frequently considered an indirect way to enhance farming activities (Ellis and Mdoe, 2003). The analyses in this chapter concern the underlying relations between supplementary incomes on the one hand and efficiency of crop production and consequences for input demand on the other. By focusing on technical efficiency of sorghum and millet production we assessed more

precisely the actual technical effects on crop husbandry of involvement in supplementary activities than was thus far available in the literature (van den Berg, 2001; Coelli *et al.*, 2002; Sherlund *et al.*, 2002). In addition, specification of the type of inputs and the production technology that is subject to change when households acquire supplementary activities allowed for obtaining better insight into interactions for different types of inputs (Ruben and van den Berg, 2001; Woldehanna, 2000; Savadogo *et al.*, 1994). Supplementary revenues were mainly used for hiring labour and to a lesser extent for obtaining external inputs.

For the resource-poor villages, the apparent positive effect of supplementary income on crop production efficiency should be explained by general capabilities. Households who were apt to acquire supplementary income were also in a better position to cultivate crops. However, where agricultural resources are scarce, there were few possibilities to invest in crop production. Wet and dry season economic activities were distinctly operated and thus there were no clear asset links between crop cultivation and supplementary activities.

Under resource-rich conditions, farm and non-farm activities were separately carried out and therefore production efficiency in both sectors was not related. Households had more opportunities to specialise in either economic sector. The growing season is longer (6-8 months) and dry season crop management activities were more important (*e.g.* transport of organic matter and soil preparation). Moreover, due to important cotton revenues households had less incentive to engage in supplementary activities.[8] The higher average technical efficiency for cereal production in one resource-rich accessible village could not be explained by involvement in supplementary activities.

These findings confirm our hypothesis that under resource-poor conditions supplementary activities are more narrowly related to cropping activities. Studies on resource-poor areas report a positive relation between farm and supplementary activities (Woldenhanna and Oskam, 2001; Reardon *et al.*, 1992) while studies on resource-rich areas report no or negative interactions between both types of activities (Coelli *et al.*, 2002; Barrett *et al.*, 2004; Sherlund *et al.*, 2002).

Effects on input demand were shown to be virtually absent. This contrasts with findings in other regions (Zaal and Oostendorp, 2002; Tiffen and Mortimore, 1994; Ruben and van den Berg, 2001). There were relatively scarce opportunities for investment in resource-poor agriculture while resource-rich agriculture generated its own investment opportunities. The

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[8] The role of cotton *vis-à-vis* cereal production and supplementary activities has not been extensively investigated in this chapter. Preliminary findings suggest that cotton cultivation and supplementary activities were mutually exclusive because of historical and cultural reasons. This finding relies on comparison of the villages of research and can therefore not be extrapolated to regional levels.

traditional agricultural sector had a similar feature as sectors of supplementary activities, namely a relatively widespread propensity to invest in the sector compared to limited opportunities. The limited opportunities were due to technological limitations rather than, as for supplementary activities, due to problems of excess capacity.

Summarising, from a perspective of efficient use of labour and land, farm and supplementary activities can be combined within households. Diversification had no negative effect on efficiency of crop production. In low-income village economies, however, it is not realistic to expect that intra-household economic diversification will lead to better crop husbandry. Coordinated rural policy interventions for technical as well as institutional development are needed to improve the performance of the agricultural sector (Heerink, 2005). Stimulating supplementary activities should be simultaneously aimed at (Bryceson, 2002).

Chapter 7

Household activity diversification and village income distribution

The present chapter focuses on income distribution. Access to and availability of supplementary activities vary widely between villages, households and individuals. It is therefore useful to review the evidence regarding their impact on income distribution and poverty alleviation.

This chapter presents an empirical framework for portfolio analysis of farm and supplementary activities to enable a subsequent decomposition of incomes at village and household level. Special attention is given to the role of infrastructure, endowment, wealth, and categories of activities. In addition, I assess the functions of supplementary activities for the gender distribution of income. Information on individual households, graphically presented, provides insight into differences within income strata.

As shown, livelihood studies illustrate that households have simultaneous access to farm and supplementary activities with different return rates. Poverty, however, is more often found among households who depend exclusively on farming income. Poorer households are also less capable to cope with income shortfalls. Supplementary activities have no uniform impact on income distribution. Higher farming income is often accompanied with more supplementary income, but there are also households who specialise in farm or in supplementary activities with similar, low as well as high, income levels.

In the empirical work supplementary activities represented 20-40 percent of household income, reaching the highest share in the two better accessible villages. Supplementary activities were especially important in villages where income distribution was moderately skewed. Their contribution to income inequality was particularly important in better accessible villages. Trade and artisan activities led to the highest income concentration, in particular amongst men, while supplementary activities carried out by women had only minor equity implications. Households in poorer income strata benefited insufficiently from supplementary income to alleviate poverty. Differences in resource endowment explained income levels and poverty incidence, but had only a minor impact on portfolio composition.

7.1 Portfolio decomposition along the income spectrum

Supplementary activities have a traceable impact on income distribution when they generate a sufficient share in total income and when they accrue to specific income strata. There is a poverty alleviating effect if the poorer income strata use supplementary activities to raise income above the poverty line.

While supplementary activities generally enhance income level, the impact on income distribution is less clear. Increasing evidence shows that supplementary activities do not necessarily lead to improvements in the income distribution between households and individuals, since entry and information costs tend to limit access for poorer households (Reardon, 1997; Lanjouw and Lanjouw, 2001). There exists contrasting evidence regarding the possibilities and constraints for supplementary activities alleviating poverty.

Most empirical research focuses on portfolio decomposition along the income spectrum. The two most frequently used criteria are Gini-coefficient decomposition, and comparison of supplementary income level and share along the income spectrum. These two analytical methods rely on linear relationships, yet portfolio behaviour is expectedly more complex. Different combinations of activities provide comparable income levels and similar activities result in income inequalities.

In this chapter I take into account some of the portfolio behaviour complexities by adding three levels of detail. The first level concerns differentiation of portfolio analysis by resource endowment and infrastructure. Second, household case information provides insight into important differences within income strata. And third, detailed information on different categories of supplementary activities yields the necessary information to make policy interventions more sector oriented and thus more effective.

The different impact of supplementary activities on rural income distribution and poverty depends on the prevailing situation.[1] A similar distribution of supplementary income may contribute little to very unequal income distributions and much to rather equal income distributions. In this respect, total inequality of income as measured by Gini coefficients appeared to be quite similar in resource-poor and resource-rich villages in Burkina Faso (Reardon and Taylor, 1996).[2]

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[1] In addition, income composition is a typical endogenous variable with respect to income distribution. Income distribution is a function of income composition, endowment and infrastructure. In turn income composition depends on endowment and infrastructure.

[2] Differences in Gini-coefficients across resource endowment appeared not significant but, as will be shown in this study, they differ across villages with different accessibility and similar resource endowment.

With similar income inequality, supplementary activities influence income distribution more when the agricultural income base is small compared to when agricultural income is relatively large (Reardon *et al.*, 2001; Reardon, 1996). In resource-poor villages in Burkina Faso supplementary activities appeared to result in a less equal income distribution while in resource-rich villages income distribution became more equal due to supplementary activities. Both studies give no further details on the effect of infrastructural differences between villages under similar conditions of resource endowment.

In general supplementary activities tend to contribute most to income inequality in settings where market outlets (within and outside the village) are better developed. In such a setting, the share of supplementary income is sufficiently large to affect income distribution. When market access is limited, supplementary activities easily meet local purchasing power constraints and will only slightly reinforce income inequalities.

Household land ownership is an important determinant of income distribution for farm as well as supplementary activities. Without a well-functioning land market, land ownership is a good indicator of social position in the village and thus of opportunities to develop supplementary activities.

The data analysis is based on a detailed assessment of different income categories and makes use of usual procedures (e.g. Lorenz diagram and Gini ratios) to illustrate income inequalities within and between villages. Hereafter, we rely on Gini decomposition to disentangle the different sources of income inequality (Rao, 1969; Pyatt, 1976). This procedure is used at household level while specific attention is given to diversification differences between men and women. In addition, different categories of supplementary activities are included in the Gini-decomposition and graphical analyses, since a strong concentration on a few activities could easily lead to new dependencies.

7.2 Effects of supplementary income on income distribution

This section reviews evidence regarding, successively, supplementary activities and income distribution, determinants of income distribution, and income and portfolio changes after important weather and economic shocks. A focus on income shares and distribution easily leads to overlooking the actual nature of poverty. Rural poverty is rooted in the regional and national economy and thus may have causes beyond the village. Barrett and Swallow (2003) elaborate in this respect the concept of fractal poverty traps. The presence of fractal poverty traps points to simultaneous poverty dynamics at different levels: household, village, region, national and international.

Poverty dynamics

Economic research into livelihood systems with income levels below the $1-per-day-a-person poverty line requires an approach distinctly different from common livelihood studies (Gore, 2002). The largest part of the literature on livelihood, diversification and poverty aims at explaining prevailing income distribution and its determinants. Few studies take poverty explicitly as a theme and describe poverty processes.

Pervasive poverty is characterised by complex vicious-circle effects of poverty on for example investment capability, nutritional condition, and access to education and health services. Consequently, the longer households live in poverty, the fewer possibilities they have to escape it (Verschoor, 2000). Processes of circular and cumulative causation are recognised in livelihood research but not analysed in detail ((DFID, 2001 presented in (Meinzen-Dick *et al.*, 2003)). The elusive causality arguments in livelihood analytical frameworks retard obtaining better understanding of the etiology of pervasive poverty (Barrett and Swallow, 2003; Verschoor, 2000).

With respect to income and portfolio dynamics, Reardon and Taylor (1996) examine the impact of agro-climatic shock on income inequality and poverty in Burkina Faso. They use household-farm data from three agro-ecological zones and calculate income-source decompositions of the Gini coefficient and the Foster-Greer-Thorbecke poverty index before and after a severe drought. Their findings reveal that supplementary activities failed to protect poor households against agro-climatic risks. The direction of the empirical relationship between changes in inequality and poverty after a drought depended critically on environmental variables. Under resource-poor conditions, poor households could not diversify and thus income shortfalls increase inequality. Under resource-rich conditions, the poor diversified more easily and were better able to cope with income shortfalls.

In Ivory Coast, households with meagre endowments and limited supplementary income were most affected by an external policy shock. An important currency devaluation worsened their income position up to a 20 percent decrease in real income (Barrett *et al.*, 2004). In contrast, the households with larger land endowment benefited from a 10 percent increase of real income. In the same study, wealthier households in Kenya appeared to consistently have a high share of supplementary income and were able to further reinforce their access to high-return supplementary activities.

Income distribution

It is sometimes assumed that supplementary income is an equality-enhancing device, in particular in land-scarce settings (Adams, 2002). Other studies confirm, however, that while supplementary income as a whole could reduce income inequality, not all sources of supplementary income have the same effect (Adams and He, 1995; Barrett *et al.*, 2001a). This confirms that thorough attention should be given to the specific sector in which people are engaged and the possible complementarities or contradictions between farm and supplementary activities.

Reardon *et al.* (2000) review household survey evidence from Africa, Asia, and Latin America regarding the distribution implications of supplementary activities. In contrast to conventional wisdom, the evidence is very mixed as to the effect of supplementary activities on rural income inequality. The effect on income inequality is ambiguous from improving income equality in most Asian situations to increasing inequality in most African situations. In most African studies cropping income, constituting the largest income share, makes up the largest contribution to income inequality (50-75 percent of the Gini-coefficient). Supplementary activities, in particular non-farm wage labour and skilled work contributed about 20–40 percent to the Gini-coefficient of total income. A negative contribution to the total income Gini-coefficient, pointing to an income equalising effect, has not been reported in other reviewed studies (see also Woldehanna (2000) and Elbers and Lanjouw (2001)).

There is substantial evidence of the inability of the poor to develop farm supplementary activities. The poorest income percentiles generally have the lowest share of supplementary income. In a study in Tanzania the highest income quartile obtained almost 60 percent of their income by supplementary activities. The lowest income quartile had a share of 30 percent of supplementary income, half of which consisted of farm wages (Ellis and Mdoe, 2003; Lanjouw *et al.*, 2001). Similar figures are reported for Burkina Faso (Wouterse and van den Berg, 2004), El Salvador (Elbers and Lanjouw, 2001) and Mexico (de Janvry and Sadoulet, 2001).[3]

A series of studies compares income levels between households with different portfolios of activities. The most common finding for rural areas in Latin America is that the incidence of poverty is higher among households which are more dependent on farming activities (reviewed by Reardon *et al.* (2001)). Typical examples come from El Salvador (Lanjouw, 2001), Peru (Escobal, 2001), and Chile (Berdegué *et al.*, 2001).

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[3] If the poorest income percentiles were much involved in supplementary activities while still remaining poor, supplementary activities would contribute to equality but much less to poverty alleviation.

A comparison of livelihood diversification strategies in Ivory Coast, Kenya and Rwanda illustrates that no single portfolio typically makes up an income stratum (Barrett *et al.*, 2000). Where agricultural resources are relatively favourable, about half of the households in the highest income quartile were exclusively involved in farming.

Determinants of diversification

The main determinants of unequal access to supplementary activities are the capacity to make investments in non-farm assets and the relative scarcity of activities with low capital-entry barriers. Reardon *et al.* (2000) and Barrett *et al.* (2000) provide some evidence that households with more land develop more supplementary activities. Barrett *et al.* (2001a) illustrate the same pattern for a rice-producing area in Ivory Coast. Households with relatively much land appear to generate income either by full-time farming or by a mix of farming and skilled supplementary work. Households with meagre endowments generate limited supplementary income.

Relatively little is known on the gender impact of the supplementary activities. While in Ecuador and El Salvador growth in supplementary activities tends to be beneficial to women (Lanjouw, 2000), in Mali and Tanzania there is a strong male bias in non-farm work (respectively, (Abdulai and CroleRees, 2001; Lanjouw *et al.*, 2001)). The latter tendency is particularly relevant when supplementary activities rely on modern and improved technologies and become more market-oriented. Individual characteristics, like age, education and gender are found to have an important impact on intra-as well as inter-household income distribution (Abdulai and CroleRees, 2001).

Studies on gender roles in rural areas of sub-Saharan Africa indicate that factors like authority over resources and access to markets play a central role for the intra-household distribution of income derived from supplementary activities. Systematic differences in land rights by gender and their social recognition, which play an important role in the factor allocation in agriculture and livestock activities, may thus be reproduced in the non-farm sector (Alderman *et al.*, 1995; Kevane and Wydick, 2001).

Quisumbing *et al.* (1995) compute income- and expenditure-based poverty measures and investigate their sensitivity to the use of per capita and per adult equivalent units. They find that persons in female-headed households in rural Ghana and Bangladesh are consistently worse-off. Cultural and institutional factors may be responsible for higher poverty among women in these countries. This result points to the need to analyse determinants of intra-household

income and consumption distribution, and to give greater attention to the processes underlying market access and asset ownership for women.

7.3   Diversification along the income spectrum

Household activity portfolios along the income spectrum are obviously diverse and cannot easily be captured. This section presents key figures and graphical presentations to illustrate poverty incidence, income distribution and diversification patterns.

Poverty incidence

Poverty incidence was structural in the resource-poor villages where some 90 percent of the sample had an income lower than Euro 2 per day per adult equivalent in terms of estimated purchasing power parity (ppp)(Table 7.1).[4] In the isolated resource-poor village 81 percent of the sample had an income lower than Euro 1 (ppp) per day per adult equivalent, compared to 41 percent in the accessible villages. A quarter of the sample in the isolated village and 13 percent in the accessible village lived in extreme poverty with an income less than Euro 0.50 (ppp) per day per adult equivalent.

  In the resource-rich isolated village only 13 percent of the sample fell below an income level of Euro 2 (ppp) per adult equivalent per day. In contrast, in one accessible village 42 percent of the sample had an income below the poverty line. It is striking that poverty incidence was larger in the accessible resource-rich villages than in the isolated resource-rich village. In the accessible resource-rich village agricultural resources were relatively scarcer and this led to more skewed distribution of cropping income. In one accessible village, supplementary activities had compensated the lack of agricultural resources much more than in the other accessible village. A larger incidence of poverty in the latter village has been the consequence.

Sources of inequality

The income distribution showed some striking similarities across the villages (Table 7.1). The 10 percent poorest of the sample received in all five villages about 3 percent of total income. The 10 percent richest of the sample received about 25 percent of total income. Only in the resource-rich isolated village the wealthiest 10 percent received about 20 percent of total income. Similarly, 50 percent of the sample received about 68 to 75 percent of total income

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[4] Euro 0.40 per day is about FCA 100,000 per year. This is about the $2-a-day poverty line in purchasing power parity (ppp). In the remainder of this chapter this income level is referred to as the poverty line. Purchasing power parity is estimated to be about 4-5 times the monetary income (World Bank, 2004a).

Table 7.1

Poverty estimates and shares in total village income by income percentiles

	Village					
	RA1	RA2	RI	PA	PI	All
Poverty lines (ppp)	**% of population below poverty line**					
Less than Euro 0.5 per day	0	0	2	13	25	11
Less than Euro 1 per day	11	5	7	41	81	34
Less than Euro 2 per day	36	42	13	84	96	60
Income percentiles	**% of total village income accruing to income percentile**					
0-10%	25	25	20	25	25	30
10-25%	23	19	18	21	19	26
25-50%	27	24	28	25	26	25
25-75%	17	17	23	18	21	13
75-90%	5	12	8	8	6	5
90-100%	3	3	3	3	3	2

Note: Purchasing power parity is estimated to be about 4-5 times the monetary income (World Bank, 2004a).

with no large differences across the villages. For the five villages together, the poorest 10 percent, who lived all except one household in the resource-poor villages, received about 1.5 percent of total income. The 10 percent wealthiest households receive 30 percent of total income. Hence, the poor were equally poor relative to co-villagers in all villages, but across the villages, poverty incidence was unevenly heavy in the resource-poor villages.

The Lorenz-curves in Figure 7.1 provide more detailed information on income distribution. Strikingly the most equal and the most unequal income distributions were found in the crop oriented agriculturally resource-rich villages (RA1 and RI). The isolated village (RI) had the most equal income distribution while the accessible village (RA2) had the most unequal income distribution. Scarcity of land in the latter accessible village has probably caused this unequal income distribution. Across the resource-poor villages (PA and PI) income distribution was slightly more equal in the accessible village. Compared to the resource-rich accessible village with the least equal income distribution, the resource-poor villages had a slightly less skewed pattern of income distribution.

Decomposition of zone and village level Gini-coefficients, by gender and by activity category, explains why supplementary activities are frequently found to have an ambiguous effect on income equality (Table 7.2). The right-hand side column indicates that over the entire sample agriculture income was the dominant factor in income inequality. Evidently, this was because of its large share (74 percent) in total income. A comparison of the resource-poor with the resource-rich villages (sixth and seventh column in Table 7.2) confirms the findings of Reardon and Taylor (1996). In the resource-poor villages, supplementary activities determined income

Figure 7.1
Differences in income distribution: Pair-wise comparison of Lorenz curves across villages
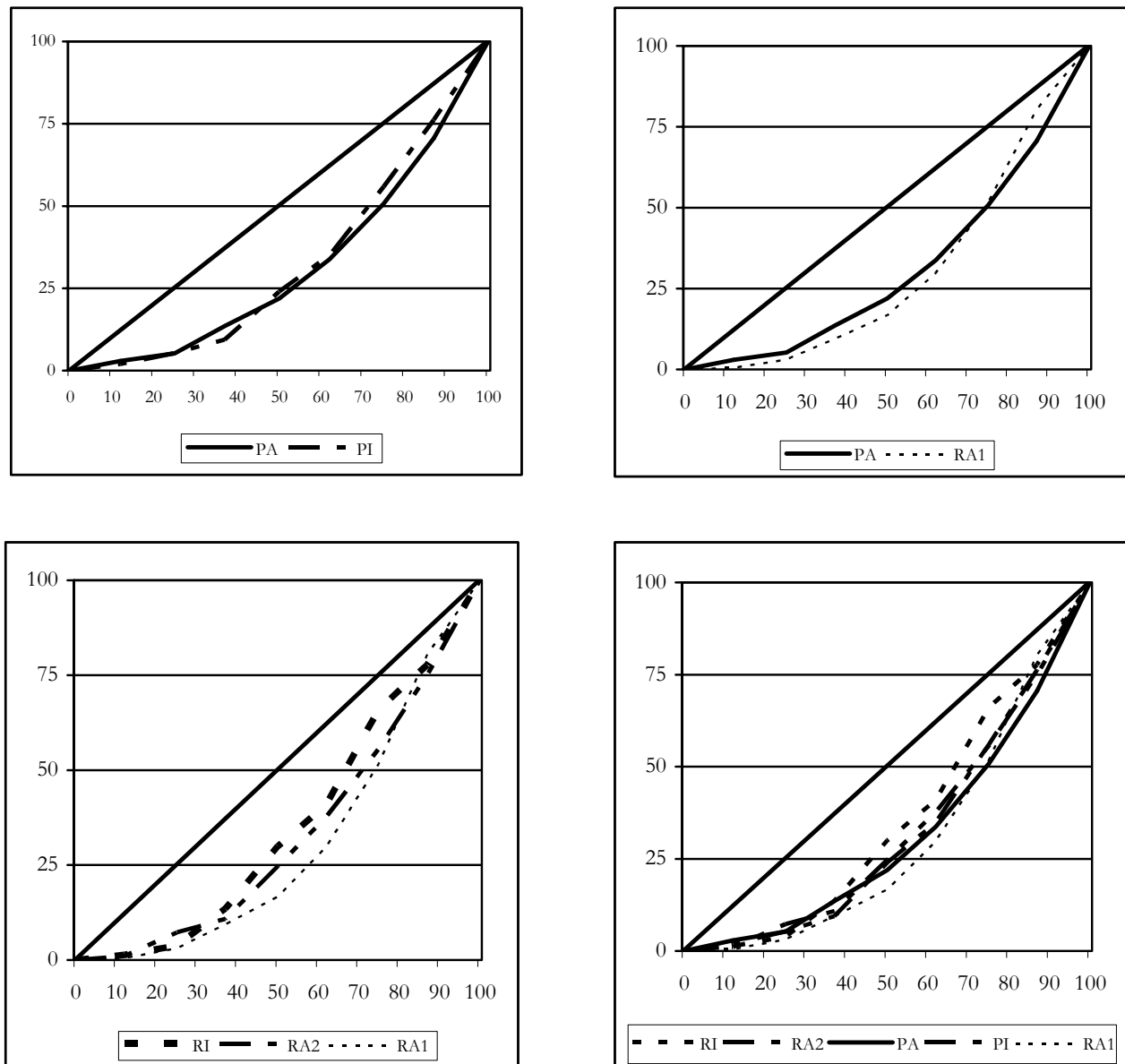
Horizontal axis: cumulative % of population   Vertical axis: cumulative % of income

inequality, while in the resource-rich villages, crop income determined income inequality. The share of supplementary income, 23 percent for the resource-poor and 33 percent for the resource-rich villages, partly explains this difference. In the resource-poor villages, total income was low so that a few households with important revenues from supplementary activities determined income inequality. In the resource-rich villages, crop income was sufficiently large to overrule the income distribution effect of a few highly remunerative supplementary activities.

Table 7.2
Gini decomposition by category of supplementary activities and village

	RA1 (n=17)		RA2 (n=20)		RI (n=31)		PA (n=30)		PI (n=23)		R all (n=68)		P all (n=53)		All (n=121)	
	ci	s	ci	s	ci	s	ci	s	ci	s	ci	s	ci	s	ci	s
Supplementary income																
Total	19	14 ***	69	46 ***	9	15 **	71	38 ***	34	23 ***	29	23 ***	65	33 ***	30	26 ***
Men	14	7 **	66	32 ***	3	6	66	29 ***	33	14 ***	24	14 ***	60	24 ***	24	16 ***
Women	5	7 **	3	14	6	9 **	5	9 *	1	8	5	10 ***	5	8 **	6	9 ***
Primary income																
Total	81	86 ***	31	54 ***	91	85 ***	29	62 ***	66	77 ***	71	77 ***	35	67 ***	70	74 ***
Crop	68	78 ***	15	43 **	77	75 ***	23	47 ***	57	61 ***	57	67 ***	28	52 ***	58	63 ***
Livestock	13	8 ***	16	12 ***	14	10 ***	6	15	9	16	14	10 ***	7	16 **	11	11 ***
Supplementary income of men																
Primary sector	0	0	-1	1	-1	1	0	0	1	5	0	1	-1	2	0	1
Horticulture and processing	0	0	0	4	0	0	0	1	0	0	0	1	0	0	0	1
Weaving	0	1	-1	2	-1	0 **	-1	2	0	0	-1	1 ***	0	2	-1	1 *
Artisan work	0	0	0	1	1	1	66	22 ***	30	7 ***	0	1	58	17 ***	5	5 *
Processing capital intensive	1	0 **	0	1	3	3	0	0	0	0	2	2	0	0	2	1 **
Trade	13	5 **	69	23 ***	1	1	1	4	2	3	24	8 ***	2	4	18	7 ***
Supplementary income of women																
Primary sector	0	0	0	0	0	0	1	3	2	3	0	0	1	3	0	1
Beer brewing	6	4 ***	0	0	3	5	0	1	-1	2	3	3 **	0	2	3	3 ***
Processing	0	1	0	4	2	1 **	2	1 **	0	1	1	2	2	1 **	1	2 **
Sheanut processing	0	1	0	5	0	1	1	1	0	0	0	2	1	1	1	2
Snacks and drinks	0	0	3	3	1	1	2	2	0	1	1	1 *	2	2 *	1	2 ***
Trade and services	0	1	0	1	0	0	0	1	0	0	0	1	0	0	0	1

Notes: ci = contribution to inequality. s = share in total income. Significance levels of correlation coefficients (r) between income source and total income is indicated with *, **, and *** at the 0.10, 0.05 and 0.01 levels, respectively. ci is calculated following the gini-decomposition method: $ci = s * r * cvi * cvt$, where r = correlation coefficient , cvi = coefficient of variance income source, and cvt = coefficient of variance total of income.

Contrary to expectation, livestock revenues explained only 11 percent of the income inequality. Livestock revenues were of larger influence on income inequality in the resource-villages compared to the resource-poor villages. In the latter villages households had less possibility to accumulate wealth through livestock holdings.

A comparison of villages with similar resource endowment but different infrastructure shows the following. As expected, under conditions of good infrastructure supplementary activities were the main determinant of inequality (about 70 percent) in the resource-poor as well as in one resource-rich village. In the resource-poor accessible village, supplementary income had a large share (38 percent) and was less equally distributed than crop income. In the resource-rich villages the situation was more complicated. In the isolated village and in one accessible village crop income constituted by far the largest share of total income. Supplementary activities were too few and too small to significantly influence the income distribution. The reasons for the difference between the two resource-rich accessible villages were varied: culture (ethnicity) and history (cotton board policies, livelihood pathways) may have caused the different activity portfolios in both wards.

Further Gini-coefficient decomposition by gender and by type of activity shows that supplementary activities by women had no impact on income distribution.[1] Constituting on average 1-6 percent of total income, no single supplementary activity operated by women stood out by influencing income distribution. In contrast, some supplementary activities carried out by men, *i.e.* trade and artisan work, were the main determinants of income inequality in the two accessible villages with the highest share of supplementary income (RA2 and PA). A few activities, *i.e.* weaving, gold mining, fishing, hunting, and mining made a negative contribution to income inequality. Local conditions explained the poverty refuge nature of these activities. In the resource-poor isolated village poor households were involved in gold mining while in the resource-rich village poor households sought income by farm wage work, fishing and gathering.

Diversification along the wealth spectrum

Income decomposition along the income spectrum requires a detailed knowledge of household level activities. Different combinations of activities provide comparable income levels and similar activities result in income inequalities. Taking average figures of income strata will thus lead to inaccurate conclusions. Therefore, a series of graphics on household income illustrate village effects on income composition and relations between activity choice and income level

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[1] The activities are grouped into 12 categories, explained in Appendix 7.1.

(Figure 7.2). The graphics allow for identification of share and level patterns and provide information on individual cases. The graph with moving average shares of income sources substitutes the more common way of presenting income portfolio by wealth classes. Each stack represents the average income share of five households in successive terms of income level.

Households in the two accessible villages, one resource-poor (PA) and one resource-rich (RA2), had diversified their activities over cropping, animal husbandry and supplementary activities to a greater extent compared to the other villages. The households at the highest income levels and those at just-below-average income levels had the most diversified combination of activities.

The middle graph with exact income shares reveals some striking differences between the villages. In both resource-poor villages (PA and PI) the share of supplementary income had the highest variation. Several households generated 40-60 percent of their income by supplementary activities. Also several households had a very limited share of supplementary income. In the resource-rich, crop oriented villages (RA1 and RI) only a few households generated more than 25 percent of their income by supplementary activities. Most of these households fell in lower income strata. In the resource-rich accessible village a single household in the lowest income stratum was relatively more involved in supplementary activities compared to the other household in this stratum. This household constituted of a group of local singers (locally named *griots*).

Appendix 7.2 presents income decomposition by gender and by activity category. In the resource-poor villages, only a few people, men as well as women, developed trade, artisan work or processing work of importance. Village conditions implied for men and women distinct patterns with respect to participation in supplementary activities. Men had in general better access to economic opportunities beyond the village and they developed remunerative supplementary activities. Women remained more dependent on the local economy and therefore women developed less remunerative economic activities.

Income decomposition along the land ownership spectrum showed an important variation within and between villages (Figure 7.3). Land ownership and supplementary income were correlated (at >10% level) only for one village. Only for the resource-rich accessible village (RA2) total supplementary income increased with increasing land ownership. The share of supplementary income in the latter village did not change along the land endowment spectrum. These findings indicate that land ownership and possibly underlying assets such as access to credit or social status did not determine involvement in supplementary activities.

Figure 7.2

Portfolio of crop, livestock and supplementary income in order of descending total income by village
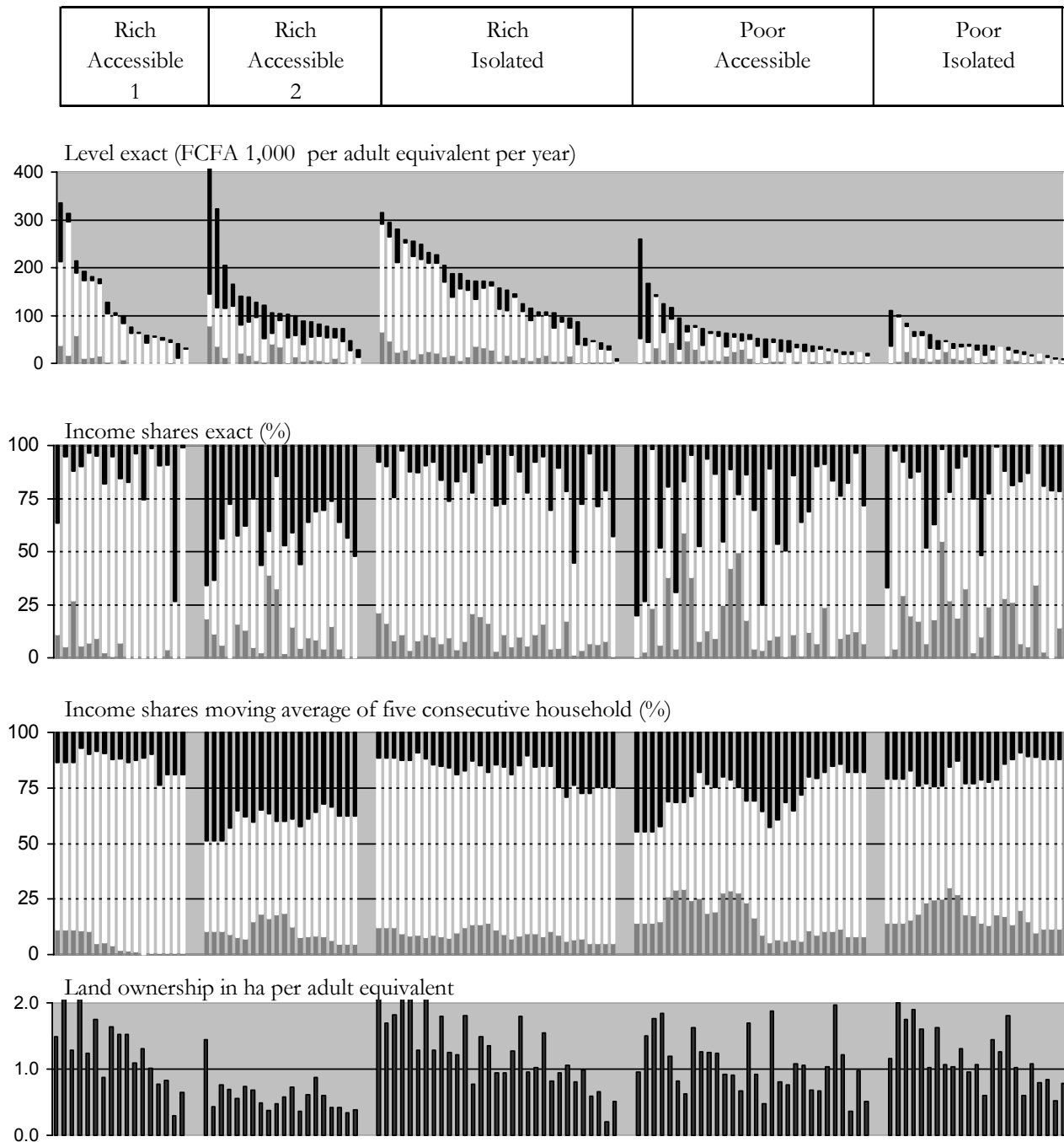
Explanation: The stacks on the horizontal axis represent individual household income sources: black is supplementary income, white is crop income, and grey is livestock income. The vertical axis indicates total income (FCFA 1,000 per adult equaivalent per year), income share and cultivated area.

Figure 7.3

Portfolio of crop, livestock and supplementary income in order of descending land ownership by village
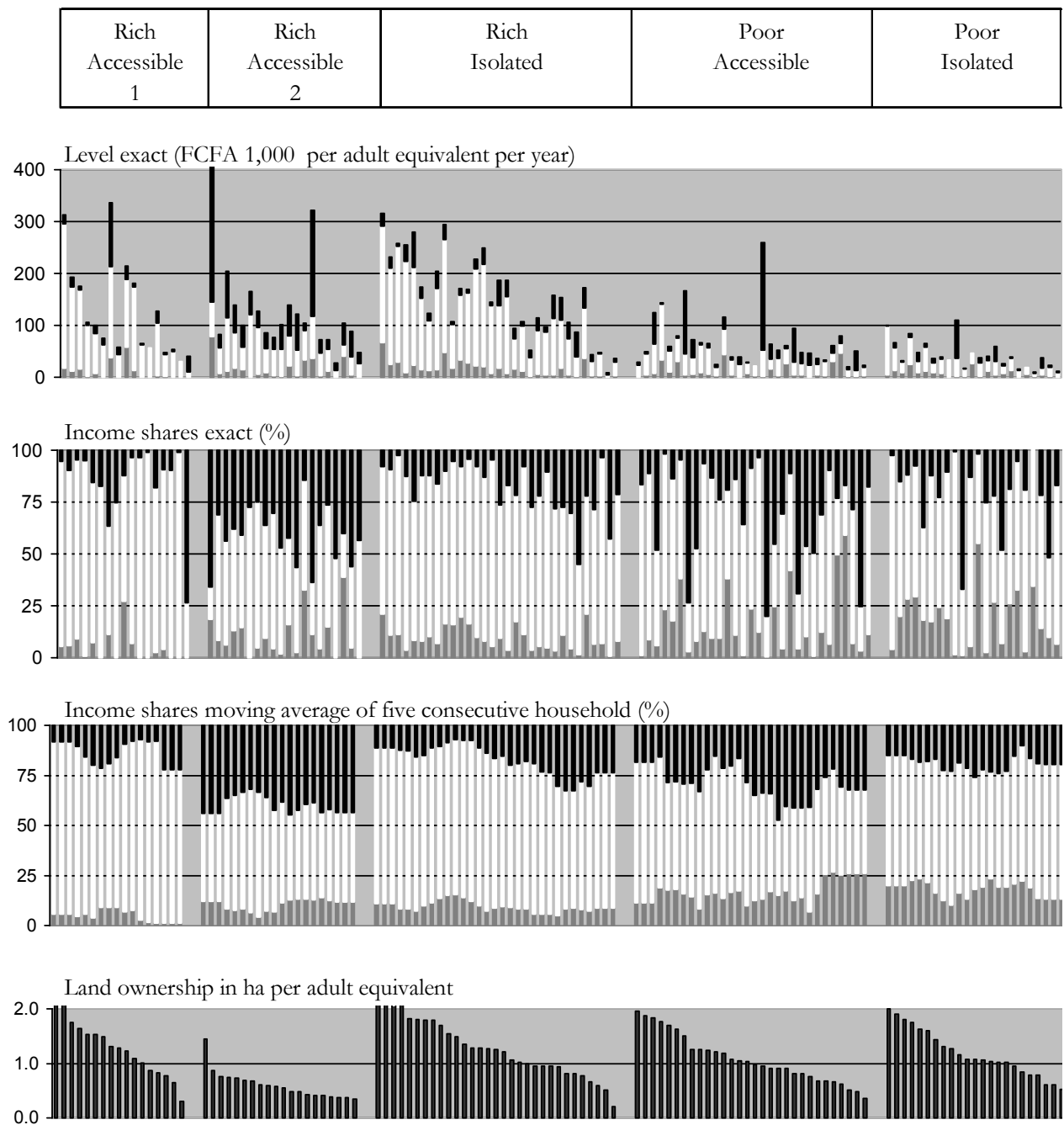
Rich Accessible 1	Rich Accessible 2	Rich Isolated	Poor Accessible	Poor Isolated

Explanation: The stacks on the horizontal axis represent individual household income sources: black is supplementary income, white is crop income, and grey is livestock income. The vertical axis indicates total income (FCFA 1,000 per adult equaivalent per year), income share and cultivated area.

Land ownership and crop income were positively correlated (at >1% level) for each village except for the second resource-rich accessible village (RA2). Total crop income did not decrease systematically with decreasing land ownership in this village. The moving average share of crop income was stable along the land ownership spectrum in each village.

7.4   Limited benefits of diversification

In the literature, household involvement in supplementary activities appears to have a highly location-specific, often ambiguous, effect on income distribution. To better understand the reasons behind this ambiguity, this chapter showed that is necessary to go beyond linear analytical methods that decompose income along the wealth spectrum. Linear analysis of activity portfolio by income percentiles rely on the assumption that diversification is the norm (Barrett *et al.*, 2001b). Such a norm appears in various comparisons of income strata (Reardon *et al.*, 1992; Reardon *et al.*, 2000; Ellis and Mdoe, 2003). Yet, it is also evident that different livelihoods result in similar income levels (Barrett *et al.*, 2001a).

Detailed empirical analysis of activity choice and income distribution provided information to refine understanding of the impact of activity diversification in different village economies. I consider three aspects related to activity choice: poverty alleviation, income distribution, and diversification.

The poorest households had a slightly more than average share of supplementary income. However, given their poverty one could not speak of poverty alleviating supplementary activities. Even in the resource-rich, with assumedly more income opportunities, several households remained below the poverty line. At the wealthier end of the income spectrum, only some households in the accessible villages relied essentially on supplementary activities. These findings are in contrast with existent literature on livelihood diversification. Apparently, due to village-wide poverty, supplementary activities did not permit accumulation of wealth nor escape from poverty.

With respect to income distribution, in three villages the non-farm sectors were too small to affect income distribution. Two of these villages are relatively isolated. In the third village, resource-rich and accessible, income decomposition suggests that cash crop cultivation and supplementary activities imposed competing demands on household labour resources. Supplementary activities enhanced household income yet at the expense of cultivation of cash crops (cotton). In two accessible villages, resource-poor and resource-rich, involvement in supplementary activities brought about income inequality. These activities concerned only two kinds of activities, namely trade and artisan work mainly carried out by men. Women were

dependent on the local economy and therefore women were involved in less remunerative economic activities. Women's income from supplementary activities had no impact on income distribution.

The diffuse pattern of level and share of supplementary income along the land endowment spectrum is in contrast with findings presented in the review study of Reardon *et al.* (2000). On the other hand, these observations confirm that different combinations of activities can result in similar income levels (Barrett *et al.*, 2001a). With respect to the choice of activity, our analysis provides no evidence that households in specific income strata purposively diversified across farm and supplementary activities. The crop sector was structurally important because it provides survival income, but did not seem to catalyse non-agricultural economic activities within the own household. Different categories of activities were diffusely distributed along the income spectrum.

Chapter 8

Conclusion: findings, reflection, and outlook

This study evaluates the role of farm-supplementary activities in the rural areas of Burkina Faso as an example of livelihood diversification in low-income developing countries. We seek to reconcile positive expectations with respect to the economic potential of household income diversification across farm and non-farm sectors with the observation that rural villages in sub-Saharan Africa have achieved limited economic growth during the last decades.

The study concerns an assessment of opportunities for generating farm supplementary income and determinants of participation in supplementary activities. It provides an analysis of individual livelihood diversification with specific attention to the role of risk preferences. It also evaluates the effects of supplementary income on production efficiency and the use of inputs in crop husbandry. Lastly, decomposition of household income along the village wealth spectrum is presented.

The present chapter addresses three issues. What new insights emerge from this study on perspectives for livelihood diversification in less-favoured rural areas? What are the differences between this research and other studies on rural livelihoods? And, which implications can be drawn regarding further research on rural livelihoods in low-income countries?

8.1 Synthesis of findings

The description of rural livelihoods in Chapter 2 shows that supplementary activities were essentially individual activities with a relatively weak institutional and technological base. Farming activities were also characterised by a low technical level. Further analysis of institutions and income distribution cannot be much more precise than the diffuse nature of the underlying core economic activities. This feature of low-income rural villages in less-favoured areas increasingly receives attention in livelihood research (Bryceson, 2002; Barrett and Swallow, 2003; Barrett, 2004; Ruben and Pender, 2004). Research into income distribution and opportunities for income enhancement calls for insight into details of actual economic activities. This study provides such a level of detail by elaborating subsequent research questions regarding individual and household livelihoods.

Nature of farm supplementary activities

The research findings reveal general excess capacity in non-farm economic sectors. The villages in this research represent different comparative advantages in resource endowment and infrastructure. Although these comparative advantages certainly influenced the size of non-farm sectors, institutional and technological developments in local non-farm sectors have remained at a similar low level across the villages. Backward linkage effects with the agricultural sector turned out to be limited in all villages and extremely limited in the resource-poor villages. Supporting markets for labour, finance, and inputs were virtually absent. The technology of supplementary activities was homogenous and rather poorly developed. Due to limited local demand for products, there were few opportunities to further expand current supplementary activities.

Apparently the prevailing supplementary activities have not warranted enhancement of institutions and technology. The non-farm economic base has remained too small to generate sufficient income opportunities. Critical assets for generating institutional and technological innovations have probably leaked away from the villages for various related reasons.

Involvement in supplementary activities

Concerning the determinants of involvement in supplementary activities, we categorise these into attributes of individual position within the household, capacity, preference and property. The presence of excess capacity in non-farm sectors in less-favoured areas had major implications on the determinants of livelihood diversification. Local supplementary activities required virtually no formal skills and hence many people were qualified for being engaged in

most available economic activities. Consequently, education, experience, and household assets did not appear as major determinants of engagement in farm supplementary activities.

The village environment had an impact on involvement in supplementary activities specifically for household heads. For dependent members, men as well as women, only the combined conditions of lack of infrastructure and poor agricultural resources impeded individual involvement in supplementary activities. Otherwise, people managed to generate important supplementary income, for which men, more than women, sought economic activities beyond the village boundaries.

At this point our findings diverge from the common perception that the poor face important entry barriers to develop economic activities (Reardon *et al.*, 2000; Barrett *et al.*, 2000; Ellis, 1998). Under conditions of large demand for and few opportunities of supplementary activities it appeared to be difficult to identify distinguishing features that determine actual involvement in supplementary activities. Multiple factors and their sometimes random matching play a role (Easterly, 2001).

In addition requirements to develop supplementary activities were commonly lower than the qualifications of individuals developing them. With different household and individual backgrounds, people have developed a wide range of supplementary activities at different scales. Barriers to develop supplementary activities concerned village rather than household and individual characteristics. This is increasingly recognised in the literature on development of livelihoods in low-income countries (Ellis and Freeman, 2004; Barrett and Swallow, 2003; Anderson, 2001).

Individual livelihoods

The analysis of livelihoods at individual level devotes special attention to attitudes to risk, which are considered the most dominant driving force for diversification (Fafchamps, 2003; Reardon and Taylor, 1996). Analysis of individual livelihood shows that individuals, men more than women, specialised rather than diversified their economic activities. This important feature of individual livelihoods implies that individuals behaved rationally with respect to the principle of economic advantage through specialisation.

A second finding from individual livelihood assessment is that risk perception was no dominant factor in diversification behaviour. If risk aversion had an impact on diversification, this seemed to be a negative impact: risk-averse people developed less supplementary activities. Risk aversion did not have an effect on willingness to invest. These findings are in line with

empirical evidence on the ambiguous role of risk preferences on diversification behaviour (Pannell *et al.*, 1997; Mosley and Verschoor, 2004).

The empirical risk assessment suggests that there is a need to give more research attention to individual livelihood. Risk aversion is a typical individual characteristic and individuals specialised rather than diversified. Thus far, these observations are insufficiently taken into account in livelihood research. A focus on individual livelihoods would provide a better opportunity to analyse risk attitude as well as risk perception. Risk perception, which has been an important part of the initial empirical work for this research, has thus far received insufficient attention in literature on livelihood in developing countries (Slovic, 2000; Smith *et al.*, 2000, 2001; Vose, 2000).

Crop husbandry

With a focus on technical efficiency of sorghum and millet production, we assess the actual technical effects of involvement in supplementary activities on crop husbandry more precisely than was thus far available in the literature (van den Berg, 2001; Coelli *et al.*, 2002; Sherlund *et al.*, 2002). The analyses concern the underlying relations between supplementary incomes on the one hand and efficiency of crop production and consequences for input demand on the other.

In the resource-poor villages, households who were apt to acquire more supplementary income used labour and land more efficiently for crop production. However, because wet and dry season economic activities were independently conducted there were no clear asset links between crop cultivation and supplementary activities. Under resource-rich conditions, farm and supplementary activities were loosely related and therefore efficiency in both sectors appeared not to be related. Households had more opportunities to specialise in either economic sector. These findings confirm earlier research findings. Studies on resource-poor areas report a positive relation between farm and supplementary activities (Woldenhanna and Oskam, 2001; Reardon *et al.*, 1992) while studies on resource-rich areas report no or negative interactions between both types of activities (Coelli *et al.*, 2002; Barrett *et al.*, 2004; Sherlund *et al.*, 2002).

Effects on input demand were shown to be virtually absent. This contrasts with findings in other regions (Zaal and Oostendorp, 2002; Tiffen and Mortimore, 1994; Ruben and van den Berg, 2001). In resource-poor agriculture, there were relatively scarce opportunities for investment while resource-rich agriculture generated its own investment dynamics. In traditional agriculture, the limited investment opportunities were due to technological limitations rather than, as for supplementary activities, due to problems of excess capacity.

From a perspective of efficient use of labour and land, farm and supplementary activities can be combined within households. Diversification has no negative effect on efficiency of crop production. In low-income village economies, however, it is not realistic to expect that economic diversification within the household will lead to better crop husbandry.

Poverty alleviation

Income decomposition along the household income spectrum provides information on whether, at household level, supplementary activities contributed to poverty alleviation. In the better accessible villages, involvement in supplementary activities was important enough to influence household income distribution. Poverty incidence was most severe under resource-poor conditions while the most unequal income distribution was found in one of the resource-rich accessible villages.

Household level analysis shows that only a few supplementary activities (trade and some artisan activities), concentrated in a few households, influenced income distribution. Other supplementary activities were too diffuse to influence income distribution. In villages with better infrastructure, the income strata with the highest or just below average income tended to have a larger share of supplementary income in total income compared to other income strata. Household case-wise analysis shows important variation within income strata. Similar portfolios of activities resulted in different income levels and different portfolios of activities generated equal income levels.

Men had better access to economic opportunities beyond the village, and the better the village accessibility the more they developed remunerative supplementary activities. Women remain dependent on the local economy and therefore they were involved in less remunerative economic activities.

The observed absence of typical portfolios of activities for different income strata diverges from the common perception that non-farm sectors can alleviate poverty. We combine information on individual livelihoods with information on village-wide income distribution. The first type of information is commonly found in case studies while the second type of information is usually presented in broader studies with large samples. This might be the reason why earlier studies overestimate the role of supplementary activities regarding their impact on village-level income distribution.

8.2   Research on diversification of rural livelihoods

The present study makes use of insights and analytical approaches presented in various types of livelihood studies. Studies that refer to the framework for sustainable livelihood analysis have yielded insight in the functioning of different categories of assets in local livelihoods (DFID, 2001; Meinzen-Dick *et al.*, 2003; Ellis and Mdoe, 2003; Tellegen, 1997; Scott, 1995). Analysis of broader surveys across regions and countries has led to identification of determinants and effects of rural diversification (Reardon *et al.*, 2001; Reardon, 1997; Ruben and van den Berg, 2001; de Janvry and Sadoulet, 2001). Lastly, quantitative studies seek to comprehensively analyse rural livelihoods by integration of economic and physical elements in village modelling (Taylor *et al.*, 1996) and household modelling (Holden *et al.*, 2004; Gladwin and *et al.*, 2001; Haddad *et al.*, 1997).

  Comparison of livelihood studies across different regions shows that specific attention is needed for the economic situation in so-called less-favoured areas (Ruben and Pender, 2004). Recent research on development and poverty calls for attention to broader research themes such as the rate of return to public investment, the relation between public and private investment, and interactions between local, national and international poverty patterns (Oskam *et al.*, 2004; Kuyvenhoven *et al.*, 2004; Barrett and Swallow, 2003). The latter studies emphasise that broad facilitating policies are required to support local economies with limited opportunities for income generation. Such policies should focus on infrastructure, finance, insurance, education and health services, thus providing a more secure environment for development of agricultural and non-agricultural sectors.

  The above-mentioned studies pay limited attention to the role of household livelihood diversification in long-term processes of "de-agrarisation" (Bryceson, 1996). For example, the advantages of opportunities for occupational specialisation besides livelihood diversification should also be considered (Bryceson, 2002). Analysis of transition processes, such as de-agrarisation, would facilitate the formulation of future-oriented rural policies. Such an analysis should provide more information on institutions and technologies of farm supplementary activities. The present study shows that most existing farm supplementary activities provided insufficient direct entry points for institutional and technological innovation. Instead, innovations should be sought in general institutional development (*i.e.* regulation, information, training and education) or in some niche activities. Paradoxically one niche activity identified in this research is horticulture, a farm supplementary activity in the primary sector which could become profitable if it were better supported through institutional and technological development.

By analysing different aspects of rural livelihoods this study contributes to an empirical assessment of the local setting at which facilitating policies are directed. Analysis of individual livelihoods appears to be a missing element in current livelihood research. To this effect, we evaluate in detail individual involvement in supplementary economic activities. Additionally, at the individual level, it is possible to empirically validate the relationship between risk attitude and income diversification (Mosley and Verschoor, 2004). An analysis of efficiency of crop production complements the assessment of economic activities carried out by rural households.

Our case-study approach on household income composition allows for identifying detailed patterns of income diversification. Similar portfolios of activities resulted in different income levels and different portfolios resulted in similar income levels (Barrett *et al.*, 2004). This finding does not appear in portfolio decomposition by income percentiles (Reardon *et al.*, 2000; Ellis and Mdoe, 2003).

Another contribution lies in a further precision of concepts used in the framework for sustainable livelihood analysis (DFID, 2001). We elaborate the relationship between resource and man-made capital on the one hand, and access-mediating capitals such as social and financial capitals on the other hand (Ellis, 2000; Pender, 1998). This distinction is in accordance with analyses of entitlements (Sen, 1992) and allows for including a better analysis of the role of institutions in rural livelihoods (Dorward *et al.*, 2001; 2003).

The present research offers a perspective on further research on livelihoods in less-favoured areas. Livelihood diversification has contributed to enhancing rural development in more-favoured areas of developing countries. Similar progress can not simply be replicated in the low-income village economies in rural sub-Saharan Africa without a careful specification of prevailing economic conditions.

8.3   Outlook

Based on the research findings, we can address some more strategic questions, on how farm supplementary activities can contribute to rural development, and what type of additional research is required to identify feasible development options. Farm household diversification into supplementary activities has come firmly onto the agenda for research on and development of rural livelihoods (Reardon *et al.*, 1988; Ellis, 2000). Even though household activity diversification is nowadays widespread in rural sub-Saharan African, it has not generated the expected economic growth of the local economy.

Two different perspectives of diversification behaviour are at the origin of the ambiguous interpretation of its role in rural livelihoods. The present study emphasises that livelihood

diversification is a response to economic stagnation and poverty. Only a few individuals, and virtually no households, are able to base their livelihood on a single economic activity. Hence diversification is caused by poverty. From a second perspective, less-favoured rural areas are highly risk-prone. Households diversify in order to deal with the many risks they are exposed to. Thus, diversification is a response to risk, and risk reduction is the envisaged effect of diversification.

From these two perspectives, it follows that diversification may be an appropriate choice to structurally mitigate risk. Much less evidently, diversification is an appropriate device to alleviate poverty. Livelihood diversification may help in avoiding short-term income shortfalls; it does not structurally improve the local economic base.

Frequently, migration is considered to be an alternative for local livelihood diversification. For the households from which members migrate, migration has related effects on external revenues (remittances), production and consumption, generally resulting in an increase of household welfare (Kuiper, 2005). Most importantly, migration generates new links with economies beyond the village boundaries, and these will be complementary to policy support for rural livelihoods.

Policy efforts could be directed at supporting existing or establishing new economic activities. Better economic opportunities will attract labour resources of households and will thus result in, possibly temporary, diversification. Because the diversification is not an aim in itself, research and policy interventions should be directed at the institutional and technological environment of rural livelihoods. Poverty alleviation is an important institutional condition while efficient use of resources for production is an example of a technological condition.

Economic studies in less-favoured areas tend to concentrate on problems of poverty and focus on aspects of inter-household income distribution. Consequently, policy interventions in less-favoured areas may have an effect of income redistribution rather than income enhancement. Yet, macro-economic studies show that economic growth has a larger impact on poverty alleviation than income redistribution (Easterly, 2001). Further research on livelihoods could validate this macro-economic finding for village-level rural development.

Livelihood studies tend to be biased towards the private sector, and specifically towards the economic activities of rural households. However, it is not realistic to expect that private investments will succeed in situations where complementary public investments are insufficiently available or inadequate (Binswanger *et al.*, 1993; Ellis and Freeman, 2004) Instead, externalities with respect to poverty and ecological problems will increasingly demand public research and development interventions (Pender, 1998, 2003). Drawing the attention of

national policy-makers to rural poverty remains an important task of livelihood research. The benefits of creating awareness on the incidence of poverty are less tangible in the short run, but may be greater in the long run than promoting local activity diversification as an apparent solution.

Further identification of remunerative economic opportunities may attract investments from outside the villages to the less-favoured areas. Such opportunities are present along the entire income spectrum. Because people are generally more than qualified for the economic activities in which they are engaged, more attention should be devoted to identification of alternative potential economic activities.

Assessment of livelihoods has shown that individuals have ample room for manoeuvre to generate economic development. Individual access to farm supplementary activities is common practice and economic activities of one person generate employment for others. However, the readiness to become involved in economic activities is invariably larger than the existing opportunities, resulting in persistent problems of poverty.

Research and policy will gain impact when issues of economic efficiency and poverty alleviation are addressed independently and simultaneously. The focus of livelihood research is then likely to shift from evaluating diversification behaviour towards assessment of economic opportunities. For the wealthier income strata emphasis should be placed on making investments economically feasible. For the poorer income strata poverty alleviation remains a major issue at stake. More than I anticipated at the start of this study, general improvements regarding market development, education and health services will find their way to village economies via individual livelihoods, and are therefore an appropriate response to the comprehensive problems of poverty in rural livelihoods in sub-Saharan Africa.

Appendix 1.1
Location of villages, selected country statistics, and collected information
Burkina Faso

- ·—·— National boundary
- ——— Province boundary
- ■ Capital
- === Road
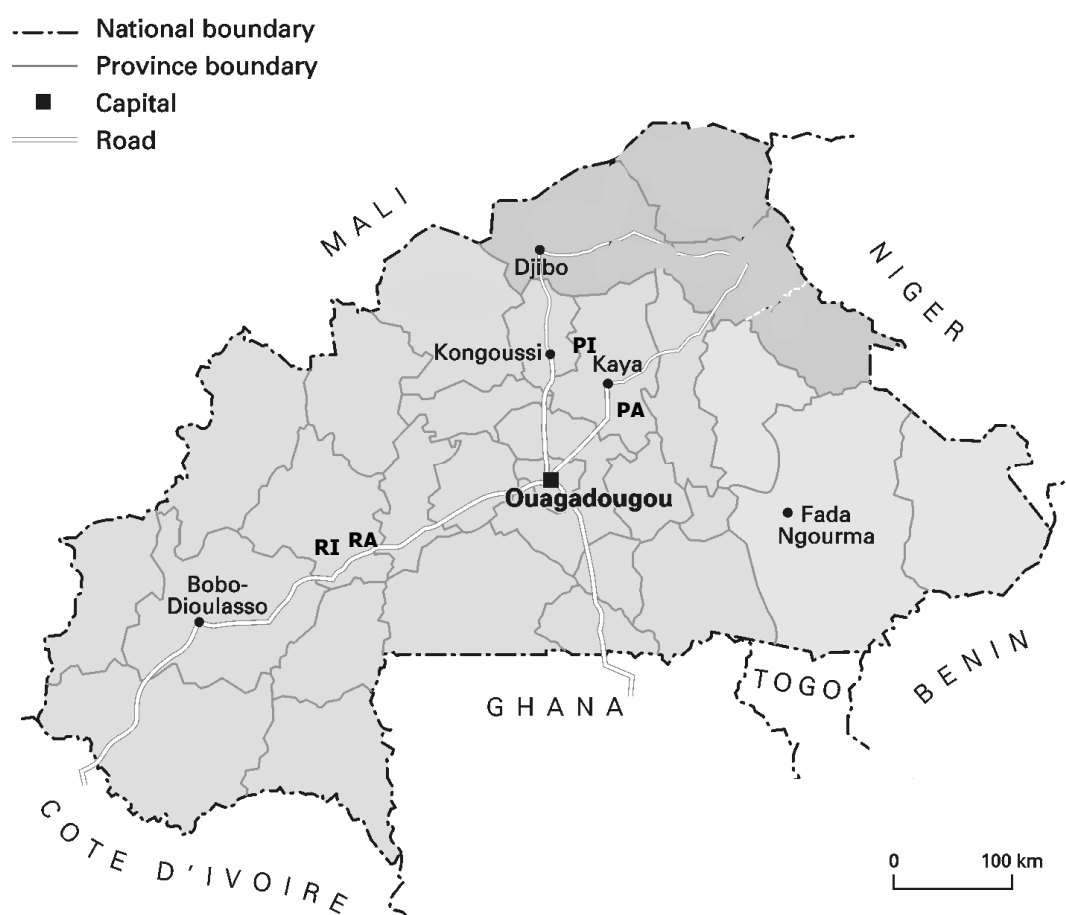
Source: Dietz et al. 2004

	Village	Acronym	Resource endowment	Accessibility
Villages of research	Koho	RA	Resource-rich	Accessible
	Sayero	RI	Resource-rich	Isolated
	Sidogo	PA	Resource-poor	Accessible
	Tagalla	PI	Resource-poor	Isolated

Selected country statistics

	Burkina Faso	Sub-Saharan Africa	Low-income countries
Total population (millions) [1]	12.1	703	2,310
GNI per capita (US$) [1]	300	490	450
GDP per capita % growth (2003-2004) [2]	4.1	1.3	4.9
PPP gross national income per capita (US$) [2]	1,180	2,190	1,770
Urban population (% of total population) [1]	18	36	30
Life expectancy at birth [1]	43	46	58
Illiteracy (% of population age 15+) [1]	77 [1a]	35	39
Gross primary enrolment (% of school-age population) [1]	46	87	92

Notes: [1] Data concern 2003, source: World Bank (2004b). [1a] Data concern 2000, source: World Bank (2004b). [2] Data concern 2003, source: World Bank (2004a).

Type of collected information

Based on interviews with the head of the household	
Household data (randomly selected households)	Household composition Number of absent household members Remittances from absent household members Aggregate of individual characteristics
Data on individual members (all household members)	Age, sex Education (years) Position in household Number of children, age of children Number and type of economic activities Livestock ownership Land ownership Capital ownership (equipment, bicycles, etc.)

Based on interviews with household members with individual economic activities	
Individual	Risk attitude Propensity to invest Weekly time allocation (estimation)
Farm supplementary activities (all economic activities)	Estimated time allocation Organisation of tasks / collaboration with others Revenues (sales, gifts, consumption) in quantity and prices Expenditures (purchases, own production) in quantity and prices Frequency of full production cycle Rhythm of activities / turnover rate Investments (materials, costs, depreciation) Finance (payment modality, credit)
Animal husbandry (cattle, small ruminants, donkeys, poultry)	Herd composition (sex, age) Purchases, sales, receipts and gifts (number and prices) Herd changes (birth, mort, theft, losses) Expenditures for feed, veterinary care or materials Labour use (own, household members, hired labour) Tenancy of livestock (individual, household, entrusted)
Crop husbandry (all plots)	Tenancy of plots Crop type, intercropping Plot area and distance to homestead (including fallow area) Type of soil and location of fields Presence of soil and water conservation techniques Field specific conditions (erosion, soil degradation) Inputs (seed, fertiliser, pesticides, organic matter) Crop management (ploughing, weeding, ridging) Use of animal traction Labour use (owner, household members, hired labour) Production and destination (stock, sales) Input and output prices based on market surveys

Appendix 2.1
Details on supplementary activities, prices of products, crops and livestock

Grouping of supplementary activities

Food	Non food
Primary	
Horticulture	Gold mining
Various (wage labour, apiculture, hunting, fishing, gathering endogenous medicines, hiring of oxen)	Various (gathering fuel wood and straw)
Processing	
Sorghum beer	Sheanut
Distilling spirits	Spinning
Snacks (cookies, meals, peanuts, tobacco, meat, drinks, and other snacks)	Various (potassium, bricks, charcoal, ash)
Various (sauce ingredients, groundnut oil, germinated millet, milling, *néré* grain, cow peas)	Ammunition
Trade	
Livestock, groundnut butter, fish, coffee, cola-nuts, cereals, medicines, rice, poultry, pepper, distilled spirits, *néré* grain, sugar, drinks, ground peas, tomato, and other products)	Retail shop, batteries, petrol, ammunition, potassium, and other products
Artisan work	
	Cotton weaving and dyeing
	Carpentry, mechanics, construction, tailoring, sewing, shoe repairing, hair dressing, making of ropes, baskets, mats and sheets

Prices used in calculations

Sorghum	80 FCFA / kg	Fertilizers	214 - 234 FCFA / kg
Millet	85 FCFA / kg	Insecticides	2500 FCFA / litre
Maize	80 FCFA / kg		
Rice	90 FCFA / kg		
Cotton	155 FCFA / kg		
Groundnut	95 FCFA / kg		

	Price adult male (FCFA)	Price adult female (FCFA)
Oxen	110,000 - 130,000	
Cattle	65,000 - 82,000	45,000 - 65,000
Small ruminants	5,000 - 8,000	4,000 - 6000
Pigs	4,000 - 5,000	3,000 - 5,000

Appendix 4.1
Indicators and measures of the determinants of supplementary income level

| | | Unit of recording | |
		Individual	Household
Endowment	**Farm endowment**		
	Cultivated land	Land ownership	Land ownership per adult equivalent
	Livestock assets	Individual livestock ownership	Livestock assets per adult equivalent
	Household endowment		
	Household size	[1]	Number of adult equivalents (ae)
	Migration revenues	[2]	Ratio migrated / present
	Supplementary income others	[1]	Supplementary income ae^{-1}
Ability	**Expertise**		
	Age (and age squared)	Individual age	Average age
	Education	Number of years of education	Average years of education men
			Average years of education women
	Availability		
	Children <7 year	Children less than 7 years	Children less than 7 years ae^{-1}
	Children 7-16 year	Children of 7-16 years	Children of 7-16 years ae^{-1}
	Farm labour demand	[2]	Farm work time ae^{-1}[*]
	Use of external labour	Ratio external / family labour	Ratio external / family labour
	Wives in household	Number of spouses	[5]
	Order of entry	Spouses by order of entry	[5]
Preference	**Comparative advantage**		
	Crop labour productivity	[3]	Crop revenues per labour input [*]
	Land productivity	[3]	Gross crop margin ha^{-1}
	Preference related		
	Gender	[4]	Percentage women
	Ethnicity	Included in village dummy	Included in village dummy

Notes: See Table 4.1. Reasons for not filling some cells: 1) not applicable to individuals; 2) not measured at individual level; 3) not applicable because of respondents without own crop or animal revenues; 4) taken into account in separate estimations; 5) not applicable to households; *) Expressed in % of zone average

Annex 5.1 Explanation of the lottery set-up

Respondents received FCFA 200 and were offered four different lottery cards. Each lottery card indicated a possible stake (0; 50; 100; 200; and 300) with a different gain (Table A 5.1). From card one to four the gains were increasing. A heads-or-tails lottery determined winning or losing and a dice determined the card that was going to be played; only one card was going to be played once and it was not necessary to divide the money among the four cards.

Table A 5.1 Lottery cards presented to the respondents

	Stake	Gain	Net gain	Exp value*)		Stake	Gain	Net Gain	Exp value
Card 1	0	0	0	0	**Card 3**	0	0	0	0
	50	100	50	0		50	150	100	25
	100	200	100	0		100	350	250	75
	200	400	200	0		200	600	400	100
	300	600	300	0		300	850	550	125
Card 2	0	0	0	0	**Card 4**	0	0	0	0
	50	150	100	25		50	200	150	50
	100	300	200	50		100	400	300	100
	200	500	300	50		200	750	550	175
	300	700	400	50		300	1000	700	200

The analysis proceeds differently, because the focus of interest is at each level of stake (Table A 5.2). Following the utility functions in equation 5.1 - 5.3 a respondent who is willing to bet FCFA 200 in order to possibly gain FCFA 600 (or a net gain of FCFA 400) appreciates his last received FCFA 200 just as much as the next to be received FCA 400. With the utility function in equation 5.1 this corresponds with an income level of FCFA 400 and a utility level 6.0. Since utility does not have a unit, the corresponding income can also be considered as being without a unit. The numbers from 1 to 5 were used in the regression calculations in Table 5.3.

Table A 5.2 Income-utility pairs by stake-gain combination

Stake: FCFA 50			Stake: FCFA 100		
Net gain	Income level	Utility	Net gain	Income level	Utility
1. 50	>>1000	8.5	1. 100	>>1000	13.6
2. 100	100	4.6	2. 200	200	5.3
3. 100	100	4.6	3. 250	166.7	5.1
4. 150	75	4.3	4. 300	150	5.0
5. No bet			5. No bet		
Stake FCFA 200			**Stake: FCFA 300**		
1. 200	>>1000	20.7	1. 300	>>10,000	25.3
2. 300	600	6.4	2. 400	1200	7.1
3. 400	400	6.0	3. 550	675	6.5
4. 550	314	5.8	4. 700	525	6.3
5. No bet			5. No bet		

Appendix 6.1
Production function estimations by crop and resource endowment

	Resource-rich				Resource-poor			
	Sorghum (n=155)		Millet (n=58)		Sorghum (n=171)		Millet (n=73)	
Production function	coefficient	t-val.	coefficient	t-val.	coefficient	t-val.	coefficient	t-val.
Inputs								
Land (ln FCFA)	0.765	5.79 ***	0.340	1.54	0.338	4.25 ***	0.343	2.58 **
Labour (ln FCFA)	0.235	1.85 *	0.697	3.52 ***	0.248	3.12 ***	0.511	3.61 ***
Fertiliser (ln FCFA)	-0.031	-0.83	n.a.		-0.002	-0.08	-0.038	-1.45
Organic matter (ln local units)	0.015	0.53	-0.040	-1.35	0.001	0.07	-0.001	-0.08
Technical and environment								
Animal traction (proxy)	-0.038	-1.58	0.081	1.92 *	0.005	0.25	0.033	1.36
Red sorghum (=1)	n.a.		n.a.		-0.240	-1.87 *	n.a.	
Been intercropped (=1)	n.a.		n.a.		0.230	1.70 *	0.289	1.61
Accessibility (=1)	-0.556	-1.66 *	-1.818	-2.05 **	0.075	0.61	0.072	0.39
Distance to homestead (ln mtr)	-0.603	-3.40 ***	-0.210	-0.65	0.032	0.77	0.110	1.01
Non-physical variables								
Owner: Women (=1)	-0.050	-0.74	-0.301	-1.86 *	-0.420	-2.99 ***	-0.354	-1.44
Owner: Dependent men (=1)	-0.033	-0.22	0.321	1.24	0.077	0.48	0.459	1.57
Suppl. income (FCFA / ae)	0.003	1.00	0.002	0.35	0.006	3.08 ***	0.006	2.35 **
Livestock assets (FCFA / ae)	-0.003	-0.63	-0.009	-0.93	0.016	2.79 ***	0.016	2.00 **
Intercept	2.021	2.81 ***	2.809	2.00 **	4.160	6.49 ***	0.805	0.64
Prob > F	0.000		0.000		0.000		0.000	
Adj R-squared	0.69		0.71		0.55		0.66	

Notes: The dependent variable is the log value of crop output (FCFA). Animal traction consists of an estimation of the costs for plowing, weeding and ridging. *, **, and *** indicate significance at the 0.10, 0.05 and 0.01 levels, respectively. Abbreviations: n.a. = not applicable; avg = average, sd = standard deviation; ae = adult equivalent.

Appendix 6.2a

Input demand functions for resource-rich villages by input type

Input	household labour		hired labour		fertiliser		oxen traction		organic matter		crop index		cotton share	
	coeffcient	z-val	coeffcient	z-val	coeffcient	z-val	coeffcient	z-val	coeffcient	z-val	coeffcient	z-val	coeffcient	z-val
Intercept	-11.16	0.0	-190.05	-1.5	401.74	0.4	29.93	0.2	-83.56	-1.5	378.17	1.6 *	-34.61	-0.7
Cultivated area (ha)	38.21	7.8 ***	27.07	11.4 ***	125.07	5.8 ***	25.01	9.6 ***	1.65	1.6	9.07	2.1 **	2.32	2.6 ***
Household size (number adult equivalent)	9.93	1.2	-19.55	-4.7 ***	-49.44	-1.3	-6.94	-1.5	-0.14	-0.1	-1.88	-0.2	-0.70	-0.4
Age (year)	0.10	0.0	13.65	2.0	-29.54	-0.5	-3.77	-0.5	2.74	0.8	3.63	0.3	0.06	0.0
Age squared (year)	0.01	0.1	-0.19	-2.1 **	0.30	0.4	0.04	0.4	-0.03	-0.8	-0.01	-0.1	0.00	0.1
Education level men (year)	-0.02	-0.3	0.00	-0.1	-0.14	-0.3	-0.02	-0.4	0.03	1.3	-0.09	-1.2	-0.01	-0.8
Education level women (year)	0.04	0.3	-0.02	-0.3	-0.26	-0.5	0.02	0.3	-0.01	-0.4	0.04	0.4	0.01	0.4
Young children per adult equiv. (number)	0.31	1.1	-0.29	-2.1 **	-0.55	-0.4	-0.16	-1.0	0.05	0.9	0.15	0.6	0.06	1.2
Teenagers per adult equiv. (number)	0.95	2.9 ***	-0.13	-0.8	-0.01	0.0	-0.41	-2.1 **	-0.10	-1.2	0.21	0.7	-0.01	-0.2
% women in household	-1.39	-0.7	-0.50	-0.5	-2.21	-0.3	1.74	1.7 *	0.73	1.7 *	0.92	0.5	0.15	0.4
Remote village (=1)	-3.84	-0.1	-30.05	-1.3	108.35	0.5	29.54	1.2	-1.25	-0.1	54.96	1.3	45.20	4.8 ***
Bwa ward (=1)	75.60	1.6	-2.11	-0.1	337.98	1.6 **	-8.68	-0.3	2.82	0.3	-13.97	-0.3	28.81	3.0 ***
Livestock assets (FCFA 1,000 per adult)	-0.40	-0.4	0.06	0.1	2.58	0.5	1.38	2.3 **	0.59	2.6 ***	0.37	0.4	0.04	0.2
Suppl. income (FCFA 1,000 per adult)	-0.41	-1.0	0.49	2.6 **	1.56	0.9	-0.17	-0.9	0.08	1.0	0.32	0.9	0.07	1.0
Scale correction	101.83	11.7 ***	49.28	11.5 ***	426.27	10.0 ***	52.56	10.8 ***	19.85	8.7 ***	90.37	11.7 ***	16.63	9.0 ***
Adjusted R-squared	0.80		0.82		0.66		0.86		0.27		0.22		0.60	
S.E. of regression	115.49		52.21		407.60		53.84		16.73		102.36		14.56	
Avg. log likelihood	-6.04		-5.18		-5.87		-4.57		-2.87		-5.92		-2.99	
Akaike info criterion	12.53		10.81		12.19		9.58		6.18		12.29		6.43	
Schwarz criterion	13.02		11.30		12.68		10.07		6.67		12.78		6.92	
Hannan-Quinn criter.	12.72		11.00		12.38		9.78		6.38		12.48		6.62	
Left censored obs	0		2		16		11		27		0		23	

Notes: n=68. *, **, and *** indicate significance at the 0.10, 0.05 and 0.01 levels, respectively.

Appendix 6.2b

Input demand functions for resource-poor villages by input type

Input	household labour coeffcient	z-val		fertiliser coeffcient	z-val	oxen traction coeffcient	z-val	organic matter coeffcient	z-val	crop index coeffcient	z-val
Intercept	-641.48	-0.9		-519.21	-0.6	-135.03	-1.0	30.10	1.1	355.89	6.2 ***
Cultivated area (ha)	78.70	3.8 ***		-34.40	-1.2	7.15	1.9 0.06	-1.21	-1.5	-0.94	-0.6
Household size (number adult equivalent)	21.13	1.3		35.82	1.9 **	5.72	1.9 0.06	1.99	3.2 ***	-0.78	-0.6
Age (year)	37.49	1.2		4.82	0.1	3.93	0.6	-1.37	-1.1	-2.55	-1.0
Age squared (year)	-0.49	-1.3		-0.09	-0.2	-0.04	-0.6	0.01	0.8	0.04	1.3
Education level men (year)	0.13	0.5		0.47	1.3	0.07	1.4	-0.01	-1.2	-0.04	-1.6 *
Education level women (year)	-0.77	-1.3		-0.14	-0.2	-0.11	-0.9	-0.05	-2.1 **	0.05	1.0
Young children per adult equiv. (number)	0.46	0.5		-0.44	-0.3	-0.22	-1.2	0.01	0.5	0.00	-0.1
Teenagers per adult equiv. (number)	1.82	2.0 **		1.58	1.2	0.18	1.0	0.05	1.3	-0.18	-2.5 ***
% women in household	0.42	0.1		6.30	1.5	-0.24	-0.4	0.19	1.6	0.26	1.0
Remote village (=1)	106.07	1.4		-27.38	-0.3	-30.19	-2.0 0.04	1.11	0.4	27.74	4.6 ***
Livestock assets (FCFA 1,000 per adult)	-4.52	-1.3		8.85	2.2 **	1.64	2.5 ***	0.01	0.1	-0.04	-0.1
Suppl. income (FCFA 1,000 per adult)	-0.50	-0.5		-1.63	-0.5	0.17	0.9	-0.02	-0.6	0.10	1.2
Scale correction	213.10	10.3 ***		181.90	4.5 ***	36.60	7.4 ***	7.85	9.6 ***	17.38	10.3 ***
Adjusted R-squared	0.48			0.36		0.35		0.30		0.27	
S.E. of regression	248.17			82.69		31.04		8.43		20.26	
Avg. log likelihood	-6.78			-1.85		-3.29		-3.17		-4.27	
Akaike info criterion	14.09			4.24		7.10		6.86		9.08	
Schwarz criterion	14.61			4.76		7.62		7.38		9.60	
Hannan-Quinn criter.	14.29			4.44		7.30		7.06		9.28	
Left censored obs	0			40		21		6		0	

Notes: n=53. *, **, and *** indicate significance at the 0.10, 0.05 and 0.01 levels, respectively.

Appendix 7.1

**Categories of activities by gender in order of ascending labour productivity**

| Men		Women	
Category	Included activities	Category	Included activities
Primary sector	Fishing Apiculture Gathering endogenous medicines Gathering fuel wood and straw Gold mining Hunting	Primary sector	Cotton spinning Gold mining Primary agricultural wage labour Horticulture
Horticulture and processing	Making bricks Horticulture Making charcoal	Beer brewing	Brewing sorghum beer
Weaving	Making low productivity products (blankets, baskets, ropes)	Processing	Processing other than sheanut products
Artisan work	Carpenter / construction Repair shop	Sheanut processing	Sheanut processing into butter and soap
Processing (capital intensive)	Distilling spirits Butcher Milling	Snacks and drinks	Meals, snacks and drinks preparation
Trade	Trade (food; non-food and services)	Trade and services	Trade (food; non-food and services)

Appendix 7.2a

Supplementary activities by men in order of descending total household income by village

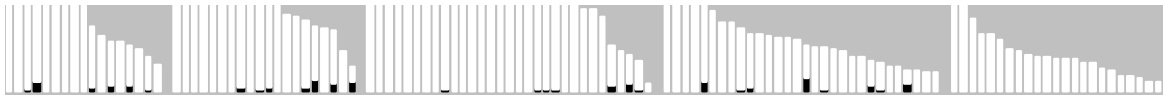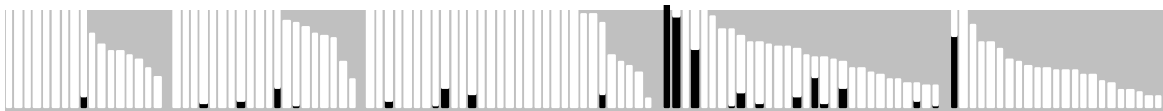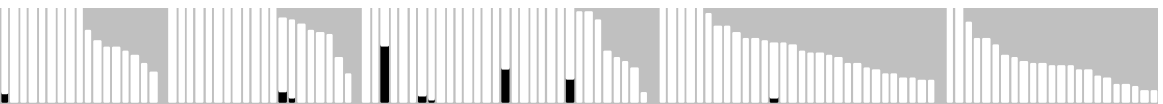| Rich Accessible 1	Rich Accessible 2	Rich Isolated	Poor Accessible	Poor Isolated

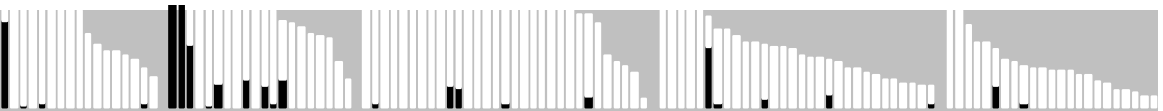Primary sector
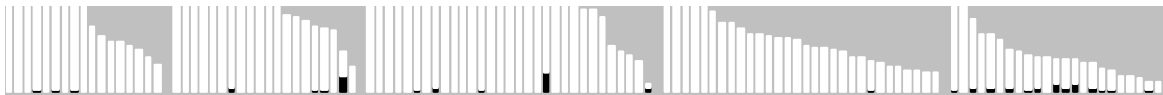
Horticulture and processing
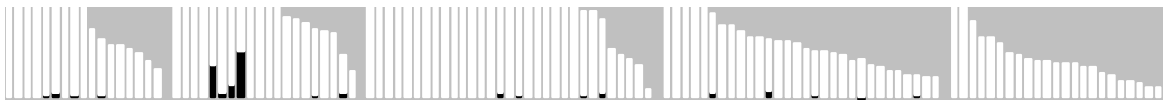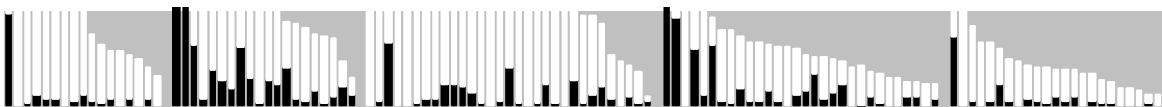
Weaving

Artisan work

Processing, capital intensive

Trade

 All supplementary activities by men

Explanation: The stacks on the horizontal axis represent income sources for each household: black is supplementary income and white is crop and livestcok income. The vertical axis is truncated at a level of FCFA 100,000 per adult equivlent per year because of the focus on poverty alleviation and herewith on the lowest income population strata.
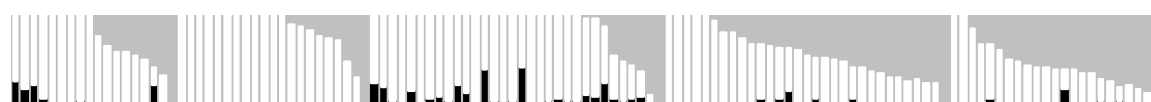
Appendix 7.2b

Supplementary activities by women in order of descending total household income by village

Rich Accessible 1	Rich Accessible 2	Rich Isolated	Poor Accessible	Poor Isolated

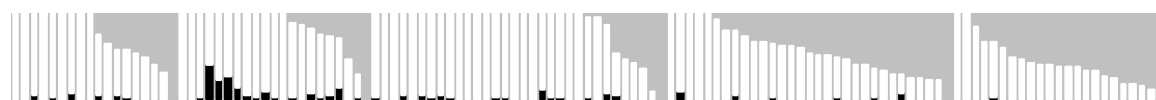Primary sector

Beer brewing
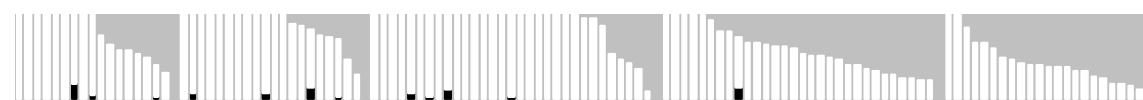

Processing other products

Sheanut processing

Preparation of meals, drinks and snacks

Trade and services

All supplementary activities by women
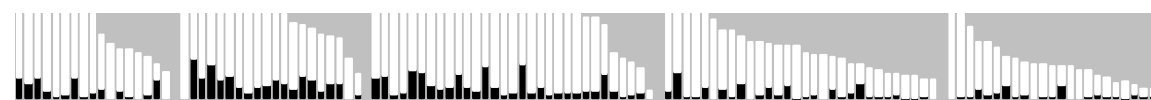
Explanation: The stacks on the horizontal axis represent income sources for each household: black is supplementary income and white is crop and livestcok income. The vertical axis is truncated at a level of FCFA 100,000 per adult equivlent per year because of the focus on poverty alleviation and herewith on the lowest income population strata.

References

Abdulai, A. and CroleRees, A. (2001) Determinants of income diversification amongst rural households in Southern Mali. *Food Policy*, 26, 437-52.

Adams, A.M., Madhavan, S. and Simon, D. (2002) Women's social networks and child survival in Mali. *Social Science & Medicine*, 54, 165-78.

Adams, R.H., Jr. (2002) Nonfarm income, inequality, and land in rural Egypt. *Economic Development and Cultural Change*, 50, 339-63.

Adams, R.H., Jr. and He, J.J. (1995) Sources of income inequality and poverty in rural Pakistan. International Food Policy Research Institute, Washington D.C.

Adégbidi, A., Gandonou, E. and Oostendorp, R. (2000) Measuring the productivity from indigenous soil and water conservation technologies with household fixed effects: A case study of hilly-mountainous areas of Bénin. Université Nationale du Bénin, Free University, Bénin, Amsterdam.

Alauddin, M. and Tisdell, C. (1995) Labor absorption and agriucltural development: Bangladesh's experience and predicament. *World Development*, 23, 281-297.

Alderman, H., Hoddinott, J., Haddad, L. and Udry, C. (1995) Gender differentials in farm productivity: Implications for household efficiency and agricultural policy. FCND Discussion Paper No. 6, International Food Policy Research Institute, Washington D.C.

Ali, M. and Byerlee, D. (1991) Economic effciency of small farmers in a changing world: A survey of recent evidence. *Journal of International Development*, 3, 1-27.

Anderson, J.R. (2001) Risk management in rural development. A review. Rural Strategy Background Paper 7, The World Bank, Washington D.C.

Barrett, C.B. (2004) Mixing qualitative and quantitative methods of analyzing poverty dynamics. Paper, Cornell University, Cornell.

Barrett, C.B., Bezuneh, M. and Aboud, A. (2001a) Income diversification, poverty traps and policy shocks in Cote d'Ivoire and Kenya. *Food Policy*, 26, 367-84.

Barrett, C.B., Bezuneh, M., Clay, D., C. and Reardon, T. (2000) Heterogeneous constraints, incentives and income diversification strategies in rural Africa. Paper, Cornell University, Ithaca.

Barrett, C.B. and Reardon, T. (2000) Asset, activity, and income diversification among African agriculturists: Some practical issues. Paper, Cornell University, Ithaca.

Barrett, C.B., Reardon, T. and Webb, P. (2001b) Nonfarm income diversification and household livelihood strategies in rural Africa: Concepts, dynamics, and policy Implications. *Food Policy*, 26, 315-31.

Barrett, C.B., Sherlund, S.M. and Adesina, A.A. (2004) Macroeconomic shocks, human capital and productive effciency: Evidence from West African rice farmers. Paper, Cornell University, University of Wisconsin, Rockefeller Foundation, Ithaca, Madison, New York.

Barrett, C.B. and Swallow, B.M. (2003) Fractal poverty traps. Paper, Cornell University, World Agro Forestry Centre.

Berdegué, J.A., Ramírez, E., Reardon, T. and Escobar, G. (2001) Rural nonfarm employment and incomes in Chile. *World Development*, 29, 411-25.

Binswanger, H.P. (1981) Attitudes toward risk: Theoretical Implications of an experiment in rural India. *Economic Journal*, 91, 867-90.

Binswanger, H.P. (1982) Empirical estimation and use of risk preferences: Discussion. *American Journal of Agricultural Economics*, 64, 391-93.

Binswanger, H.P., Khandker, S.R. and Rosenzweig, M.R. (1993) How infrastructure and financial institutions affect agricultural output and investment in India. *Journal of Development Economics*, 41, 337-66.

Binswanger, H.P. and McIntire, J. (1987) Behavioral and material determinants of production relations in land-abundant tropical agriculture. *Economic Development and Cultural Change*, 36, 73-99.

Bouahom, B., Douangsavanh, L. and Rigg, J. (2004) Building sustainable livelihoods in Laos: Untangling farm from non-farm, progress from distress. *Geoforum*, 35, 607-619.

Breusers, M. (1998) *On the move: Mobility, land use and livelihood practices on the Central Plateau in Burkina Faso.* Ph.D. thesis, LIT, Hamburg.

Breusers, M. (2001) *Pathways to negotiate climate variability. Land use and institutional change in the Kaya region, Burkina Faso.* African Study Centre, Leiden.

Brons, J.E. (1998) Social-economic aspects in spatial organization of land use and natural resources management. Paper, DHV Consultants B.V., Amersfoort.

Brons, J.E., Zaal, F., Ruben, R. and Kersbergen, L. (2004) Livelihood strategies and development pathways at household and village level. In Dietz, A.J., Verhagen, A. and Ruben, R. (eds.), *The impact of climate change on drylands with a focus on West Africa.* Kluwer Academic Publishers, Dordrecht, Boston, London, 267-292.

Bryceson, D.F. (1996) Deagrarianization and rural employment in sub-Saharan Africa: A sectoral perspective. *World Development*, 24, 97-111.

Bryceson, D.F. (1999) Sub-Saharan Africa betwixt and between: Rural livelihood practices and policies. ASC Working Paper 43, Africa Study Centre, Leiden.

Bryceson, D.F. (2002) The scramble in Africa: Reorienting rural livelihoods. *World Development*, 30, 725-39.

Carter, M.R. (1997) Environment, technology, and the social articulation of risk in West African agriculture. *Economic Development and Cultural Change*, 45, 557-90.

Chalfin, B. (2000) Risky business: Economic uncertainty, market reforms and female livelihoods in Northeast Ghana. *Development and Change*, 31, 987-1008.

Chavas, J.P., Kristjanson, P.M. and Matlon, P. (1991) On the role of information in decision making: The case of sorghum yield in Burkina Faso. *Journal of Development Economics*, 35, 261-80.

Coelli, T., Rahman, S. and Thirtle, C. (2002) Technical, allocative, cost and scale efficiencies in Bangladesh rice cultivation: A non-parametric approach. *Journal of Agricultural Economics*, 53, 607-26.

Coelli, T., Rao, D.S.P. and Battese, G.E. (1998) *An introduction to efficiency and productivity analysis.* Kluwer Academic Publishers, Boston, Dordrecht, London.

Coelli, T.J. (1995) Recent developments in frontier modelling and efficiency measurement. *Australian Journal of Agricultural Economics*, 39, 219-45.

Collier, P. and Lal, D. (1986) *Labour and poverty in Kenya, 1900-1980.* Oxford University Press, Clarendon Press, Oxford, New York, Toronto, Melbourne.

Corral, L. and Reardon, T. (2001) Rural nonfarm incomes in Nicaragua. *World Development*, 29, 427-42.

Davies, S. (1996) *Adaptable livelihoods: Coping with food insecurity in the Malian Sahel.* MacMillan, Basingstoke.

de Bruijn, M. and van Dijk, H. (1995) *Arid ways: Cultural understandings of insecurity in Fulbe society, Central Mali.* Ph.D. thesis, Thela, Amsterdam.

de Groote, H. and Coulibaly, N. (1998) Gender and generation: An intra-household analysis on access to resources in Southern Mali. *African Crop Science Journal*, 6, 79-95.

de Haan, A., Brock, K. and Coulibaly, N. (2002) Migration, livelihoods and institutions: Contrasting patterns of migration in Mali. *Journal of Development Studies*, 38, 37-58.

de Janvry, A. and Sadoulet, E. (2001) Income strategies among rural households in Mexico: The role of off-farm activities. *World Development*, 29, 467-80.

de Janvry, A., Sadoulet, E. and Thorbecke, E. (1995) State, market, and civil organizations: New theories, new practices, and their implications for rural development: Introduction. In de Janvry, A., Radwan, S., Sadoulet, E. and Thorbecke, E. (eds.), *State, market, and civil organizations: New theories, new practices, and their implications for rural development: Introduction.* Macmillan, ILO, London, 1-19.

de Steenhuijsen Piters, B. (1995) *Diversity of fields and farmers: Explaining yield variations in northern Cameroon.* Ph.D. thesis, Wageningen University, Wageningen.

Delgado, C.L., Hopkins, J., Kelly, V.A., Hazell, P., McKenna, A.A., Gruhn, P., Hojjati, B., Sil, J. and Courbois, C. (1998) *Agricultural growth linkages in sub-Saharan Africa.* Research report 107, International Food Policy Research Institute, Washingthon, D.C.

Delgado, C.L. and Siamwalla, A. (1999) Rural economy and farm income diversification in developing countries. International Food Policy Research Institute, Thailand Development Research Institute Foundation, Washingthon, D.C.

DFID (2001) Sustainable livelihoods Guidance Sheets. Department for International Development, http://www.livelihoods.org/.

Dietz, A.J., Verhagen, A. and Ruben, R. (eds.) (2004) *The impact of climate change on drylands with a focus on West Africa.* Kluwer Academic Publishers, Dordrecht, Boston, London.

Dorward, A., Anderson, S., Clark, S., Keane, B. and Moguel, J. (2001) Asset functions and livelihood strategies: A framework for pro-poor analysis, policy and practice. Contribution to EAAE seminar on livelihoods and rural poverty.

Dorward, A., Kydd, J. and Poulton, C. (1998) *Smallholder cash crop production under market liberalisation: A new institutional economics perspective.* CAB International, Wallingford.

Dorward, A., Poole, N., Morrison, J., Kydd, J. and Urey, I. (2003) Markets, institutions and technology: Missing links in livelihoods analysis. *Development Policy Review*, 21, 319-32.

Easterly, W. (2001) *The elusive quest for growth: Economists' adventures and misadventures in the tropics.* The MIT Press, Cambridge, London.

Elbers, C. and Lanjouw, P. (2001) Intersectoral transfer, growth, and inequality in rural Ecuador. *World Development*, 29, 481-96.

Ellis, F. (1993) *Peasant economics: Farm households and agrarian development.* Cambridge University Press, Cambridge.

Ellis, F. (1998) Household strategies and rural livelihood diversification. *Journal of Development Studies*, 35, 1-38.

Ellis, F. (2000a) The determinants of rural livelihood diversification in developing countries. *Journal of Agricultural Economics*, 51, 289-302.

Ellis, F. (2000b) *Rural livelihoods and diversity in developing countries.* Oxford University Press, Oxford and New York.

Ellis, F. and Freeman, H.A. (2004) Rural livelihoods and poverty reduction strategies in four African countries. *Journal of Development Studies*, 40, 1-30.

Ellis, F. and Mdoe, N. (2003) Livelihoods and rural poverty reduction in Tanzania. *World Development*, 31, 1367-84.

Ensminger, J. (1992) *Making a market: The institutional transformation of an African society.* Cambridge University Press, Cambridge, New York, Melbourne.

Escobal, J. (2001) The determinants of nonfarm income diversification in rural Peru. *World Development*, 29, 497-508.

Fafchamps, M. (1995) Peasant houshoolds behaviour with missing markets: Some paradoxes explained. *The Economic Journal*, 101, 1400-07.

Fafchamps, M. (1998) Efficiency in intrahousehold resource allocation. FCND Discussion Paper No. 55, International Food Policy Research Institute, Washington, D.C.

Fafchamps, M. (2003) *Rural poverty, risk and development.* Elgar, Cheltenham.

Fan, S. and Chan-Kang, C. (2004) Returns to investment in less-favored areas in developing countries: A synthesis of evidence and implications for Africa. *Food Policy*, 29, 431-44.

Ferreira, F.H.G. and Lanjouw, P. (2001) Rural nonfarm activities and poverty in the Brazilian Northeast. *World Development*, 29, 509-28.

Francis, E. (2002) Rural livelihoods, institutions and vulnerability in North West Province, South Africa. *Journal of Southern African Studies*, 28, 531-550.

Francis, E. and Hoddinott, J. (1993) Migration and differentiation in Western Kenya: A tale of two sub-locations. *Journal of Development Studies*, 30, 115-45.

Gervais, R.R. and Mande, I. (2000) From crisis to national identity: Migration in Mutation, Burkina Faso, 1930-1960. *The International Journal of African Historical Studies*, 33, 59-79.

Gladwin, C.H., Thomson, A.M., Peterson, J.S. and Anderson, A.S. (2001) Addressing food security in Africa via multiple livelihood strategies of women farmers. *Food Policy*, 26, 177-207.

Goldstein, M. (1999) Chop time, no friends. Intra-household and individual insurance mechanisms in Southern Ghana. University of California, Yale University, Berkeley.

Gore, C. (2002) Globalization, the international poverty trap and chronic poverty in the least developed countries. CPRC Working paper, United Nations Conference on Trade and Development, Chronic Poverty Research Centre.

Haddad, L., Hoddinott, J. and Alderman, H. (1997) *Intrahousehold resource allocation in developing countries: Models, methods, and policy.* The Johns Hopkins University Press, Baltimore, London.

Haggblade, S., Hazell, P. and Brown, J. (1989) Farm-nonfarm linkages in rural sub-Saharan Africa. *World Development*, 17, 1173-1201.

Haggblade, S., Hazell, P. and Reardon, T. (2002) *Strategies for stimulating poverty-alleviating growth in the rural nonfarm economy in developing countries.* Eptd, Washington, D.C.

Hardaker, J.B., Huirne, R.B.M. and Anderson, J.R. (1997) *Coping with risk in agriculture.* CAB International, Wallingford.

Harris, C. and Laibson, D. (2001) Dynamic choices of hyperbolic consumers. *Econometrica*, 69, 935-57.

Heerink, N. (2005) Soil fertility decline and economic policy reform in Sub-Saharan Africa. *Land Use Policy*, 22, 67-74.

Henry, S., Piché, V., Ouédraogo, D. and Lambin, E.F. (2004) Descriptive analysis of the individual migratory pathways according to environmental typologies. *Population and Environment*, 25, 397-422.

Hicks, J. (1969) *Theory of economic history*, London.

Holden, S., Bekele, S. and Pender, J. (2004) Non-farm income, household welfare and sustainable land management in a less-favoured area in the Ethiopian highlands. *Food Policy*, 29, 369-392.

Huijsman, A. (1986) *Choice and uncertainty in a semi-subsistence economy : a study of decision making in a Philippine village.* Ph.D. thesis, Wageningen University, Wageningen.

Hyden, G. (1981) Modern cooperatives and the economy of affection. Conference paper, Ford Foundation, Nairobi.

IFAD. (2001) *Rural poverty report 2001.* Oxford University Press, Oxford.

Just, R.E. and Pope, R.D. (2003) Agricultural risk analysis: Adequacy of models, data, and issues. *American Journal of Agricultural Economics*, 85, 1249-56.

Kanwar, S. (1991) *The analytics of labour supply under alternative risk regimes.* Unpublished Ph.D. thesis, University of California, Berkeley.

Kevane, M. and Wydick, B. (2001) Social norms and the time allocation of women's labor in Burkina Faso. *Review of Development Economics*, 5, 119-29.

Kooreman, P. and Wunderink, S. (1997) *Economics of household behaviour.* MacMillan Press Ltd, Houndmills.

Kruseman, G. (2000) *Bio-economic household modelling for agricultural intensification.* Ph.D. thesis, Wageningen University, Wageningen.

Kuiper, M.H. (2005) *Village modelling: A chinese recipe for blending general equilibrium and household modeling.* Ph.D. thesis, Wageningen University, Wageningen

Kuyvenhoven, A., Pender, J. and Ruben, R. (2004) Development strategies for less-favoured areas (editorial). *Food Policy*, 29, 295-302.

Lanjouw, J.O. and Lanjouw, P. (2001) The rural non-farm sector: Issues and evidence from developing countries. *Agricultural Economics*, 26, 1-23.

Lanjouw, P. (2000) Rural non-agricultural employment and poverty in Latin America: Evidence from Ecuador and El Salvador.

Lanjouw, P. (2001) Nonfarm Employment and Poverty in Rural El Salvador. *World Development*, 29, 529-47.

Lanjouw, P., Quizon, J. and Sparrow, R. (2001) Non-agricultural earnings in peri-urban areas of Tanzania: Evidence from household survey data. *Food Policy*, 26, 385-403.

Lawrence, P.G., Sanders, J.H. and Ramaswamy, S. (1999) The impact of agricultural and household technologies on women: A conceptual and quantitative analysis in Burkina Faso. *Agricultural Economics*, 20, 203-14.

Lewis, B., D. and Thorbecke, E. (1996) Economic linkages in a small regional economy: The case of Kutus region, Kenya. In Taylor, J.E. and Adelman, I. (eds.), *Village economies: The design, estimation, and use of villagewide economic models.* Cambridge University Press, Cambridge, 122-145.

LNV. (1996) Naar een monitoringsysteem groene ruimte. Een eerste stap. Minisisterie van Landbouw, Natuur en Voedselkwaliteit, Ministerie van Ruimtelijke Ordening en Milieubeheer, Den Haag.

Low, A. (1986) *Agricultural development in Southern Africa: Farm household theory and the food crisis.* James Currey, London.

Maatman, A.J. (2000) *"Si le fleuve se tord, que le crocodile se torde": Une analyse des systèmes agraires de la région nord-ouest du Burkina Faso à l'aide des modèles de programmation mathématique.* Ph.D. thesis, Centre for Development Studies, University of Groningen, Groningen.

Mas - Colell, A., Whinston, M.D. and Green, J.R. (1995) *Microeconomic theory.* Oxford University Press, New York.

Mazzucato, V. and Niemeijer, D. (2000) *Rethinking soil and water conservation in a changing society: A case study in eastern Burkina Faso.* Ph.D. thesis, Wageningen University, Wageningen.

Meindertsma, J.D. (1997) *Income diversity and farming systems: Modelling of farming households in Lombok, Indonesia.* Ph.D. thesis, Royal Tropical Institute, Amsterdam.

Meinzen-Dick, R.S., Adato, M., Haddad, L. and Hazell, P. (2003) Impacts of agricultural research on poverty: Findings of an integrated economic and social analysis. EPTD Discussion Paper No. 111 / FCND Discussion Paper No. 164, International Food Policy Research Institute, Washington, D.C., p. 74.

Meinzen-Dick, R.S., Brown, L.R., Fieldstein, H.S. and Quisumbing, A.R. (1997) Gender, property rights and natural resources. *World Development*, 25, 1303-15.

Mochebelele, M.T. and Winter-Nelson, A. (2000) Migrant labor and farm technical efficiency in Lesotho. *World Development*, 28, 143-53.

Mosley, P. and Verschoor, A. (2004) Risk attitudes in the 'vicious circle of poverty'. Paper, University of Sheffield, Sheffield.

Negash, A. and Niehof, A. (2004) The significance of Enset culture and biodiversity for rural household food and livelihood security in Southwestern Ethiopia. *Agriculture and Human Values*, 21, 61-71.

Nibbering, J.W.S.M. (1991) *Hoeing in the hills: Stress and resilience in an upland farming system in Java*. Ph.D. thesis, Australian National University.

Niehof, A. (2004) The significance of diversification for rural livelihood systems. *Food Policy*, 29, 321-38.

North, D.C. (1990) *Institutions, institutional change and economic performance*. Cambridge University Press, Cambridge.

Oskam, A., Komen, M.H.C., Wobst, P. and Yalew, A. (2004) Trade policies and development of less-favoured areas: Evidence from the literature. *Food Policy*, 29, 445-66.

Pannell, D.J., Malcolm, B. and Kingwell, R., S. (1997) Are we risking too much? Perspectives on risk in farm modelling. Paper, University of Western Australia, University of Mellbourne.

Pender, J., Scherr, S. and Durón, G. (1999) Pathways of development: Causes and implications for agricultural production, poverty and sustainable resource use. EPTD Discussion Paper No. 45, International Food Policy Research Institute, Washington, D.C.

Pender, J.L. (1998) Population growth, agricultural intensification, induced innovation and natural resource sustainability: An application of neoclassical growth theory. *Agricultural Economics*, 19, 99-112.

Poulton, C. (1998) Cotton production and marketing in northern Ghana: The dynamics of competition in a system of interlocking transactions. In Dorward, A., Kydd, J. and Poulton, C. (eds.), *Smallholder cash crop production under market liberalisation: A new institutional economics perspective*. CAB International, Wallingford, 56-112.

Pyatt, G. (1976) On the interpretation and disaggregation of Gini coefficients. *Economic Journal*, 86, 243-55.

Quisumbing, A.R., Haddad, L. and Pena, C. (2001) Are women overrepresented among the poor? An analysis of poverty in 10 developing countries. *Journal of Development Economics*, 66, 225-69.

Quisumbing, A.R., Haddad, L. and Peña, C. (1995) Gender and poverty: New evidence from 10 developing countries. FCND Discussion Paper No. 9, International Food Policy Research Institute, Washington D.C.

Quisumbing, A.R. and Maluccio, J.A. (2003) Resources at marriage and intrahousehold allocation: Evidence from Bangladesh, Ethiopia, Indonesia, and South Africa. *Oxford Bulletin of Economics and Statistics*, 65, 283-327.

Rao, V.M. (1969) Two decompositions of concentration ratio. *Journal of the Royal Statistical Society, Series A. Part*, 3, 418-25.

Reardon, T. (1997) Using evidence of household income diversification to inform study of the rural nonfarm labor market in Africa. *World Development*, 25, 735-47.

Reardon, T., Berdegue, J.A. and Escobar, G. (2001) Rural nonfarm employment and incomes in Latin America: Overview and policy implications. *World Development*, 29, 395-409.

Reardon, T., Delgado, C. and Matlon, P. (1992) Determinants and effects of income diversification amongst farm households in Burkina Faso. *Journal of Development Studies*, 28, 264-96.

Reardon, T., Matlon, P. and Delgado, C. (1988) Coping with household-level food insecurity in drought-affected areas of Burkina Faso. *World Development*, 16, 1065-74.

Reardon, T. and Taylor, J.E. (1996) Agroclimatic shock, income inequality, and poverty: Evidence from Burkina Faso. *World Development*, 24, 901-14.

Reardon, T., Taylor, J.E., Stamoulis, K., Lanjouw, P. and Balisacan, A. (2000) Effects of non-farm employment on rural income inequality in developing countries: An investment perspective. *Journal of Agricultural Economics*, 51, 266-88.

Rooy, P.T.J.C. (1997) *Interactieve planvorming voor waterbeheer*. Ph.D. thesis, Technische Universiteit, Delft.

Ruben, R. and Pender, J. (2004) Rural diversity and heterogeneity in less-favoured areas: The quest for policy targeting. *Food Policy*, 29, 303-320.

Ruben, R., Pender, J. and Kuyvenhoven, A. (2004) Less-Favoured Areas: Special Issue of Food Policy. In Kydd, J., Dorward, A., Poole, N. and Poulton, C. (eds.), *Food Policy*.

Ruben, R. and van den Berg, M., M. (2001) Nonfarm employment and poverty alleviation of rural farm households in Honduras. *World Development*, 29, 549-60.

Sadoulet, E. and Janvry, A.d. (1995) *Quantitative development policy analysis*. Johns Hopkins University Press, Baltimore.

Savadogo, K., Reardon, T. and Pietola, K. (1994) Farm productivity in Burkina Faso: Effects of animal traction and nonfarm income. *American Journal of Agricultural Economics*, 76, 608-12.

Schultz, T.W. (1964) *Transforming traditional agriculture*, New Haven.

Schumpeter, J.A. (1947) Theoretical problems of economic growth. *The Journal of Economic History*, 1947, 1-9.

Scott, E., P. (1995) Home-based industries: An alternative strategy for household security in rural Zimbabwe. *The Journal of Developing Area*, 29, 183-212.

Scott, J.C. (1976) *Moral economy of the peasant : rebellion and subsistence in Southeast Asia*. Yale University Press, New Haven.

Sen, A. (1992) *Inequality re-examined*. Sage, New York.

Shapiro, D. and Tambashe, B.O. (2001) Gender, poverty, family structure, and investment in children's education in Kinshasha, Congo. *Eonomics of Education Review*, 20, 359-75.

Sherlund, S.M., Barrett, C.B. and Adesina, A.A. (2002) Smallholder technical efficiency controlling for environmental production conditions. *Journal of Development Economics*, 69, 85-101.

Slovic, P. (2000) *The perception of risk*. Earthscan, London.

Smidts, A. (1990) *Decision making under risk: A study of models and measurement procedures with special reference to the farmer's marketing behavior*. Ph.D. thesis, Wageningen University, Wageningen.

Smith, K., Barrett, C.B. and Box, P.W. (2000) Participatory risk mapping for targeting research and assistance: With an example from East African pastoralists. *World Development*, 28, 1945-59.

Smith, K., Barrett, C.B. and Box, P.W. (2001) Not necessarily in the same boat: Heterogeneous risk assessment among East African pastoralists. *Journal of Development Studies*, 37, 1-30.

Smith, L.C. and Chavas, J.P. (1997) Commercialization and the balance of women's dual roles in non-income-pooling West African households. *American Journal of Agricultural Economics*, 79, 589-94.

Smith, L.C. and Chavas, J.P. (1999) Supply response of West African agricultural households: Implications of intrahousehold preference heterogeneity. FCND Discussion Paper 69, International Food Policy Research Institute, Washington, D.C.

Stroosnijder, L. and van Rheenen, T. (2001) *Agro-silvo-pastoral land use in Sahelian villages*. Catena Verlag, Reiskirchen.

Taylor, J.E. and Adelman, I. (1996) *Village economies: The design, estimation, and use of villagewide economic models*. Cambridge University Press, Cambridge.

Tellegen, N. (1997) *Rural enterprises in Malawi: Necessity or opportunity?* Research Series African Studie Centre, Ashgate Publishing, Aldershot.

Thorbecke, E. (1993) Impact of state and civil institutions on the operation of rural market and nonmarket configurations. *World Development*, 21, 591-605.

Thorsen, D. (2002) 'We help our husbands!' Negotiating the household budget in rural Burkina Faso. *Development and Change*, 33, 129-46.

Tiffen, M. (2003) Transition in sub-Saharan Africa: Agriculture, urbanization and income growth. *World Development*, 31, 1343-66.

Tiffen, M. and Mortimore, M. (1994) Malthus controverted: The role of capital and technology in growth and environment recovery in Kenya. *World Development*, 22, 997-1010.

Toulmin, C. (1992) *Cattle, women, and wells: Managing household survival in the Sahel*. Clarendon, Oxford.

Turner, M.D. (2000) Drought, domestic budgeting and wealth distribution in Sahelian households. *Development and Change*, 31, 1009-35.

Udry, C., Hoddinott, J., Alderman, H. and Haddad, L. (1995) Gender differentials in farm productivity: Implications for household efficiency and agricultural policy. *Food Policy*, 20, 407-23.

UNDP (2004) *Human Development Report 2004, Cultural liberty in today's diverse world*. http://hdr.undp.org/reports/global/2004/.

van den Berg, M.M. (2001) *Off-farm income, risk, and agricultural production: A case study of smallholders in India's semi-arid tropics*. Ph.D. thesis, Wageningen University, Wageningen.

van Dijk, H., de Bruijn, M. and van Beel, W. (2004) Pathways to mitigate climate variability and climate change in Mali: The districts of Douentza and Koutiala compared. In Dietz, A.J., Verhagen, A. and Ruben, R. (eds.), *The impact of climate change on drylands with a focus on West Africa*. Kluwer Academic Publishers, Dordrecht, Boston, London, Vol. 39, 173-206.

Verbeek, M. (2000) *A guide to modern econometrics*. John Wiley & Sons Ltd, Chichester.

Verschoor, J.A.J. (2000) *Economics of poverty : Processes within an economic system that lead to the emergence, persistence or reduction of material hardship*. Ph.D. thesis, Thela-Thesis, Amsterdam.

Vose, D. (2000) *Risk analysis. A quantitative guide*. Wiley, West Sussex.

Walker, T.S. and Ryan, J.G. (1990) *Village and household economies in India's semi-arid tropics*. Johns Hopkins University Press, Baltimore, London.

Webster, L. and Fidler, P. (1996) The informal sector and microfinance institutions in West Africa. The International Bank for Reconstruction and Development, The World Bank, Washington, D.C.

Wik, M. (1998) *Risk, market imperfections and farm household behaviour in Northern Zambia*. Ph.D. thesis, Agricultural University of Norway.

Woldehanna, T. (2000) *Economic analysis and policy implications of farm and off-farm employment : a case study in the Tigray region of Northern Ethiopia*. Ph.D. thesis, Wageningen University, Wageningen.

Woldenhanna, T. and Oskam, A. (2001) Income diversification and entry barriers: Evidence from the Tigray region of Northern Ethiopia. *Food Policy*, 26, 351-65.

World Bank (2004a) *World Development Report 2005: A Better Investment Climate For Everyone*. http://econ.worldbank.org/wdr/.

World Bank (2004b) *Burkina Faso at a glance*. http://www.worldbank.org/data/.

Wooldridge, J.M. (2001) *Econometric analysis of cross section and panel data*. Cambridge, London.

Wouterse, F. and van den Berg, M. (2004) Migration for survival or accumulation: Evidence from Burkina Faso. Conference Paper, Wageningen University, Wageningen, p. 14.

Yunez Naude, A. and Taylor, J.E. (2001) The determinants of nonfarm activities and incomes of rural households in Mexico, with emphasis on education. *World Development*, 29, 561-72.

Zaal, F. and Oostendorp, R.H. (2002) Explaining a miracle: Intensification and the transition towards sustainable small-scale agriculture in dryland Machakos and Kitui districts, Kenya. *World Development*, 30, 1271-87.

Zimmerman, F.J. and Carter, M.R. (2003) Asset smoothing, consumption smoothing and the reproduction of inequality under risk and subsistence constraints. *Journal of Development Economics*, 71, 233-60.

Summary

When opportunities to obtain sufficient income from a single economic activity are scarce, many farm households in developing countries have looked for diversification of their livelihood across farm and farm supplementary activities. It is commonly assumed that economic diversification allows farm households to mitigate the income risks to which they would be exposed if they were dependent on farm income alone. There is much less clarity whether activity diversification offers, compared to economic specialisation, better perspectives for improving the livelihoods of rural households.

The present study assesses the economic potential of a diversified portfolio of farm and supplementary activities for households in rural economies of low-income countries that are characterised by economic stagnation. It provides detailed information on the economic activities that, in addition to farming, constitute the livelihoods of rural households. It evaluates the opportunities for and the access to these activities, the nature of individual livelihood diversification, and the effect of farm supplementary revenues on crop husbandry and household income composition. The thesis elaborates the following research questions:

1. What are the characteristics of existing farm supplementary activities?
2. What are the factors that determine whether people participate in supplementary activities?
3. How do supplementary activities contribute to individual livelihoods?
4. What is the effect of diversification towards supplementary activities on crop husbandry?
5. What income level do different portfolios generate and which activities are developed by the poorest population strata?

Because individual and household livelihood formation occurs simultaneously and alternately, we unravel these aspects in successive chapters that address specific questions about rural livelihoods. We suppose that income generation by any member is eventually beneficial to all household members, and avoid relying on assumptions regarding motives and satisfaction of individual members with respect to intra-household allocation mechanisms. Another argument for the set-up of this study is to anticipate the formulation of effective policy instruments that could make use of the information generated by livelihood research.

The research took place in five villages in Burkina Faso, one of the world's poorest countries with a rural economy that is characterised by economic stagnation. The selected villages differ with respect to agricultural resource endowment and infrastructure conditions. The analyses are

based on the results of a household survey among 121 households comprising 733 adult members. We analyse the complete household portfolio of economic activities.

For the first research question, we take a closer look at the nature of farm supplementary activities. We argue that present comparative advantages should be exploited through institutional and technological development. A description of enterprise practices illustrates institutional and technical characteristics of a variety of supplementary activities. Across categories of supplementary activities, which are usually gender-specific, we compare size, distribution and capital requirements.

Current farm supplementary activities were characterised by an excess capacity and the absence of institutional and technological innovations. Supporting markets for labour, finance, and inputs were virtually absent. The technology of supplementary activities was homogenous and rather poorly developed. Due to limited local demand for products, there were few opportunities to further expand current supplementary activities. Consequently, most existing farm supplementary activities provided insufficient direct entry points for institutional and technological innovation. Promoting diversification based on prevailing supplementary activities does not seem to offer a local economically feasible income alternative. Instead, innovations should be sought in general institutional development (*i.e.* regulation, information, training and education) or in some niche activities.

With respect to the second research question, we consider involvement in farm-supplementary activities to be an individual choice, which is based on one's position within the household, and on ability, preference and capital endowment. Household heads chose for farm supplementary activities when farm and family means were insufficient to assure livelihood. Dependent men had a relatively large room for manoeuvre to generate supplementary income. Women had more opportunities to expand involvement in supplementary activities when more household farm-resources were available, yet they were involved mainly in less remunerative activities.

The variables considered were selected based on a review of earlier livelihood studies. However, the present study does not identify these variables as the main determinants of supplementary income. In the context of a weak economic base of local farm supplementary activities, actual labour supply was likely to be much smaller the readiness to develop farm supplementary activities. In order to enhance the opportunities for people to increase labour supply more attention need to be accorded to alleviating broader poverty dynamics at village and regional level.

For the third research question, we assess the role of risk attitudes and investment propensity in individual livelihoods. We review some theoretical and empirical studies on intra-household income pooling and consumption sharing. The review offers inconclusive results concerning the relationships between risk attitude, income level and activity diversification.

Our analysis shows that women were more risk averse compared to men and risk aversion first decreased and then increased with age. In addition, respondents in villages with a better road infrastructure were consistently less risk aversive. However, risk and income appeared to be related to a limited extent. Local conditions strongly determined risk attitude and thus probably also risk perception. Risk aversion had a limited effect on individual diversification and investment choices. Different to the findings of other livelihood studies, we found that less risk-averse people showed greater involvement in supplementary activities.

Concerning the fourth research question, we combine livelihood analysis with an efficiency analysis for production of millet and sorghum. The literature provides examples of positive and negative effects of involvement in supplementary activities on crop husbandry. We show that in a resource-poor environment, households with more supplementary and livestock revenues used labour and land more efficiently for cereal production. In the resource-rich villages, supplementary income and livestock assets did not influence factor use efficiency. Supplementary income did not affect the use of external inputs for crop husbandry in the resource-rich nor in the resource-poor villages, except for some increased demand for hired labour in a resource-rich environment. To some extent, mechanisation and the use of organic matter for crop production were more important for households who own more livestock assets. In general, diversification had no negative effect on efficiency of factor use in cereal production.

To answer the fifth research question, we decompose income at village and household level, and devote special attention to the role of infrastructure, resource endowment, wealth, and categories of activities. It appeared that supplementary activities had no uniform impact on household income distribution. Higher farming income was frequently accompanied with more supplementary income, but there were also households who specialised in farm or in supplementary activities with similar, low as well as high, income levels. Differences in resource endowment explained income levels and poverty incidence, but had only a minor impact on portfolio composition. Households in poorer income strata benefited insufficiently from supplementary income to alleviate poverty. Also in the resource-rich villages several households remained below the poverty line. At the wealthier end of the income spectrum, only some households in the accessible villages relied more than average on supplementary activities. Only

in two accessible villages, resource-poor and resource-rich, involvement in supplementary activities was large enough to bring about income inequality. The activities concerned included trade and artisan work, mainly by men. Income from supplementary activities accruing to women had little impact on income distribution. Our analysis provides no evidence that households in specific income strata purposively diversified across farm and supplementary activities. Different categories of activities were diffusely distributed along the income spectrum.

In conclusion, the present study emphasises that livelihood diversification is a response to and a consequence of economic stagnation and poverty. This perspective contrasts with prevailing assumptions that households diversify in order to deal with the risks they are exposed to. Consequently, diversification results in risk reduction as a specific outcome of the configuration of livelihoods. Emphasis on the latter positive effect of livelihood diversification tends to divert the attention from the limited contribution of diversification to alleviation of poverty. Livelihood diversification may reduce seasonal income shortfalls; it does not structurally improve the local economic base.

Samenvatting

Bij gebrek aan mogelijkheden om uit één economische activiteit een voldoende inkomen te behalen, hebben rurale huishoudens in ontwikkelingslanden gezocht naar inkomens-diversificatie door het agrarische bedrijf aan te vullen met diverse nevenactiviteiten. Algemeen wordt aangenomen dat deze vorm van economische diversificatie leidt tot een afname van de inkomensrisico's die de rurale huishoudens lopen wanneer zij volledig afhankelijk zouden zijn van gewasproductie en veeteelt. Het is echter veel minder duidelijk of deze inkomensdiversificatie het bestaansniveau verbetert op een efficiëntere wijze dan mogelijk zou zijn bij economische specialisatie.

Deze studie evalueert of het voor rurale huishoudens in landen met een laag gemiddeld inkomen economisch aantrekkelijk is om nevenactiviteiten te ontwikkelen naast akkerbouw en veeteelt. Deze nevenactiviteiten omvatten een aantal activiteiten in the primaire sector (tuinbouw, jacht en verzameling), in de secondaire sector (voedselbereiding en nijverheid), en in de tertiaire sector (handel en andere diensten). We evalueren de mogelijkheden voor en de toegang tot deze nevenactiviteiten, de aard van individuele bestaansverwerving, het effect van neveninkomsten op de efficiëntie van het gebruik van grond en arbeid in de productie van gierst en sorghum, en het aandeel van neveninkomsten in het totale inkomen van het huishouden. De opéénvolgende hoofdstukken behandelen de volgende onderzoeksvragen:

1. Wat zijn de karakteristieken van de bestaande economische activiteiten naast akkerbouw en veeteelt?
2. Welke factoren bepalen of mensen deze nevenactiviteiten kunnen ontwikkelen?
3. Wat is de rol van de nevenactiviteiten in individuele bestaansverwerving?
4. Wat is het effect van het uitvoeren van nevenactiviteiten op de gewasteelt?
5. Welk inkomensniveau komt voort uit verschillende combinaties van activiteiten en, zijn de armere huishoudens betrokken in specifieke nevenactiviteiten?

Omdat motieven van bestaansverwerving gelijktijdig en alternerend betrekking hebben op het individu en op het huishouden, behandelen we verschillende deelaspecten van rurale bestaansverwerving. Voor deze studie nemen we aan dat inkomensverwerving door elk lid van een huishouden uiteindelijk voordelen bieden zal aan het hele huishouden. De individuele motieven en waardering van de uitkomsten van consumptieverdeling binnen het huishouden liggen buiten het domein van deze studie. Een andere reden voor de opzet van deze studie is

dat een efficiënt ruraal ontwikkelingsbeleid uiteindelijk zal moeten kunnen werken met informatie die voortkomt uit onderzoek naar rurale bestaansverwerving.

Het onderzoek vond plaats in vijf dorpen in Burkina Faso, één van de armste landen van de wereld, gekenmerkt door economische stagnatie. De geselecteerde dorpen verschillen in beschikbaarheid van natuurlijke hulpbronnen en infrastructuur. De analyses zijn gebaseerd op een onderzoek onder 121 huishoudens met gezamenlijk 733 leden van ouder dan 16 jaar. We analyseren de volledige portfolio van economische activiteiten uitgevoerd binnen het huishouden.

Met betrekking tot de eerste onderzoeksvraag, behandelen we de aard van bestaande nevenactiviteiten. Lokaal comparatief voordeel kan slechts benut worden via institutionele en technologische ontwikkeling. Daarom beschrijven we de institutionele en technologische kenmerken van de nevenactiviteiten. Voor verschillende categorieën van activiteiten bespreken we schaal, verdeling en kapitaalbenodigdheden.

Bestaande nevenactiviteiten kenmerkten zich, evenals de belangrijkste agrarische activiteiten, door een beperkte institutionele en technologische ontwikkeling. Ondersteunende markten voor arbeid, financiering en intermediaire producten waren vrijwel absent. Productie-technologieën waren homogeen en traditioneel van aard. Door een beperkte lokale vraag naar producten, waren er slechts weinig nevenactiviteiten met een potentieel voor uitbreiding. Het gevolg is dat bestaande nevenactiviteiten weinig aangrijpingspunten bieden voor directe institutionele en technologische innovatie. Ondersteuning van diversificatie gebaseerd op deze nevenactiviteiten biedt daarom geen economisch haalbaar inkomensalternatief. In plaats hiervan zullen innovaties gezocht moeten worden in algemene institutionele ontwikkeling (*i.e.* regulering, informatievoorziening, training en onderwijs) of in specifieke niche-activiteiten.

Voor de tweede onderzoeksvraag beschouwen we het uitvoeren van nevenactiviteiten als een individuele keuze die bepaald wordt door de positie die iemand inneemt binnen het huishouden, en door individuele capaciteiten, preferenties en andere eigenschappen van bezit en omgeving. Het bleek dat het hoofd van het huishouden slechts dan voor nevenactiviteiten had gekozen wanneer het gewas en het vee onvoldoende inkomen genereerden. Andere mannen in het huishouden hadden een relatief grote ruimte om nevenactiviteiten te ontwikkelen. Vrouwen hadden relatief weinig neveninkomsten die toenamen naarmate de totale landbouwinkomsten van het huishouden hoger waren.

De variabelen waren gekozen op basis van eerder onderzoek naar bestaansverwerving. Deze bleken echter weinig invloed te hebben op toegang tot nevenactiviteiten. In de context van een stagnerende locale economie was het geëffectueerde aanbod van arbeid wellicht vele malen

kleiner dan de intenties om nevenactiviteiten te ontwikkelen. Om economische activiteiten te stimuleren zal er meer aandacht besteed moeten worden aan armoedeverlichting op het niveau van het dorp en van de regio.

De derde onderzoeksvraag beantwoorden we met een analyse van de rol van risicoattitudes en investeringsbereidheid op individuele bestaansverwerving. Bestaande theoretische en empirische onderzoeken naar individuele bestaansverwerving binnen het huishouden geven onvoldoende inzicht in de relatie tussen risicoattitudes, inkomensverwerving, en economische diversificatie.

Als exogene determinanten van risicoattitudes bleek dat vrouwen meer risicomijdend waren dan mannen en dat risicoaversie eerst afnam en later toenam naarmate de leeftijd vorderde. In de dorpen met een betere infrastructuur bleken mensen minder risicomijdend. Risicoattitudes en inkomen bleken slechts in beperkte mate gerelateerd. Lokale omstandigheden hadden een veel grotere invloed op de houding ten aanzien van risico's en dus waarschijnlijk ook op risicoperceptie. Evenmin kunnen we een effect van houding ten aanzien van risico's op investeringsbereidheid aantonen. In geringe mate leken mensen met minder risco-aversie juist meer nevenactiviteiten te ontwikkelen.

Voor de vierde onderzoeksvraag schatten we de efficiency van het gebruik van grond en arbeid in de productie van gierst en sorghum. De literatuur geeft voorbeelden van zowel positieve als negatieve effecten van nevenactiviteiten op de efficiëntie van het gebruik van productiefactoren in de akkerbouw. In een omgeving met geringe natuurlijke hulpbronnen, waren het de huishoudens met meer inkomsten uit nevenactiviteiten en veeteelt die de grond en de arbeid op een efficiëntere wijze gebruikten voor graanproductie. In een omgeving met een betere beschikbaarheid van natuurlijke hulpbronnen hadden neveninkomsten geen effect op een efficiënt gebruik van productiefactoren in de graanteelt. In geen van de dorpen hadden neveninkomsten enig effect op het gebruik van extern aangekochte middelen voor de akkerbouw. Een uitzondering hierop is dat huishoudens met meer neveninkomsten meer gebruik maakten van gehuurde arbeid. Als verwacht, leidde eigendom van een grotere veestapel tot meer gebruik van ossentractie en organische mest in de akkerbouw.

Voor de beantwoording van de vijfde onderzoeksvraag ontleden we het totale inkomen van de huishoudens langs het inkomensspectrum in de dorpen. We geven specifieke aandacht aan de rol van infrastructuur, aanwezigheid van natuurlijke hulpbronnen, het totale inkomen van de huishoudens en aan de verschillende categorieën van activiteiten. Het bleek dat neveninkomsten geen éénduidige invloed hadden op de inkomensverdeling. Hoewel een hoog akkerbouwinkomen veelvuldig samen ging met meer neveninkomsten, zijn er ook huishoudens

die meer dan gemiddeld specialiseerden en toch vergelijkbare, zowel lage als hoge, inkomens behaalden. Verschillen in beschikbaarheid van natuurlijke hulpbronnen verklaarden verschillen in inkomensniveaus en het voorkomen van armoede, maar hadden geen invloed op de samenstelling van de huishoudportfolio van economische activiteiten. Armere huishoudens profiteerden in onvoldoende mate van nevenactiviteiten om van een armoedeverlichtend effect te kunnen spreken. Ook in dorpen met een betere beschikbaarheid van natuurlijke hulpbronnen bevonden zich een aantal huishoudens met een inkomen onder de armoedelijn. Slechts een aantal personen in deze laatste dorpen konden het zich permitteren om voor het grootste gedeelte van hun inkomen van nevenactiviteiten afhankelijk te zijn. Hun nevenactiviteiten betroffen veelal nijverheid en groot- en detailhandel, voornamelijk uitgevoerd door mannen. Neveninkomsten van vrouwen bleken geen effect te hebben op de inkomensverdeling binnen het dorp. Onze analyse kan niet aantonen dat huishoudens doelgericht diversifieerden in akkerbouw-, veeteelt- en nevenactiviteiten. Daarvoor waren de inkomsten te diffuus verspreid langs het inkomensspectrum van de dorpen.

Concluderend, we benadrukken dat diversificatie van bestaansverwerving een reactie was op economische stagnatie en armoede. Om deze reden was diversificatie een gevolg van een belangrijk aspect van bestaansverwerving, namelijk armoede. Dit perspectief contrasteert met de gangbare aanname dat rurale huishoudens diversifiëren om hun inkomensrisico's te beperken. In dit laatste perspectief leidt economische diversificatie tot risicobeperking als een specifiek resultaat van de configuratie van rurale bestaansverwerving. Wanneer de nadruk wordt gelegd op dit laatste positieve effect van diversificatie, vervalt veelal de aandacht voor het feit dat inkomensdiversificatie dusver weinig heeft bijgedragen aan armoedeverlichting, althans niet in de lage-inkomens regio's van de minst welvarende landen. Diversificatie van bestaansverwerving mag tijdelijke inkomensschokken verminderen, het bewerkstelligt geen structurele verbetering van de lokale economie.

Training and supervision plan

Educational program within Mansholt Graduate School (MGS) completed by J.E. Brons

Courses

Name of the course	Institute / Department	Year	Credits[*]
Mathematical Methods for Economists	Tinbergen Institute, The Netherlands	2000	4
Econometrics II	Wageningen University, The Netherlands	2002	4
Microeconomics Theory	Tinbergen Institute, The Netherlands	2000	4
Household Economic Behaviour	Netherlands Network of Economics (NAKE)	2001	2
Pathways for Agricultural Intensification	Mansholt Course, Wageningen University, The Netherlands	2002	2
Scientific journalism	Communicatiebureau de Lynx, The Netherlands	2004	2

Presentations at conferences and workshops			2
Farming Systems Research Symposium, University of Hohenheim, INRAB/INRAN and UNB/FSA, Cotonou, Benin		1999	
Final workshop on the research programme 'Impact of Climate Change on Drylands', University of Amsterdam, Wageningen University and Research Centre, Africa Study Centre (Leiden)		2001	
CERES Summer school, CERES Research School for Resource Studies for Development, The Netherlands		2002	
Mansholt Multidisciplinary Seminar, Wageningen University, The Netherlands		2004	

Total credits			20

[*] One credit is equivalent to 40 hours of course work.

Curriculum vitae

Johan Eduard Brons (1965, Ermelo, The Netherlands) graduated from Wageningen University in 1991, obtaining a Masters (M.Sc.) degree in Agricultural Economics with special reference to Agricultural Development Economics. During his study he carried out research on farming systems in the highlands of Rwanda. This research was a part of an integrated rural development programme carried out by the local government and the Netherlands Development Organisation (SNV). After his graduation, he worked in Indonesia for a research project on the production of food crops. This project was carried out by the Research Institute for Legume and Tuber Crops (RILET) in collaboration with the Royal Tropical Institute in the Netherlands. For the latter institute, he continued research work at the Equipe Systèmes de Production et Gestion des Ressources Naturelles (ESPGRN) in Sikasso (Mali). In 1994, he started working in the Philippines for Users' Perspectives with Agricultural Research and Development (UPWARD), a collaborative project of the International Potato Centre (CIP) and Wageningen University. The above-mentioned positions were financed by the Ministry of International Co-operation of the Netherlands. During a leave period in 1998, these assignments were completed with a desk study on the role of social and economic aspects in spatial organisation in various integrated rural development projects in Latin America, Indonesia, Malaysia and Ethiopia. The projects included in this study were carried out by DHV Consultants BV in the Netherlands in collaboration with national and local organisations. In 1998, he joined a collaborative research programme on the impact of climate change on West African dry lands. This research programme was carried out by the University of Amsterdam, the Africa Study Centre, the University of Utrecht and Wageningen University and Research Centre, in collaboration with research partners in Burkina Faso, Mali and Ghana. The present Ph.D. research originated from the latter research programme and has been financed by the Netherlands Foundation for the Advancement of Tropical Research (WOTRO).