1 Introduction

1.1 Background and Problem Statement

This thesis deals with trade on cereal markets in semi-arid West Africa, and in particular with the distribution of cereals in space and time in Burkina Faso. A well functioning cereal market is a prerequisite for attaining food security, which is of great concern in many African countries. In Burkina Faso, food security is a problem for a large part of the population. Before discussing in the next section the objectives and research questions analysed in this thesis, I briefly discuss some problems of the cereal market in Burkina Faso first. Although the research concentrates on Burkina Faso, problems in many other developing countries are similar, so that the scope of this research is not restricted to the case of Burkina Faso only.

The cereal market in Burkina Faso, on which cereals are transacted from cereal producers via a number of intermediaries to cereal consumers, has changed a lot in the last decade. This is among other things due to the adoption of the Structural Adjustment Programme in the early 1990s and the devaluation of the Franc CFA in 1994. One of the objectives of the Structural Adjustment Programme was to improve the accessibility of cereals in order to increase food security. To reach this goal, the government liberalised the cereal market in 1992. The cereal board OFNACER (Office National des Céréales) was abolished and a number of measures were announced to create an environment favourable for efficient cereal trade. These measures included 1) setting up an organisation to manage a national security stock of cereals (SONAGESS; Société Nationale de Gestion des Stocks de Sécurité), 2) informing producers, consumers and traders about current market prices (via the price information system SIM; Système d’Information sur les Marchés), 3) permitting a free circulation of cereals over the country, 4) encouraging banks to facilitate credit granting to cereal traders, and 5) enforcing competition between traders. During the liberalisation process many difficulties have been encountered and the implementation of some of the measures has been problematic. However, a number of recently published studies on cereal trade in Burkina Faso concluded that cereal market functioning did improve (Deybe and Robilliard, 1996; Egg et al., 1997; Ki-Zerbo, 1997; Ki-Zerbo and Ancy, 1997, Yonli, 1997; AHT, 1999; Danagro, 1999; Bassolet, 2000, Sirpé, 2000). For example, competition between
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Cereal traders have increased, market transparency has improved, and producers have become more price-conscious. Despite these improvements, many difficulties persist. Some of them are due to the partial implementation of measures or due to malfunctioning institutions. Other difficulties are caused by some peculiar characteristics of the cereal market in Burkina Faso, some of which are briefly discussed in the following.

Thin markets
In some parts of Burkina Faso, the cereal market can be characterised as a thin market. A large part of the population lives in sparsely populated areas and buys and sells small quantities of food on the market only incidentally. Most of them are subsistence farmers, producing mainly cereals to feed the members of their own household. In particular, the production of the cereals sorghum, millet and maize is important. Farmers often perceive their cereal stocks as a liquid source that may be used for urgently needed household necessities. In a recent study by Maatman (2000) it was concluded that the scope of improving agricultural production is limited. It is not likely that supply will substantially expand in the near future if no drastic improvements are made in the agricultural sector.

The fragmented market structure inflates marketing costs, as the assembly and distribution of cereals becomes a labour-intensive and costly activity for the traders. This is even worse in bad harvest years, when the amount of cereals passing through the cereal market may be just half of the amount in good harvest years. High marketing costs make markets even thinner.

1 In 1998 about 80% of the land was cultivated with the cereals sorghum, millet, and maize. About 9% of the land was cultivated with cotton, mainly in the south-western regions of the country. 6% of the land was cultivated with groundnuts, 1% with rice, and the rest with cowpea, sesame, potatoes, fonio, and soja. Data are obtained from DSAP, the statistical department of the Ministry of Agriculture.

2 Marketing costs refer to all costs which are involved in transactions. In Chapter 2 it will be defined which costs are included.

3 It is estimated that in Burkina Faso about 15% of the cereal production, or approximately 340,000 tonnes, is sold on the cereal market (AHT, 1999; Danagro, 1999). According to AHT (1999) this ranges from 13% of the production in bad harvest years to 19% in good harvest years. Consequently, the quantity traded in bad harvest years may be half the quantity in good harvest years. A number of village level studies observed that households in the northern, Sahelian parts of the country only sell a few percent of their harvest (0% to 5%), whereas households in the fertile, south-western regions occasionally even sell more than 40% of their harvest (in most villages between 10% and 40%). Differences between villages, households, and years are, however, very large. Furthermore, these studies also observed that many farmers sell during the post-harvest season when prices are low. Most households, however, sell small quantities during
or may result in missing markets. Cereal traders may be absent in some sparsely populated remote regions during some periods of the year. The investments necessary to achieve a continuous supply and demand constitute an entry barrier for potential competitors. Moreover, small marketable surpluses (i.e. surpluses after the farmers’ own consumption has been satisfied) also restrict competition among traders, as only a limited number of traders is sufficient to drain the surplus. Consequently, high marketing costs will decrease the competitiveness of farmers and, as a result, they may decide to withdraw from the market (see Janvry et al., 1991). They can exchange cereals within the family and some services and goods can be paid in kind. However, the disadvantage of this strategy is that food security of farmers will be at stake if production falls short. Market exchange makes it possible to exploit comparative advantages and to spread production risks (production of cash and food crops). If marketing costs are high and markets are missing (or imperfect), these opportunities will not be available (or of little interest).

**Seasonal and spatial arbitrage with imperfect information**

In Burkina Faso food production is not synchronised to food consumption. Producers only have one harvest per year, while consumption is continuous. This seasonal aspect may cause substantial price fluctuations, because storage costs are high and information on local supply and demand conditions is difficult to collect. Indeed, prices in the cereal market can be volatile. During the harvest from September to November the value of old stocks reduces quickly. In contrast, prices may be high in August at the end of the lean season when traders only keep minimum amounts of cereals in stock due to the risk of a price drop. Under these conditions traders may realise high speculative profits or losses, dependent on the accuracy of their market price expectations.

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all periods of the year, and especially richer households prefer to sell when prices are higher. The common statement that subsistence farmers sell when prices are low needs to be nuanced. See the village level studies by ICRISAT (e.g. Reardon et al., 1987), the University of Michigan and the University of Wisconsin (e.g. Pardy, 1987; Sherman et al., 1987; Szarleta, 1987), CILSS (Pieroni, 1990), and the Université de Ouagadougou and the University of Groningen (Yonli, 1997). See Ruijs et al. (2001) for an extensive review of these studies.

4 Arbitrage can be defined as the exchange on a market with the objective of taking advantage of price differences that exceed marketing costs (see Lutz, 1994: p.25).
In the same vein, the place of cereal production usually does not correspond to the place of cereal consumption, and cereal trade is not only directed from the rural towards the urban markets. Production differences between the northern, Sahelian regions and the more fertile southern and western regions are large due to the large variations in rainfall. Moreover, harvests are regularly threatened due to volatile rainfall.\(^5\) Arbitrage over long distances is necessary to provision not only urban consumers, but consumers in the northern part of the country as well. Consequently, the food marketing channels, i.e. the channels through which cereals are transacted from producers to consumers via a number of intermediaries, may be long. Furthermore, the food marketing channels are complex. Many food suppliers in one period of the year are the buyers of substantial quantities of food in a later period. This is also observed in the fertile regions of the country (see for example Sherman et al., 1987; Reardon et al., 1989, 1992; Pieroni, 1990).

The above implies that adequate information on local market conditions (prices, quantities, local market rules) is a prerequisite for successful trade. In Burkina Faso, as in most African countries, this information is difficult to obtain as the telecommunication infrastructure is imperfect and market rules are non-transparent. In many cases information depends on a trader’s personal network of assemblers, brokers, retailers, other traders, and farmers. In order to safeguard their existing trade relations, traders may be reluctant to share information with competitors. Another problem is that some information simply does not exist, while the existing sources of information are sometimes not equally accessible to all traders or are unreliable. Moreover, official regulations may not be transparent and their implementation arbitrary (see e.g. Bassolet, 2000). In practice traders stick to their individual marketing networks which are nested in particular geographical regions. This restricts competition, as a lack of information constitutes an entry barrier.

\(^5\) The average 1984-98 annual rainfall for the entire country was 711 mm, fluctuating over the years between 531 and 809 mm. In the Sahelian region (see Figure 1.1), the average rainfall was only 396 mm (ranging from 278 to 594 mm). Average rainfall in the south-western region Hauts-Bassins was 941 mm (ranging from 778 to 1123 mm; data from the National Meteorological Institute in Burkina Faso). Consequently, yield levels in the region Hauts-Bassins are more than twice as large as those in the Sahel.
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Missing or incomplete markets
Trade crucially depends on the availability of services, such as transport, finance, and insurance. In most developing countries, the markets for some of these services are imperfect. Such imperfections hamper the functioning of the food market and increase transaction costs (see also Klaasse Bos et al., 1999). First, transport services are only available to a limited extent. The majority of the traders do not own trucks themselves but hire transport services. These services are mainly oriented towards the capital Ouagadougou and the second largest city Bobo-Dioulasso (see Figure 1.1). In addition, large rural areas may become inaccessible during the rainy season. Consequently, the transport of commodities is less flexible than required for optimal trade flows (see Sirpé, 2000). Secondly, imperfect credit facilities constrain the commercial activities of traders and farmers, in particular the storage function. The formal financial sector does provide credit for trade activities, but almost exclusively the large wholesalers in Ouagadougou and Bobo-Dioulasso have access to it nowadays. The conditions imposed by the agricultural credit bank CNCA are too stringent for most traders. Other traders have to operate with their own capital or with informal credit which is often against usury interest rates (see Zeller et al., 1997; Bassolet, 2000). Thirdly, for individual traders and farmers, an insurance (for harvest failures) and futures (hedging) market does not exist.

To overcome these problems, initiatives are undertaken to provide better prices to producers, to improve market access, and to provide credit. Especially cereal banks, i.e. village co-operatives for marketing and storage of cereals, seemed promising organisations on paper. However, many of them have had limited success during the last decades due to objectives that were too ambitious and to organisational problems (Yonli, 1997). An interesting recent initiative is the development of a cereal auction market (supported by the non-governmental organisation Afrique Verte) which aims at facilitating the exchange between farmer organisations. Until now, however, the impact of this auction remains limited (Bassolet, 2000).
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Figure 1.1: Maps of Burkina Faso, showing a) provinces and rainfall zones, and b) regions (CRPA) and major cities.

Notes: 1) In 1996, some of the 30 provinces which are illustrated in the figures above, have been split in two or more new provinces, resulting in a total of 45 provinces. In this thesis I still use the ‘old’ provinces, because most data refer to the old provinces; 2) The Sahelian rainfall zone is the climatic region with an average annual rainfall less then 600 mm, the Sudan-Sahelian rainfall zone receives on average between 600 mm and 900 mm of rain per year; the Sudanian rainfall zone has an average rainfall exceeding 900 mm (see for example Laclavère, 1993); 3) The twelve regions are the regions in which the Ministry of Agriculture has set up agricultural extension services (Centres Régionals de Promotion Agricole, CRPAs).
The discussion above displays the importance of well functioning cereal markets for attaining food security in Burkina Faso. However, due to the peculiarities and problems of the food market, the expenses made during the exchange process by the intermediaries and traders are high (transport, storage, collecting information, salaries, etc., see Chapter 2). Furthermore, the agents have to deal with many uncertainties (see also Chapter 3). In the literature on the functioning of food markets in West Africa, the marketing costs are often perceived as a major constraint for food trade, and consequently for food security in general. Market liberalisation is considered a necessary policy to overcome these problems. A lively debate is taking place on the effects of market liberalisation programmes on poverty alleviation (see e.g. Sahn et al., 1997; Klaasse Bos et al., 1999; Kuyvenhoven et al., 2000; Thorbecke, 2000). Early liberalisation policies (e.g. elimination of state commodity boards, leaving producer and consumer prices free, devaluation) focussed primarily on getting the prices right. Nowadays, there is more or less consensus that these policies provided only a partial solution, and that they hardly influenced marketing costs. Thorbecke (2000) argues that the importance of an ‘institutional development’ has long been underestimated (see Section 3.1). Experiences with liberalisation policies reveal the need to adopt a broader set of policies which can best be described as ‘getting the prices and institutions right’. In these policies, trade liberalisation goes together with a constellation of structural measures designed to improve the functioning of markets. It is, however, still an open question whether these liberalisation policies, if correctly implemented, lead indeed to lower marketing costs, improved market functioning, and a higher level of food security in West Africa.

1.2 Research Objectives and Questions

In some recent studies on the cereal market in Burkina Faso, problems of cereal traders (Bassolet, 2000), of cereal transport (Sirpé, 2000), and of cereal banks (Yonli, 1997) have been analysed. Furthermore, some studies were been executed under the authority of the government of Burkina Faso, presenting a number of actions thought to be necessary to facilitate cereal trade and to lower marketing costs (AHT, 1999; Danagro, 1999). In these studies, it has been observed that, for example, the cereal supply fluctuates considerably between the years; that the price information system is not functioning without problems;
that the market is not transparent for many traders; that traders need more training and education; that credit facilities are still hardly open to cereal traders; that market rules are regularly not followed well by civil servants; that infrastructure (roads, telephone and fax services) is unreliable; that carriers sometimes have difficulties regaining their operating costs; and that management of transport companies is often below standards. In addition, competition between cereal traders is fierce in surplus and urban areas, but the number of traders in the northern, deficit areas is limited. This is caused by low consumer demand, but also by the presence of SONAGESS, which sells a part of the national security stock each year. In brief, due to malfunctioning and missing market institutions and to problems caused by seasonality and thin markets, cereal trade in Burkina Faso is a risky business where in particular transport and storage costs are high. Here, market institutions can be defined as the constraints (e.g. norms, traditions, laws, property rights, contracts) that structure interaction and reduce uncertainty in transactions (North, 1994). They will be discussed in detail in Section 3.1.

The conclusions of the above studies are mainly based on qualitative evidence. While they seem plausible, the suggestions as proposed in these studies are not founded on a thorough quantitative analysis of their expected effects on cereal trade flows and market prices. In this thesis, I concentrate on a quantitative analysis of such effects, because I wonder whether they are as large as is often suggested in the literature. For such an analysis, (partial or general) equilibrium models are usually applied. These models were originally set up for a situation of ‘perfect markets’ in the neo-classical sense. The markets in developing countries are, however, anything but ‘perfect’. Nowadays, efforts are made to integrate market imperfections in equilibrium models. However, no blueprint is available to do that. It depends very much on the situation which specific elements have to be considered. The challenge here is to develop a model that pays proper attention to existing imperfections on the cereal market

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6 In the neo-classical perfect market theory, the following strong assumptions are typically made to simplify the analysis: 1) farmers, traders and consumers are price takers, since their numbers preclude any influence on prices; 2) no uncertainty or risk exists, because information on market conditions is perfect; 3) no entry or exit barriers constrain the behaviour of potential competitors; 4) the commodity is homogeneous, quality and variety do not influence prices.

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in Burkina Faso and that allows a quantification of the effects of institutional changes which are a part of market liberalisation policies. Such changes refer to changes in the mechanisms which structure, organise, regulate, and legitimate transactions. In this thesis, I pursue the following two objectives.

1. To contribute to the discussion on the effects of market liberalisation and institutional changes on cereal flows and cereal prices, or more generally, on market functioning and food security, by providing arguments in quantitative terms.
2. To develop a mathematical model which can be applied to analyse the effects of changing marketing costs and market institutions on cereal trade flows and cereal prices, in a market situation with future price uncertainty.

To achieve these objectives, I raise the following research question.

To what extent are cereal trade flows and cereal prices influenced by market liberalisation policies and their corresponding changes in the organisation of transactions on the cereal market?

The following research questions can be derived from this question.

1. How may institutional improvements reduce marketing costs and influence the organisation of transactions on the cereal market in Burkina Faso?
2. Which mathematical formulation is appropriate and which assumptions and elements are essential, in order to analyse with the use of a mathematical model the effects of changing marketing costs and market institutions on cereal trade in Burkina Faso in a situation with future price uncertainty?
3. What is the quantitative effect of changes in marketing costs and market institutions, on cereal trade flows and cereal prices in Burkina Faso?

In this study, cereal trade refers to the transaction of cereals from cereal producers via a number of intermediaries to cereal consumers. Elements of cereal trade, on which I focus my attention in this thesis are a) cereal market price levels and seasonal price developments, b) consumer demand and producer supply of cereals, c) quantities transacted by cereal traders, d) cereal transport flows between the different regions of the country, e) cereal storage by
producers and traders within a year, and f) the organisation of the marketing channels, i.e. the channels through which cereals are transacted from producers to consumers. All these elements of cereal trade may change due to changing marketing costs or changing market institutions. Central in this thesis will be the set up of a mathematical model to analyse the influence of changes in marketing costs and of some institutional developments on cereal trade flows and market prices. This model will be used to analyse the effects of a number of possible scenarios of changing market institutions and marketing costs caused by developments in the cereal market. I will concentrate on a) transport and storage costs, b) credit granting to cereal traders, c) facilities to provide information on prices, supply, and demand to traders and producers, d) market efficiency and competition enhancing measures, e) household income, and f) cereal production levels.

1.3 Overview of the Study

This thesis comprises three parts. In each part, one of the research questions is addressed. In Part I, the impact of potential changes in market institutions on marketing costs and the organisation of market transactions is investigated qualitatively. In Chapter 2, using the Marketing Channel Approach, it is examined how the cereal marketing channels, through which cereals are transacted from producers to consumers via a number of intermediaries, are organised in Burkina Faso. Important in this approach are the intermediaries involved in cereal trade (such as assemblers, (semi-)wholesalers, brokers, retailers) and the functions they perform in the channel. Furthermore, it is analysed which marketing costs account for the difference between the price a producer receives and the price a consumer pays on the cereal market in Burkina Faso. In Chapter 3, I concentrate on the factors which influence marketing costs and the organisation of a transaction. The theory of Institutional Economics is very useful in this respect. It can be indicated which market institutions may influence a transaction. These institutions concern social norms and laws as well as market facilitating institutions like infrastructure, credit facilities, and information services (on supply, demand, prices, and the behaviour of trading partners). They influence uncertainties and costs of a transaction as well as the way a transaction is organised (e.g. a spot market transaction or a longer term relation between trading partners). Transaction Cost
Theory and Principal-Agent Theory, both part of the theory of Institutional Economics, provide the arguments to explain this influence. At the end of Chapter 3, a number of scenarios is defined. Each scenario indicates the expected influence of a potential institutional development, induced by market liberalisation, on cereal marketing costs, uncertainties, and organisation. In Part III of this thesis, these scenarios are analysed quantitatively using the model set up in Part II.

In Part II of this thesis, a mathematical model is set up to analyse the effects of changing marketing costs and market institutions on cereal trade flows and cereal prices. A stochastic, dynamic, non-linear mathematical programming model is constructed in which the strategies of producers and consumers as well as cereal traders are simulated. In Chapter 4, it is discussed which types of models are frequently used for such analyses and why I set up a partial equilibrium model to analyse cereal trade, transport, and storage. Moreover, the assumptions of equilibrium theory and some micro-economic methods to analyse the strategies of individual market actors are briefly recapitulated. In Chapter 5, a multi-period spatial equilibrium model is set up. In this model, semi-welfare is optimised subject to the assumption that markets are in equilibrium. Transportation and storage costs are important model elements, and markets are supposed to be perfectly competitive. Much attention is paid to the derivation of some properties of the optimal strategies of producers, consumers, and traders, and of the properties of the outcomes of the equilibrium model. Next, in Chapter 6, this model is extended to include the uncertain character of future prices. Price uncertainty is reported to be one of the factors constraining cereal market functioning in Burkina Faso. It is analysed in detail how producers and traders deal with future price uncertainty, and which marketing costs are important determinants of their strategies. Furthermore, it is explained how this can be integrated in a stochastic, multi-period, spatial equilibrium model. The properties of this model will be carefully derived.

In Part III, this model is applied to analyse the quantitative effects of the scenarios defined in Chapter 3, on cereal trade and cereal prices in Burkina Faso. In Chapter 7, the parameters used in the equilibrium model are estimated for the case of Burkina Faso. Cereal demand functions, producers’ supply and production costs, and traders’ transport, storage, and transaction costs are
estimated. Furthermore, price probability distribution functions are estimated. In Chapter 8 and 9, the above mentioned scenarios are analysed using the equilibrium model. Finally, in Chapter 10, conclusions are drawn from these results and a summary is given of the approach followed in this thesis. Furthermore, it is discussed to what extent the applied theories and methodologies really enable us to understand the problem of cereal trade in Burkina Faso.