Chapter 1:Introduction

1.1 The Agricultural Sector in Kenya

The agricultural sector remains dominant in the developing countries and is potentially capable of making contributions to overall national economic growth and development. According to Kuznets (1964), these contributions are product contribution, market contribution, factor contribution and foreign exchange contribution. Thus, the sector is important in that it provides food and raw materials for the industrial sector, markets for industrial goods, transfer of surplus labour to the non-agricultural sector, as well as foreign exchange earnings.

In the 1980s, Sub-Saharan Africa suffered from stagnant production in agriculture. The World Bank (1981) explained this poor performance as being due to misguided macroeconomic and price policies, excessive government interventions in factor and commodity markets, poor economic management, inefficient parastatals, and a failure to exploit the competitive advantage in export agriculture, largely because of unnecessarily low producer prices. Specifically, farmers were required by law to sell most of the important crops to public marketing corporations at set producer prices, which were generally set to yield a positive revenue margin. However, the surplus earnings from the corporations were often used to finance general government expenditure rather than reinvested in the agricultural sector. Since the corporations often had monopolistic powers, they did not try to maintain efficiency, which led them to operate at a loss. Consequently, producer prices were kept low so that government expenditure could be maintained.

The importance of the agricultural sector in Kenya is shown by the fact that agriculture contributes 27 per cent of the Gross Domestic Product (GDP) and 60 per cent of the country's export earnings. It employs about 75 per cent of the country's labour force and also provides raw materials to the industrial sector. In addition, nearly all the food consumed in Kenya comes from the domestic agricultural sector. Kenya will therefore continue to depend on agriculture for some time in the future.

The sector has been assigned the following tasks: to provide food security to a population that is expected to be 39 million by the turn of the century; to generate farm family incomes that should grow by at least 5 per cent per year; to absorb new farm workers at the rate of about 3 per cent per year; to supply export crops sufficient for a 150 per cent increase in agricultural export earnings; and to stimulate the growth of about 3.5 to 5 per cent per year (Kenya 1986, Kenya 1994a).

These objectives are to be achieved through provision of incentives to farmers, and avoidance of consumer subsidies (Kenya 1994a), the promotion of agricultural research, extension, credit, and input supply for small holders. The policies also aim at expanding the role of the private sector in the marketing system, at rationalising public expenditure in the agricultural sector, and at reforming the parastatals (Kenya 1986).

The agricultural sector registered an annual growth rate of 4.7 per cent in the decade following independence in 1963. This was because it 'benefited from the maintenance of a consistent set of policies, stable institutions and marketing systems and a conducive macroeconomic environment' (FAO 1992). After 1972, the growth decreased to an annual rate of 3.7 per cent and in the 1980s it dropped further to 3 per cent. There was however a recovery between 1986 and 1989 when the growth rate was 4.1 per cent. From then, the growth rate was 3.4 in 1991 and negative 4 in 1992 (FAO 1992).

The decline in agricultural growth was the result of a combination of exogenous and policy related factors (FAO 1992). The exogenous factors included drought and unfavourable terms of trade for agricultural goods. The policy related factors included failure of the policies to respond adequately to the needs of the transformation that was going on in agriculture from an extensive to an intensive system. Official prices were unremunerative in some years and price adjustment erratic; the increased role of the public sector in the control of marketing and pricing systems also exceeded the parastatals' managerial capacity to perform such tasks. To correct this situation, the FAO (1992) and the World Bank (1981) seem to agree that agricultural growth could be stimulated by adopting an outward-looking strategy that would become operational through domestic policy reforms.

Contrary to what the FAO believes, Kenya's policy objectives are considered to be well stated (Lofchie 1989, Colman and Young 1989, and Institute of Economic Affairs 1994).

Therefore, if the decline in growth was as a result of the policies, then the problem may have been at the implementation level.

This study examines the pricing and marketing policies of maize in Kenya with a view of determining whether the supply responded to the policies and the magnitude of this response. Maize was chosen because it is the single most important food crop. By 1992 it was providing about 40 per cent of the calorific intake of the population and was grown in about 40 per cent of the land under cultivation. Maize also provided employment for the majority of the rural population as 80 per cent of the total production was from small scale farmers (FAO 1992).

Though maize is the most important and valuable crop, it is the least understood agricultural good (Lofchie 1989). For example, very little is known about what proportion of the total production is consumed directly by small scale households. Whereas the amount marketed through the official grain parastatal, the National Cereals and Produce Board (NCPB), can be calculated, this cannot be done for the informal market. These uncertainties continue to generate debates about such basic matters as whether small holder maize growers respond to price incentives, the total amount of land devoted to maize, total annual production, and the country's average maize yield per hectare (de Wilde 1984).

Maize has attracted considerable attention as far as policies are concerned. The marketing and pricing policies have been integrated since 1942 when the Maize Control was formed. This body fixed prices at all levels following the border pricing principle.

The immediate post-independence policy on food production was to ensure a steady supply of basic food-stuffs at modest, stable prices for both urban and rural areas. The principal goal was however not to maximise maize production but to attain the highest degree of self-sufficiency. This could be maintained best if maize marketing was controlled. The various policies that have been in force are reviewed in detail in Chapter 2. The following section defines the problem to be studied.

1.2 Problem Definition

Maize pricing and marketing in Kenya has suffered from the problems of price regulation, the border pricing principle, the need to balance agricultural production, and the continued use of the Board. These problems are discussed below.

1.2.1 Price Regulation

Neo classical economists are not in favour of price controls as they are responsible for a mismatch between supply and demand. If the price is regulated above the equilibrium point (price support), this will encourage excess production which must be purchased by the regulating authority if the price is to be sustainable. On the other hand, if the regulated price is below the equilibrium point (price ceiling), shortages will arise and so the supply will be physically rationed, and the commodity will have to be imported or a black market will develop. Importation drains foreign exchange while a black market is a distortion on resource allocation. In contrast to price rationing, physical rationing restrains demand; however, it does not give rise to a supply response.

The regulation of maize prices results in pan-territorial and pan-seasonal prices with the buying and selling prices having large margins between them. This causes the problem of too much price uniformity which discourages farmers from storing their produce as there is no incentive to do so. The Board has been therefore frequently overburdened with maize stocks during harvesting time.

1.2.2 Border Pricing Principle

When prices are regulated, there is a problem as to how they should be determined. The general principle that conventional economists urge is the border pricing principle. This principle states that 'producer prices should be equated with the prices at which the country could buy or sell the same product on world markets subject to certain adjustments' (Killick 1990). This is opposed by the structuralist school who state that the border price paradigm for domestic price determination is misdirected. This is especially so for basic commodities which have important roles in the macroeconomy and welfare of the consumers. The argument is that since supply and demand elasticities are quite small for these commodities, the triangles of allocative losses from not equating domestic

prices with border prices are trivial. Border prices themselves are unstable and are heavily influenced by gross distortions in the agricultural policies of the developed world. They therefore carry minimal information on how resources should be allocated in the long run.

Border pricing also has problems like the exchange rate, and the question of what border price to use when crops switch from being export crops to import ones.

(a) The exchange rate

Exchange rates are important because they determine the local currency equivalent of a given world price. Up to December 1993, Kenya maintained an over-valued exchange rate and so had difficulty in maintaining attractive production incentives. This is because the world price, multiplied by an over-valued currency, may not provide a sufficient margin over production costs to attract producers. It was also difficult to predict which world price levels, and which exchange rates, should be used for price estimation especially when prices are announced six months in advance. Thus most estimates of import and export parities tend to be off the mark (Ellis 1982).

(b) Imperfections in the world markets

Imperfections in the international markets are reflected by the high level of protection offered to farmers by most industrial countries. Protection means that resources are not directed into their most efficient uses. As such, the world prices may not serve to guide resources into their most globally efficient uses.

World commodity prices are also unstable, with modest changes in conditions of supply or demand resulting in large price movements. This causes problems of planning and allocation of resources.

(c) Crops switching from exports to imports

Two problems arise as maize switches from being an export to an import crop. First, because of the large difference between import and export parity prices, it is not possible to alternate from export to import parity pricing from one year to the next. Thus, a price somewhere between the export and import parities must be found.

The second problem is that when maize is exported, the local consumers are taxed to subsidise farm income (Wyeth 1981). This is criticised on the grounds that maize is a staple food for the poorer sections of the population who should not be taxed to subsidise the income of others. Kenya is an inefficient and high cost producer of maize; if it has to maximise maize production, it would be producing surpluses that could only be disposed of at a loss in the international markets.

1.2.3 The Need to Balance Agricultural Production

The theory of comparative advantage states that if there are two producers producing two commodities at different efficiencies, both stand to gain if they concentrate on what they are good at and obtain the other commodity through trade. High artificial prices of maize mean that areas which are best suited for production of other crops are devoted to maize. This slows down the trend towards specialisation and so goes against the principle of comparative advantage. Moreover, if maize prices are allowed to rise to a level that encourages the production of exportable surpluses, it will, in all likelihood, drain production inputs away from such crops as coffee and tea, commodities in which Kenya has a substantial comparative advantage.

1.2.4 Use of the Board

One of the major reasons why governments intervene in agricultural marketing is to maintain food security. The Board has been unable to do so, and has been criticised for its inefficiency, its poor management, and its inability to stabilise supply. According to Lofchie (1989), Kenya's maize pricing system results in lower than shadow-market prices to producers, unnecessarily high prices for consumers, extreme unpredictability in supply, and consistently low levels of marketed surplus. The system has also been seen as inherently prone to widespread corruption, because it places great discretionary authority in the hands of purchasing agents at the local buying centres. As a legal monopoly, there may also be the propensity towards administrative mismanagement and bureaucratic inefficiency, thus making the marketing system costly (World Bank 1986). Lastly the Board has also been accused of inefficiency in the pricing system which distorts the geographical location of production (Argwings-Kodhek *et al* 1993). These problems are discussed in detail in Chapter 2.4.

In trying to rectify these problems, the donor community led by the World Bank and the IMF has recommended total liberalisation of all agricultural produce. However, whereas other commodity prices have been liberalised, the government has been reluctant to liberalise the maize sector. The government argues that putting such an important staple in the hands of private traders whose motive is only profit, may lead to collusion by the traders causing temporary shortages for a short term gain. Relying on international markets is also seen as risky as the 'country cannot fully expose itself to the vagaries and instability of the world cereal market' (Kenya 1994a). One of the questions this dissertation will address is whether the government should totally liberalise maize trade.

1.3 Research Objectives

The objectives of the research are:
(a) to determine whether the supply of maize has responded to the price policy,
(b) to estimate the short-run and the long-run elasticities of the supply of maize, and
(c) to evaluate the policies that have been followed since 1993 when maize liberalisation was carried out, and their possible implications in light of the results.

1.4 Significance of the study

The demand for maize in Kenya is expected to increase from 2.398 million tonnes in 1992 to 3.232 million tonnes in 1996 (Kenya 1994a). This is due to population increase and increased urbanisation. Since most maize is grown to satisfy the home consumption needs of the producers, it is necessary to determine whether the supply of maize was affected by the price policy. This is important especially during the transition period when the government is unsure whether to totally liberalise maize marketing or to maintain some form of control.

Although the crop output of individual farmers responds to price movements, the aggregate supply of agricultural products from the sector as a whole is thought to be unresponsive to incentives. This has been referred to as the aggregate supply inelasticity (Valdes 1991). Bond (1983) claims that supply response to prices may not take place in Africa because the subsistence sector is assumed to be very risk averse, the producers

value leisure activities highly, and therefore they are assumed to have income targets. Consequently, if the producer price is increased, the production of a smaller amount of the commodity will provide the necessary income. This perverse reaction leads to a backward sloping supply curve for output.

Empirical estimates of price elasticity of supply are useful for forecasting future supplies or for making a realistic assessment of the effects of different policies on maize supply. For example, if the supply schedule for a commodity is relatively elastic, a modest reduction in the support price may be sufficient to solve a surplus problem (Tomek and Robinson 1990). The need for estimated elasticities of supply is even more crucial at this time when a subsidy on fertilisers is to be re-introduced, because the level of subsidy should depend on the elasticities of supply and demand. These elasticities can also explain where the incidence of the subsidy may fall. In some cases, depending on the elasticity of demand for fertilisers, producers may not gain at all. Previous studies that have been conducted on maize pricing and marketing policies (Jabara 1985, Lofchie 1989) did not use time series data, or if they did, then this was only for large scale farms (Scandizzo and Bruce 1980). Booker International's(1983) study used regional as opposed to aggregate data, moreover, the study was conducted some time back and therefore lacked sufficient data which is needed for a time series study. This study will therefore shed some light on whether the fertiliser subsidy is important and how it may be carried out.

1.5 Hypotheses

Following the neo classical paradigm, it is assumed that using the Board as an avenue for setting prices and controlling them leads to inefficiency in the allocation of resources. Three hypotheses will be tested to evaluate this assumption. The first is that there were no adjustment costs between the time the prices were announced and the area planted. The second is that the price that was announced had zero effects on the area planted. The third is that the effects of fertiliser prices were also zero. A two-tail *t*-test will be used because of the belief that there is no relationship between prices set and area planted. The desired level of significance is 0.05.

The study is organised as follows. Chapter 2 contains a literature review on maize industry in Kenya and the importance of price policies. It also discusses why governments should intervene in agricultural marketing; why and how government intervened in maize pricing and marketing in Kenya, as well as the instrument of intervention that was used, namely the NCPB. The chapter ends by pointing out why intervention is not necessary. In Chapter 3, the agricultural price policy, the theory of supply and the factors involved in supply elasticities are reviewed. Chapter 4 deals with the design of the study, including a description of the model, the nature and sources of the data, how the data is analysed, and the limitations of the data. This is followed by results and discussion in Chapter 5. In Chapter 6 policy implications are detailed. The study ends with Chapter 7 where conclusions are drawn.

Chapter 2 :The Maize Industry In Kenya

2.1 Introduction

The origins of maize in Kenya are unclear but it is thought that it was introduced by the Portuguese in the 16th century. However, maize did not become popular until the first decade of this century when there was widespread European settlement. This was because it offered greater yields than the traditional millet and sorghum, gave whiter flour and so was more palatable as well as being more suitable for the export market, and was the food offered to labourers in the settled areas. Maize was first grown as an export crop, but for the above reasons, it had become the major food crop by the 1950s (Miracle 1966).

During World War II, Kenya was called upon to produce all the food it could. Maize prices to European producers of shs 6.30 per bag were guaranteed, which were 134 per cent the level of the previous year. In 1942 and 1943, the support level was boosted another 23 and 38 per cent respectively. The response was immediate, and by 1945 the area under maize had doubled. A further subsidy came from 1952 up to the early 1960s. The response is shown in Table 2.1.

By the mid 1960s, the development of hybrid and synthetic varieties meant that maize could be grown more cheaply to compete with world markets. Cropped land expanded by an estimated 20 per cent during this decade and yields also increased in small-holder areas by between 47 percent and 300 per cent (FAO 1992). Producer prices were therefore reduced, first to keep pace with decreasing costs of production so that large surpluses could be avoided, and ultimately to arrive at a price where the surplus crop could be exported without losses. This led to local shortages in the early 1970s. The rapid yield increase did not continue into the 70s because of a lack of further technical innovations and a shortage of arable land: the cropped area expanded by only about 3 per cent and by 1992 maize was grown in 1.2 million hectares. This area however declined in 1993 due to ethnic clashes in the maize growing areas.

Most of the maize is inter planted with beans. In the drier areas, the plant population is sparse because of the scarce nutrients and moisture. Labour is mainly provided by the family as most maize is grown in family farms, and there are only a few plantations where machinery and hired labour are used.

Table 2.1 Maize acreage, Marketing and Prices Received by Europeans and Asians in Kenya (1941/42 to 1957/58)

Year	Prices (shs/90 kg bag)	Area (acres)	Marketings ('000 bags)
1941/42	6.34	63 100	...
1942/43	7.80	81 561	...
1943/44	10.80	107 688	600
1944/45	11.40	119 934	528
1945/46	11.40	124 855	552
1946/47	15.90	110 211	508
1947/48	20.00	108 060	379
1948/49	20.00	120 925	616
1949/50	23.40	133 164	737
1950/51	28.80	144 777	763
1951/52	30.30	141 927	755
1952/53	42.25	140 510	638
1953/54	42.12	164 827	784
1954/55	40.35	173 998	1 200
1955/56	40.35	157 870	887
1956/57	42.48	166 285	867
1957/58	42.48	166 689	1015

Source: Miracle M P. 1966, p.142.

In the 1990s, due to the liberalisation of the fertiliser prices, maize in Kenya has been produced at high costs, this is seen from Table 2.2. Whereas the costs of shs 450 per acre are based on the average yields of 20 bags per acre, these costs can increase up to shs 650 depending on the yields of maize (Daily Nation, 9 Feb. 1995). The producer prices fluctuate from shs 450 to 1 200 depending on the season.

Maize is grown in most parts of Kenya where crops can grow. It therefore competes with various crops: tea in high potential areas, coffee in medium potential areas and wheat in both medium and low potential areas. In drier areas, it is also grown but this is mainly for subsistence, and crop failure is more common. Since tea and coffee are more permanent, the crop that maize competes with in the real sense is wheat.

Table 2.2 Costs of Maize Production at 20 bags/acre in Kenya (1994)

Items	Cost
Ploughing	1200
Harrowing	1000
Planting	750
1st Weeding	700
2nd Weeding	600
Fertiliser (CAN)	1000
Dipterex	300
Labour for top dressing	150
Harvesting	750
Shelling	2000
Total	8400

Source: Calculated by Dr Odongo, a maize agronomist at Western Regional Research Station, Kakamega, Kenya (personal communication).

Maize production in Kenya has suffered from instability since 1918. This instability was attributed in the past to weather, theft, and technological changes (Kenya 1966). More recently, the instability has been explained by ethnic clashes in maize growing areas, poor quality seeds, and high input prices (Kenya 1994b), but these instabilities have not been very serious. In normal weather years, Kenya has produced about the same amount of white maize as it has consumed. Shortages were experienced only in 1965, 1972, 1980, 1984, and 1992 to 1993. On the other hand, there was overproduction in 1979, 1987 and 1994.

The instability took a new turn in 1994. Whereas, the importation of maize by private individuals was banned up to December 1993, the liberalisation of maize imports in 1994 brough in a total of 760 000 tonnes as opposed to 600 000 tonnes in 1993 and 430 000

tonnes in 1992. As said above, there was improvements in yields in 1994 from 2.10 million tonnes to 2.97 million tonnes in 1993. As a result, producer prices fell in January 1995 from the equivalent of US $27.5 in June 1994 to US $9. To protect the producers, the government has pledged to buy maize from farmers at the controlled price of US $21.35 which does not reflect the market price (Daily Nation, 9 Feb., 1995).

2.2 Maize Marketing and Pricing Policy in Kenya

Maize marketing is perhaps the most crucial of all agricultural marketing in Kenya, because it is the most widely consumed crop; therefore, consumer prices and its availability are crucial to the well being of non-agricultural consumers. Since it is widely grown, the producer prices of maize affect the majority of agricultural workers; and as the most important food crop, maize marketing has foreign exchange implications: when it is in short supply, the shortfall must be bridged by importation. Maize has therefore attracted at least thirteen committees that have been set up to investigate and make recommendations on its pricing and marketing since 1918 when the first maize crisis was documented.

As stated in Chapter 1, Kenya's agricultural pricing policy cannot be separated from its agricultural marketing institutions (Jabara 1985). Maize pricing policy has therefore been integrated with the marketing institution since 1942 when the Maize Control was established.

The immediate post-independence policy on food production was to ensure a steady supply of basic food-stuffs at modest, stable prices in both urban and rural areas. This was aimed at encouraging the industrial sector to grow 'as a steady supply of basic food-stuffs is a prerequisite to the growth of a disciplined urban labour force and the maintenance of social stability' which are necessary for industrial growth (Kenya 1966). In the agricultural sector, modest and stable food prices were to enable the producers of export crops to obtain an economic level of specialisation. If food supply was not guaranteed, it was feared that those producing export crops might devote some of their time to food production, thus discouraging specialisation. It was also feared that if maize were allowed to be produced to the maximum, it would compete with high value crops such as tea, coffee and horticultural crops for imported inputs, mainly fertilisers.

The principal goal is therefore not to maximise maize production, but to attain the highest possible degree of self sufficiency. Self sufficiency does not mean that the country must supply all its requirements all the time and under all conditions. It means that it is preferable to be self-supplying only in average-to-good years and to have a diversified agricultural economy sufficiently buoyant to finance food imports during bad years. Thus, the country has set aside an equivalent of US $ 60 million since 1994 for this purpose (Kenya 1994a). The price policy in Kenya has therefore favoured the production of coffee and tea at the expense of maize (Lele 1989).

2.3 The Maize Marketing Board

2.3.1 Historical Background

Marketing boards in Kenya were established under the 'Agricultural Production Marketing Act' of 1936 (Livingstone and Ord 1981). World War II made it necessary to pass the 'Increased Production of Crops Ordinance' in 1942 which provided short-term credit and guaranteed minimum returns for a wide variety of crops grown on European farms. In return, after harvest, the farmer had to treat the crop as government property and store it until ordered to dispose of it (Smith 1976).

Maize Control, a government department, was set up in 1942 to market maize. In 1959, the Maize Marketing Board, a statutory body with growers, commercial and government representatives, replaced the Maize Control. The Act under which the Board was constituted gave it monopoly powers to 'regulate, control, and improve maize supply and marketing' In 1967, the Maize and Produce Board in turn replaced the Maize Marketing Board. This body had potential compulsory marketing powers for maize and general produce in most areas of the country. The present National Cereals and Produce Board (NCPB) was created in 1980 by amalgamating the Maize and Produce Board and the Wheat Board of Kenya. Although minor changes were made, the Board's functions of regulating the marketing of maize and other 'scheduled' crops remain the same.

Maize control was established in Kenya for four reasons: to stabilise the flow of maize to the consumer, to protect the large scale farmers' incomes, to protect the producer and consumer from the 'exploitative' monopolistic tendencies of the private traders, and to protect the small farmers from price uncertainty by offering them known prices ahead of

the planting season (Livingstone and Ord 1981). Lele and Christiansen (1989) add that public sector intervention in agricultural markets during colonial times was to impose order on a seemingly chaotic marketing system, to create economic rents for European trading companies and estates and to generate revenue for the public sector.

After independence, marketing boards were seen as a means of ensuring food security, enabling governments to perform development functions, stimulating agricultural production, maintaining control over politically strategic commodities and providing a source of political patronage.

The boards were therefore expected to perform the legitimate economic functions of:

- reducing the inherent riskiness of agriculture for small-scale farmers,
- ensuring markets and input supply to promote price stability,
- providing revenue for the public sector,
- supporting large-scale investments in processing that the private sector is unable or unwilling to undertake,
- addressing the constraints imposed by inadequate financial markets,
- creating demand for inputs, and
- assuring supply of food and inputs to low-income households in remote regions.

The following section discusses the performance of the Maize Marketing Board. Special emphasis is placed on the performance of the National Cereals and Produce Board as it is during its time that there has been a prolonged call for maize marketing liberalisation.

2.3.2 Allocation of Resources

From 1943 up to December 1993, maize prices were set at all levels of marketing; that is, at the producer, the wholesale, the manufacturing and the retail levels. In order to discourage exportation and importation of maize, the producer prices were set just above the export level, while that of the consumers was just below the import level.

The system of fixing prices has been seen as distorting the geographical patterns of production (Heyer 1976, World Bank 1986, Argwings-Kodhek, *et al* 1993), which led, in the first place, to maize being produced less efficiently than might have been the case if specialisation in areas of comparative advantage had been encouraged. Since the differences between the buying and the selling prices were high in surplus areas,

production decisions were governed by the low Board purchasing price, whereas in areas of deficit, production decisions were governed by the high Board selling price. This led to relatively low production in areas of surplus, where maize could be grown at low costs, and relatively high production in areas of deficit, where maize growing costs were high. This price system therefore encouraged the growing of maize in marginal areas and discouraged its growing in more suitable areas.

The Board could not maintain the monopoly it was accorded, according to the 1983-1989 estimates of the Central Bureau of Statistics (Kenya 1990): out of 41 per cent of the maize that was sold, the board captured about 20 per cent (see also Table 2.3). The rest was sold locally through a parallel market that developed over the years because the Board could not handle all the maize offered in the surplus areas. It was therefore unable to guarantee a supply of maize in deficit areas.

Table 2.3 Maize Production, and the Percentage handled by NCPB (1981/82 to 1990/91)

Year	Marketed Prodn ('000 tons)	Total Prodn ('000 tons)	% Prodn. Marketed by NCPB
1981/82	472.9	2560.0	18.47
1982/83	571.3	2450.1	23.32
1983/84	637.1	2214.8	28.88
1984/85	560.6	1500.0	37.37
1985/86	582.9	2440.3	23.89
1986/87	669.5	2870.0	23.33
1987/88	651.1	2400.0	27.13
1988/89	485.3	3140.0	15.46
1989/90	625.9	3030.0	20.66
1990/91	509.3	2890.0	17.62

Source: Kenya (1992) Table 36 p 51.

The pan-territorial and pan-seasonal system of pricing was faulty in that it persistently penalised efficient, large scale producers who had low transportation costs. This is because the buying centres were located near the surplus areas while the less efficient small holders were located at some distance from the country's major urban centres.

Since the Board had buying centres throughout the country, it had to transport maize at high costs from these far off places to deliver to the fourteen major stores in the country. As part of the cost-reduction strategy, NCPB's buying centres have been reduced from 680 to 220 since 1986 (FAO 1992).

The marketing system was also costly: in addition to high transportation costs, high costs came about because the Board had to incur unnecessary storage expenses. If the Board had offered a storage premium, private individuals would have found it worthwhile to store some maize. The Board would then not have faced the problem where every producer delivered the maize at the same time, thus overtaxing the available space.

The Board could also not manage the national stock of maize adequately (Lofchie 1989). This became evident during country-wide shortages like that of 1985 when maize was imported at a high costs only to be exported the following year at a loss.

2.3.3 Stabilisation

The Board was supposed to stabilise the country's maize supply, by maintaining a price band within which the market price was to fluctuate. The price band was to be maintained by the Board buying the excess maize in surplus areas and releasing the same in deficit areas. This did not happen, the reasons being that the Board lacked storage space and enough money to pay the producers. Even after the maize was accepted, it took time for the producers to be paid. The latest example was in early 1994 when it was reported that farmers were asking the NCPB to return their maize due to non payment (The Nation, 26 Jan. 1994).

2.3.4 Increasing self sufficiency in food

The Board did not have enough stock and, because it also lacked the capacity to act quickly to import maize due to foreign exchange constraints, it could not offer increasing self-sufficiency in food. In 1972 (Leys 1975) and 1984 (Lofchie 1989), the Board could not transport maize fast enough to the deficit areas even when there was plenty of maize in the surplus areas, as it lacked enough transportation facilities. Food security was therefore not maintained.

2.3.5 Raising the average level of prices and incomes

The Board was established mainly to raise the average level of income of producers. However, according to Lofchie (1989), Kenya's maize pricing system had resulted in lower than shadow-market prices to producers. Jabara (1985) on the other hand found that the real producer prices of maize increased from 0.39 K shs/kg in the 1972/73 season to 0.42 K shs/kg in the 1982/83 season. The nominal prices also increased from 0.39 K shs/kg to 1.44 K shs/kg during the same time period. Producers benefited from the Board through the high prices, even when there was a decline in real maize prices between 1985/86 and 1988/89 (FAO 1992).

To summarise, the policy has resulted in the following economic anomalies. It has stopped the agricultural sector from exploiting the comparative advantage. It has also created too much price uniformity, thus preventing private individuals from taking the risk of storage. It also overworked the system during harvesting time thus creating inefficiency. This has resulted in unnecessarily high prices to consumers, extreme unpredictability in supply and consistently lower levels of marketed surplus. Producers have also suffered due to erratic payments, which has made them resort to parallel markets which did not pay as high as the Board but were paying promptly.

Chapter 3: Literature Review, Agricultural Policies and Supply Theory

3.1 General reasons for Government Intervention in markets

Economists have agreed that because of market failure, there are reasons for government interventions in agricultural development. Markets fail to allocate resources when there are externalities and public goods, economies of scale and natural monopolies, market imperfections, and distributional inequality.

3.1.1 Externalities and public goods

Externalities arise when the price system works imperfectly. Under imperfect market conditions, and if markets were to allocate activities, those with favourable externalities would be insufficiently expanded while those with unfavourable externalities would be overexpanded. In agriculture, an example of an activity with positive externality is an innovation such as the discovery of hybrid seed. Once discovered and multiplied, all maize producers gain while the discoverer receives only a fraction of the total gains. To encourage individuals to be innovative, their discovery must be protected by law so that they can gain windfall profits. Negative externalities are like pollution that may come as a result of excess use of chemicals. In the absence of regulation, there will be too much pollution, hence the need for legislation to guide the responsible use of chemicals.

Public goods may be regarded as an extreme case of positive externality. When left to market forces, facilities such as dams and research that are essential for the development of agriculture may not be provided at all or, if they are, then they may be provided in insufficient amounts. This is because of their nonrivalrous and non-excludable properties. Government intervention is necessary if these services are to be provided adequately.

3.1.2 Economies of scale and natural monopolies

Under conditions of decreasing costs, the lowest cost mode of production is by a single producer. Industries with substantial economies of scale are efficiently served by one firm or a few firms. These industries with large initial inputs are called natural monopolies because threat of entry is minimised by the initial outlay needed. If such industries are left to produce without some form of regulation, they will tend to produce by setting their marginal revenues equal to their marginal costs, thus reducing production so as to maximise profits. Incentives for innovation will also be weaker as there is no need to lower costs.

Where increasing returns exist, a government may be justified in intervening by directly regulating a 'natural monopoly', by setting prices or allowable rates of return on capital, or by legal protection to prevent a single firm take over.

3.1.3 Market imperfections

Market imperfections arise where price, information and mobility characteristics of 'perfect' markets depart significantly from reality. This occurs when prices do not indicate relative scarcities and opportunity costs, and where consumers do not have equal access to information about product markets. Market imperfection can also occur where information about market opportunities and production technology are not available to all producers or where factors of production are restricted in their ability to move in response to such information.

3.1.4 Distributional inequality

Left to itself, the market outcome for equitable redistribution will entail no redistribution or too little of it, due to the 'free-rider' problem associated with public goods and incomplete markets. Therefore, most governments intervene to 'improve' distribution of income in society.

To the above reasons, the structuralist school of thought adds that in places where demand and supply are inelastic, price mechanisms work badly as large price changes are needed to achieve small quantities of adjustment. However, large price changes are disturbing as they result in changes in income distribution (Little 1982).

Arndt (1988) observed that markets work incrementally: all required changes in price, in response to incentives, and in shift of resources take time. Therefore, all large changes that have to be accomplished quickly cannot be left to the market forces. If economic change has to be achieved quickly, then government forces must come into action.

3.2 Government Intervention in the Pricing of Agricultural Commodities

Agricultural price policy is a major component of the development policies of both developed and developing countries. Because the developed economies have low income elasticity of demand for agricultural products, and since agriculture plays a nominal role in their national incomes, they can afford to subsidise agricultural production. Government intervention in these economies is aimed at improving farmers' incomes which lag behind incomes of other sectors of the economy. In developing countries on the other hand, there is a sharp fluctuation in agricultural prices because the aggregate demand and supply are inelastic. A central objective of price policy is to reduce fluctuations and to stimulate productivity in the agricultural sector (Bhuyan 1992).

In areas where the majority of the population are poor, politics also play a significant part in determining pricing policies as price policies have an influence on equity, income distribution, consumption, production and economic development (Mellor and Ahmed 1988).

Economists are however divided as to whether governments should intervene in the marketing and pricing of agricultural goods. Free market economists argue that all agricultural prices should reflect their opportunity costs at the border. However, border pricing has its difficulties which have already been discussed in section 1.2.2. The free market approach has therefore been rejected in Latin America where the structuralist school is strongest. It has also been neglected in the formulation of price policies for primary foodstuffs, especially rice and wheat, in East and South-east Asia (Timmer 1989). The structuralist school has also been rejected in Asia because the deviations of allocative and budgetary costs from border prices have turned out to be substantial. The result of these rejections has been:

> a *mélange* of *ad hoc* pricing interventions intended to satisfy the needs of farmers for price incentives, the needs of consumers for low cost foods, the constraints imposed by budget minded finance ministers and the powerful sociopolitical desire for price stability as the proximate indicator of a society's degree of food security (Timmer 1989).

There has emerged a middle of the road school which Timmer (1989) calls the 'stabilisation' school. Their argument is that by following short run price movements in international markets, an economy incurs significant efficiency losses, but the economy incurs equally significant efficiency losses by not following longer run trends in international opportunity costs. Optimal efficiency therefore calls for some degree of market intervention to stabilise short run prices. However, there must be sufficient flexibility to allow domestic prices to reflect international price trends. Rent seeking behaviour is constrained, if not eliminated, by using competitive market agents to carry out most marketing activities, but within government established price bands.

In the pricing of farm produce, governments intervene to achieve one or a combination of the following objectives (Tomek and Robinson 1990):
(i) to support or raise farmers' incomes,
(ii) to protect or preserve small farms and thus slow down rural to urban migration,
(iii) to reduce price and income instability,
(iv) to achieve self sufficiency in food and fibre production, or to decrease dependency on imports,
(iv) to hold down consumer costs and/or increase consumption of foods and fibres.

3.2.1 Raising the average level of prices and incomes

This was the original reason why governments became involved in agriculture, and it is still the major purpose for government intervention in the United States. In Kenya, *ad hoc* producer price increase of maize such as that of October 1992, has been mainly to raise the producers' levels of income.

3.2.2 Protection or preservation of small farms

This is the main argument for overpricing farm products in Europe and Japan. Without protecting farmers by high prices, farming may become unprofitable for small farmers and they may be encouraged to sell their farms. This argument may not be relevant to Kenya as farms have been undergoing subdivision rather than consolidation.

3.2.3 Achieving self sufficiency in food and fibre

In food deficit countries, support programs have been introduced and maintained in an attempt to reduce dependence on imports, to conserve foreign exchange, and to insulate domestic producers from international price instability. These arguments have been advanced in defence of protectionist farm policies adopted by Japan and the European Union (Tomek and Robinson 1990). However, these policies have been maintained at the expense of residual supplies.

Governments involve themselves in the marketing and storage of food to ensure food security. If marketing is left to market forces, the poor in remote areas may not be able to afford food as prices may be above their reach, which may in turn discourage private individuals from serving these areas.

3.2.4 Reduction of price and income instability

Government concerns regarding price instability can be divided into microeconomic and macroeconomic effects. Microeconomic effects are those that relate to the welfare and economic decisions of individual producers and consumers, while macroeconomic effects are those that relate to the general economy: inflation, savings, investments and growth.

In colonial Africa, as was the case in the United States during the 1940s, price intervention was justified on the ground that risks in agriculture were greater than in other sectors (Lele and Christiansen 1989). If farmers were to invest in modern purchased inputs, an assurance of a guaranteed market was considered essential.

Yields and market prices should normally move inversely, which should lead to stable incomes. In developing countries, this does not always occur, because both agricultural supply and demand tend to be highly inelastic in the short run. Another reason is that

there are no futures market to absorb the risk. Besides, under conditions of subsistence agriculture, where only a small proportion of the total food production is marketed, fluctuations in marketed production tend to be proportionately greater than those in overall production. Thus in the absence of some price support, a given increase in marketed surplus will in all likelihood result in a greater proportionate drop in market prices.

Instability in prices makes investment levels at the farm and in the marketing infrastructure riskier. At the farm level, instability leads to lower investment in long term activities such as irrigation and new technology. At the same time, investments by the private sector in marketing infrastructure are also dampened in the face of price instability. This lack of investment has a negative impact on growth because of the increasing returns and public goods aspect of development of an efficient marketing system.

On the macroeconomic side, the worry is that price increases in major consumption goods will generate pressure for wage increases that will fuel inflation and make industries less competitive. Price stabilisation also has an impact on the consumers in that there are transaction costs incurred in reallocating their budget every time there is a variation in food prices. To fulfil their minimum nutritional requirements, the poor feel the pressure to substitute among food commodities much more acutely than do the rich. Accordingly, there are important implications of food price stability for income distribution (Timmer 1989).

Windfall gains in export earnings can affect the stability of exchange rates and the domestic economy because exporters will gain little. Unstable prices may also have an adverse effect on the demand for raw materials. For example, in the 1950s there was a high demand for natural fibres which could not be satisfied as a result of the Korean war, so fibre manufacturers switched to synthetic materials such as nylon. This persisted long enough that the manufacturers became accustomed to the substitutes and did not switch back to the original sisal, thus sisal lost the market.

Fluctuations in farm prices can lead to cycles in production with excess resources being excessively allocated to certain commodities during some periods and under utilisation of processing and marketing facilities during others. In countries where both cash and subsistence crops are produced on the same farm, the prices of food crops cannot be

allowed to escalate because most farmers would be tempted to grow their own food crops; this would compete with, and thus reduce the volume of, export crops, which would diminish foreign exchange earnings. It becomes necessary therefore to balance resources between staple and export crops.

Efficiency in the use of capital may be enhanced through measures to stabilise prices. Price uncertainty may lead to capital rationing where farmers may borrow capital and invest less of it because of the risks involved. With more stable prices, more capital would be used leading to greater output and efficiency.

Little is known empirically about the size of the macroeconomic benefits of stability: producers may or may not gain from the instability. This is due to the fact that the effects on producer returns depend on a complex set of circumstances that include the shapes of the demand and supply curves, the sources of instability and how producers respond to stabilisation programmes. However, the universal tendency of governments to stabilise their domestic prices for essential foodstuffs tends to suggest that the benefits of doing so may be large.

Price policies that successfully avoid sharp increases may contribute substantially to levels of overall social welfare, because food shortages are the mirror image of sharp price rises. Governments would therefore rather intervene to keep food prices stable than allow sharp price rises.

3.2.5 Holding down consumer costs

In developing countries, there is a belief that governments respond to 'urban bias' in making pricing decisions with respect to agricultural products. In an attempt to keep urban food prices low, governments often try to procure food at prices that are lower than the world markets. For example, the maize procurement price for Tanzania was only a quarter of the border price (World Bank 1986).

3.3 Some Forms of Government Intervention

Government interventions have always been in the forms of (a) production restriction (b) price support, (c) restriction of imports through tariffs, variable levies or quotas, and (d) subsidies of inputs. This section introduces the policies while their effects on maize production in Kenya are discussed in Chapter 6.

3.3.1 Crop Restriction

Crop restriction is where producers are urged not to produce beyond a certain amount so that the price is maintained at some level. This is particularly common in the United States. In Kenya, this policy is used mainly in the coffee industry where producers have to register and get their seedlings from the coffee societies. The policy reduces national production, thus making the product more expensive. With inelastic demand, the revenue to producers is improved, but the consumers pay more for the product.

3.3.2 Price support and ceiling price

Price support is when a 'fair' price is set to benefit the producers. This is only possible in regulated markets. Price ceiling is the opposite of price support and it is effected to protect the consumers.

3.3.3 Restriction through taxes

This is when a country restricts importation of a commodity to a certain percentage. The restriction is put in practice by levying tariffs and import levies, or by imposing quotas. Tariffs are taxes levied on imported goods to discourage their importation, to raise revenue for the government, as well as to influence the development of individual industries. Tariffs raise the level of domestic production, because the taxes levied raise the domestic prices of the commodity thus stimulating production, which in turn lowers consumption. The effects of quotas are the same as those of tariffs, but the disadvantage of the quota is that the revenues that accrue go to importers rather than the government.

3.3.4 Input subsidies

Most developing countries tax agriculture and then support it through input subsidies. The inputs that are subsidised are usually fertilisers and irrigation water. Credit subsidy is also common as it is one of the facilitators of agricultural growth. In many developing countries, financial markets are weak and do not equally serve all the people; for this reason, and to encourage the adoption of new technologies, governments provide mainly subsidised credit.

3.4 Why Government Intervention is Not Necessary

Schultz (1978) explained the failure of the 'Green Revolution' as the consequence of government policies that prevented prices in the world markets from reaching farmers in the developing countries. In India, fertiliser was overpriced while paddy was underpriced by at least 50 per cent or more. This impaired the profitability of growing rice. Wolf (1979) claims that because governments are likely to fail just like markets, the rationale for government intervention due to the inadequacies of market outcomes is really only a necessary and not a sufficient condition for policy formulation. He suggests that before government intervention is called for, the specific market failures should be compared with potential non market failures associated with the implementation of public policies.

Killick (1989a) explains that in the 1980s, there was a major disillusionment with the State as an economic agent. Fiscal policies were seen as creating major disincentives while State attempts to regulate and control the economy ended up by distorting it. The result was a large number of parallel markets and inefficient public owned enterprises. He therefore summarises reasons against government intervention as:

(a) Governments are not necessarily well informed about the nature of a given problem, and the complex consequences of its own policy actions which may produce perverse or unwanted effects.

(b) Governments have only partial control over the consequences of their actions.

(c) There are often large differences between policy measures on the drawing board and the way they are implemented. This is because there are large intrinsic difficulties in improving the accountability and control of bureaucracies. This is made worse by the existence of corruption, nepotism and other malpractices and by the tendency for state agencies to be 'captured' by special interest groups.

(d) Since lump-sum taxes, which do not affect incentives at the margin, are invariably not available to governments, any increase in taxation necessitated by a policy intervention will itself introduce new distortions by affecting relative prices and incentives.

3.4.1 Criticisms of the Agricultural Marketing Boards

The critics of marketing boards are convinced that the main source of the problem lies in the monopoly these bodies possess (Timmer 1991). The lack of competition means that their administration is vulnerable to corruption, overstaffing and indifference to matters of quality and market volume. In such cases, government intervention is therefore not necessary as the society could be better off through free trade. If marketing boards were instituted to collect taxes from producers, this can be more efficiently done by implementing broader-based, value-added taxes and incentive-neutral, revenue-producing trade taxes.

Stabilisation policies are also expensive (World Bank 1986); they therefore affect the budget or the credit system. The alternative to stabilisation can be the implementation of a separate policy with independent instruments, for example; opening the market to private traders who can offer effective competition to the state controlled board. In this way, monopolistic tendencies are eliminated.

A consensus has emerged that the welfare gains from price stabilisation are only positive on theoretical grounds (Timmer 1991). When put to an empirical test the gains are not very substantial relative to the costs governments incur to stabilise them. Consequently, little rationale exists for governments to attempt to stabilise prices.

If the need to control prices is because of the fear that the private sector is inefficient and can be monopolised by a small number of traders, there is little evidence to support this view. On the contrary, evidence from Kenya has shown that the public sector charged 15 to 20 per cent more for marketing maize and beans than the private sector (World Bank 1986).

Keene, Monk & Associates (1984), describe parastatals as organisations that impede the development process by creating disincentives to production by small farmers. These organisations also tax farmers through artificially low product prices, and they discriminate against the farmers through control of production inputs. Their pricing

policies create pricing distortions in factor and product markets which lead to misallocation of resources and economic inefficiency. Marketing is therefore an intrinsically difficult task for public agencies to perform well especially in areas dominated by small holders and poor infrastructure.

Government interventions are therefore necessary to provide public goods such as research, extension, marketing infrastructure and irrigation investments. However, there is disagreement on whether governments should intervene in the operation of marketing boards and pricing. This is because in these cases, well-intentioned policies often have perverse effects on the intended beneficiaries, especially on impoverished rural inhabitants, as efforts to improve income distribution frequently carry unforeseen losses in efficiency that hurt the long-term prospects of the poor (Timmer 1991).

3.5 The Theory of Supply

Cochrane (1955) discussed the theory of supply in both the static and the dynamic sense. In the static sense, he defined supply as the amount of the product that will be offered for sale per unit of time as the price varies, other factors held constant. This he referred to as supply function. In the dynamic sense, supply specifies the output response to a price change not holding other factors constant. This was referred to as supply response relation. The supply function is useful for theoretical supply analysis, but it is not useful for empirical analysis as the supply response is dynamic.

The assumption usually adopted in discussing the supply concepts is that the industry is competitive and that producers want to maximise net returns. This is because the supply curve is not defined outside the context of competitive industry.

3.5.1 Theoretical Basis of Supply function

In theory a static supply schedule can be derived from a knowledge of the underlying input-output relationship. Deriving a supply function is based on the assumption that producers are price takers and that they equate marginal revenue to marginal cost. In a competitive industry, each firm's marginal revenue is the prevailing market price. So with an upward-sloping marginal cost curve, the profit-maximising output of each firm

rises as the market price increases. This curve is upward sloping because it is expected that a price increase will encourage a larger quantity of the product to be supplied.

The shapes of these functions are dictated by the underlying production function which depends on the level of technology available. Technology, and therefore the shape of the production function, as well as the marginal productivity curve for a particular input or factor, are assumed constant. A supply curve can therefore be derived by altering product prices, computing the optimal factor use, and then using the results to compute the output from the production function. For a single firm producing a single output, the relevant supply function in the short run is that section of the marginal cost curve above the variable cost.

The analysis assumes that output prices are certain at the planning stage, and that producers have control over output. However, neither assumption may in fact be correct in agricultural production, owing to the time lag between planting and harvesting which may cause yield and price risks. Yield risks are the differences between actual yields and expected yields, while price risks are the differences between realised prices and expected prices.

Another way of deriving the supply function is by using the production function and the cost function. Planned output changes if the marginal productivity of one or more inputs change, the prices of inputs change, or the price of output changes. Heady (1961), using a Cobb-Douglas production function and a linear cost function, derived the short run as well as the long run static supply function. In the short run, the supply is a function of the production coefficients, level of fixed resources, price of the product and prices of the variable inputs. In functional notation

(3.1) $$Q_s = f(P_o, P_c, P_{i...n}, K)$$

where

Q_s = quantity produced

P_o = price of the product

P_c = price of competitor product

$P_{i...n}$ = price of inputs

K= level of fixed resources

If it is assumed that the prices of other products are held constant, the supply schedule (curve) can be traced out.

The most important economic factor affecting production of an individual commodity in the short run is the availability of alternatives, as the supply relation is much more likely to be price elastic when alternative opportunities are available (Tomek and Robinson 1990).

The approach of deriving the supply curve using production functions and linear cost functions is not practical according to Lim (1975). since the numbers of producers are large and therefore the data required for the exercise may not be easily available. The more convenient approach is to correlate the quantity supplied with the price of the output. However, this approach suffers from a number of weaknesses such as the identification problem, the *ceteris paribus* assumption, the serial correlation and the problem of multicollinearity. Some of these problems and how they are handled in this study are dealt with in Chapter 4.

3.5.2 Dynamic Theory of Supply

In the long run, all factors of production become variable. The supply response may involve both movements along the supply curve and a shift in the supply. A shift in the supply curve is based on the hypothesis that when prices change, there are likely to be correlated changes in supply shifters. For example, under conditions of rising prices, producers may adopt new techniques at a somewhat faster rate than with constant or declining prices. An increase in price may cause producers to increase output along the static supply curve and it may also lead to a shift to a new supply curve. The resulting increase in supply will thus be greater than if it was based solely on the static concept of supply. Once the improved practices are adopted, they are often retained even when the price of the product subsequently declines. The dynamic supply schedule is therefore irreversible.

The other factors that introduce dynamics into the theory of supply are technological changes, the institutional setting, risks and uncertainty, fixity of resources and expectations.

(a) Institutional Settings

The institutional factors that are relevant for this study are technology, credit and extension services. Apart from technology, the other factors are not discussed as they are beyond the scope of this study.

With time, changes in the supply of farm products are determined principally by shifts in the supply schedule. This shift is most often associated with improvements in technology and changes in the availability and costs of inputs. That is, through technological change the production function will shift over some range so that either more output can be produced with the same quantity of inputs, or, the same output can be produced with a smaller quantity of inputs.

In the absence of technological change, higher production is only possible through a movement along the production function. This increases the real cost of resources. A study conducted by Krishna (1982) in India shows that technology elasticity is greater than price elasticity, as output growth is essentially a function of productivity. Given a certain level of technology, price elasticity must be positive and significant to raise or stimulate production. This was confirmed by studies that analysed the role of both price and technology elasticities of supply (Krishna and Raichaudhuri 1980, and Renade, Jha, and Delgado, 1988). The studies concluded that the increase in price elasticities of supply was positive and significant only due to an increase in the technology elasticity of supply. Production was stimulated most when both prices increased and modern technology was adopted progressively. This led Bhuyan (1992) to conclude that in its continued efforts to raise the rate of technology adoption by farmers, the government should not increase input subsidies. Instead, there should be a more realistic cost-sharing policy.

(b) Risks and Uncertainty

The first attempts to categorise production processes subjected to conditions of less than perfect certainty were patterned after the 1921 pioneering work of Knight. Knight created two subclasses to describe lack-of-knowledge situations, which he called risks and uncertainties (Doll and Orazem 1984).

Risks influence the production decisions of producers. Risks in production are when producers are aware of all possible outcomes that can result from the process and can attach a probability to each outcome. A risky situation exists when the outcome of production is a random variable with a known probability situation. In agricultural production, risks arise from variability in output as well as in prices.

Doll and Orazem (1984) argue that producers making decisions under uncertainties of future prices do not necessarily maximise expected profits. What they maximise is expected utility, which is a function of expected profit and the variance of expected profit. It is generally believed that producers in developing countries sometimes appear to be unresponsive or hostile to proposed technical changes probably because the risks are high. As Behrman (1968) states, 'the possible rewards for returns above the expected value may not offset the secure penalties for returns below the expected value'. Given these conditions, risks affect the supply of the produce and so are important as far as the theoretical determinants of supply are concerned.

Uncertainty occurs due to lack of information. When confronted with lack of information, producers rely on their subjective evaluations or expectations to determine the selection of an action appropriate to the uncertain situation. In a free market economy, producers do not have accurate knowledge of the exact prices and yields at the time of planting. Production decisions are therefore based on the expected price and yields.

Risk is therefore an important variable affecting producers' decision making. Failure to include risk variables in the supply models results in underestimation of supply elasticities (Just 1974, Ryan 1977, and Traill 1978). Wolgin's (1975) study showed that risk aversion plays a very important role in farmer behaviour, and that farmers are willing to grow high risk crops only if they get a higher pay off in expected return. This also explains why farmers in Kenya continue to interplant maize and beans contrary to technical recommendations. By producing a mutual fund of crops, they can get the same range of expected return at lower levels of risk, than they would if they grew only one crop at a much higher risk level.

The influence of risks in production decisions has traditionally been studied using programming methods. However, starting with Behrman (1968), risk variables have been fitted in the supply response. There is still no consensus as to how risk variables should

be measured. Behrman (1968) measured both price and yield risks by a three year moving standard deviation about a moving average of price and yield, and this was what Jaforullah (1985) also adopted. Just's (1974) adaptive risk model is more complex: he used the squared deviation between actual and expected prices, whereby expected prices and risk variables were measured by geometrically weighting of past observations. Traill (1978) first estimated the distributed lag effects of the past variables by an iterative procedure and then formulated the risk observations by quantifying the absolute deviations of the actual and expected prices. He finally specified the expected risk as a distributed lag function of past observations of risk.

The hypotheses as to how producers form their expectations for future prices and yields are discussed in section 3.6 below.

(c) Fixity of Resources

One of the assumptions usually made in the discussion on input demands is that producers can buy or sell inputs at the same factor price. This may not be so in agricultural production as there are some fixed or durable inputs that provide a flow of services over several years. These fixed assets are one of the factors that are responsible for the lag between a change in prices and quantity supplied. The nature of such factors makes adjustment costs higher if all adjustments are made immediately after a change in prices. For example, a tractor once bought cannot be changed simply because a better one is on the market as changing it may incur expenses that are far greater than the extra revenue that may accrue from continued use. Therefore, there is no incentive to replace the tractor with a new one.

Whereas fixity of resources is not as serious for annual crops as it might be for perennial crops, it is still a factor worth considering as, once a crop has been planted, the producers can do very little to vary the area.

Empirical studies of the supply relationship for farm products indicate that changes in product prices typically (but not always) explain a relatively small proportion of the total variation in output which has occurred over a period of years (Tomek and Robinson 1990). In the short run, the supply is commonly affected by weather and pests, while in the long run it is technology that is important.

The principal causes of changes in supply are changes in input prices, changes in returns from commodities that compete for the same resources, changes in technology, and institutional constraints.

3.6 Supply Response Models

Several supply response models have been developed to analyse the impact of price on output. These models are based on the assumption that producers use past observed prices in formulating their expectations. The simplest model is where the output equation is specified with reference to only two variables. An example of such a model is the naive or static price expectation model.

3.6.1 Naive or static price expectations hypothesis

Following Ghatak and Ingersent (1984), a typical simple supply response function can be written as:

(3.2) $$Q_s = f(P_{t-1}, A_t, W_t, U_t)....$$

where

Q_s = quantity supplied

P_{t-1} = a proxy for expected price

A_t = area

W_t = weather

U_t = error term

Yield variation can be captured in the error term U_t.

It is expected that $\frac{\partial f}{\partial P_{t-1}} > 0, \frac{\partial f}{\partial A_t} > 0, \frac{\partial f}{\partial W_t}$ more than or less than 0

Output is expected to vary positively with prices and area under cultivation but may rise or fall depending on weather.

Due to a very close and direct relationship between acreage and output, acreage can be taken as a proxy for output. Equation (3.2) becomes

(3.3) $$A_t = f(P_{t-1}, W_t, \ldots U_t)\ldots$$

It is possible to postulate a direct relationship between price of an agricultural output and its supply. This can be written as

(3.4) $$Q_t = f(P_{t-1}).$$

This is a very simple and common expectation model. If price is used instead of quantity, the model becomes

(3.5) $$P_t^* = P_{t-1}$$

where

P_t^* = expected price, and

P_{t-1} = latest known price

It assumes that expected price is equal to the latest known price.

This type of expectation model was originally used in the cobweb model. The supply curve can be written as a function of the price in the last period (P_{t-1}) since it is assumed that current supply decisions are taken solely on the basis of past prices. Hence:

(3.6) $$S_t = b_1 + b_2 P_{t-1}$$

Such a model is recursive as the current year's supply is given by the previous year's price and such a supply determines current prices. Once production is realised, the model assumes that this quantity is sold. This assumption suggests that the model is most applicable to perishable or semi perishable farm products.

The drawback of this model is its implication that producers do not learn from experience. The other limitations are the assumptions that supply and demand relations remain constant and that producers are able and willing to change production plans within one time period. Adjustment costs are also ignored in this model. It is thus probably an oversimplification of reality. However the more complex models such as the rational expectations model used by Fisher (1982) are an extension of this concept.

3.6.2 Simple weighted expectation

This relates expected price to a weighted combination of the two previously observed prices. It is presented as

(3.7) $$P_t^* = \gamma P_{t-1} + (1-\gamma)P_{t-2},\ 0 \geq \gamma \leq 1$$

This model is an improvement on the static price expectations hypothesis as it takes into account two previous prices.

3.6.3 Extrapolative expectations hypothesis

This model was proposed by Goodwin (1947) and is a more sophisticated adaptive approach to expectations that allows for a 'learning' process on the part of the cultivators. It assumes that expected price is the latest known price plus some proportion of the change in actual price between two periods ago and the last period.

(3.8) $$P_{t-1}^* = P_{t-1} + g(P_{t-1} - P_{t-2})$$

where

P_t^* = expected price in period t

P_{t-1}^* = actual price in period t - i, where i = 1,2 and

g = the coefficient of aggregate expectations

The Extrapolative expectations model encompasses a great variety of producers' behaviour depending on the size of γ. If $\gamma = 0$, this model converges to the static expectations model. The naive expectations model can therefore be considered as a special case of Goodwin's model, and this is where its weakness lies as farmers are still assumed to have short memories.

3.6.4 Adaptive expectations hypothesis

This model was developed by Cagan (1956) in his study of the effects of hyper inflation. The model assumes that each year, producers update their expectations for future 'normal'

price by an amount proportional to the error associated with the previous level of expectations. Mathematically, it is expressed as

(3.9) $$P_t^* - P_{t-i}^* = \pi_e(P_{t-i} - P_{t-1}^*), \quad 0<\pi \leq 1$$

where

P_{t-i}^* = expected price in period t - i, i = 0,1;
P_{t-i} = actual price in period t - i, and
π_e = the coefficient of expectations.

If π_e is equal to zero, then actual prices have no effect on expected 'normal' price. If it is equal to one, then expected 'normal' price is equal to previous year's actual price and so this corresponds to the naive model.

This hypothesis can also be expressed as a weighted average of past prices where the weights are functions of the coefficient of expectations, and are declining geometrically. Expressed this way, the mathematical expression takes the following form.

(3.10) $$P_t^* = \pi_e P_{t-1} + 1(1-\pi_e)\pi_e P_{t-2} + (1-\pi_e)^2 \pi_e P_{t-3} + \ldots.$$

or

$$P_t^* = \pi_e \sum_{i=0}^{\infty} (1-\pi_e)^i P_{t-i-1}$$

This equation is the Koyck (1954) distribution lag expressing expected price as an exponentially weighted moving average of past prices.

This model is inadequate because it implies that the distributed lag parameters are restricted in an *ad hoc* way, as the parameter restrictions in the distributed lag are not the result of an optimisation process (Fisher 1982).

3.6.5 Partial Adjustment Model

Like the adaptive expectations model, the partial adjustment hypothesis leads to an infinite distribution lag model. The basic idea is that the current value of the independent

variable determines the 'desired' value of the dependent variable. However, adjustment is not complete in one period as only some fixed fraction (γ) of the desired adjustment is accomplished.

A simple example of a partial adjustment supply function is

(3.11)
$$Q_t^* = \alpha + \beta P_{t-1}$$
$$Q_t - Q_{t-1} = \gamma(Q_t - Q_{t-1}) + u_t$$

where $0 < \gamma < 1$ is the coefficient of adjustment.

This model was developed by Nerlove (1956) and is the one used in this study. The model hypothesises farmers' reactions in terms of price expectations and/or partial area adjustments. The model basically consists of three equations.

Area equation

(3.12)
$$A_t^D = a_0 + a_1 P_t^e + a_2 Z_t + u_t$$

(3.13)
$$P_t^e = P_{t-1}^e + \beta(P_{t-1} - P_{t-1}^e)$$

(3.14)
$$A_t = A_{t-1} + \gamma(A_{t-1}^D - A_{t-1})$$

Yield equation

(3.15)
$$Y_t^* = \sum_{i-k}^{\infty} \delta_i A_{t-i}$$

(3.16)
$$Y_t = b_o + b_1 Y_t^* + b_2 P_t + b_3 Z_t + u_t$$

where

A_t = actual area under cultivation at time t

A_t^D = area desired to be under cultivation at time t

P_t = actual price at time t

Y_t^* = potential yield at time t

Y_t = actual yield at time t

P_t^e = expected price at time t

Z_t = other exogenous factors affecting supply at time t

β = expectation coefficient

γ = adjustment coefficient

δ = potential yields per acre in year t

Equation (3.13) is the expression of the price adjustment where β, the coefficient of expectation, is constant and is 0 or less than 1. If β is zero, then actual price has no effect on expected 'normal' price. If it is 1, then expected 'normal' price is equal to last year's actual price. However, all past prices do not have equal influence: greater weights are attached to more recent prices.

In its simplest form, with no determinant and assuming a linear relationship, the *Nerlovian adjustment model* can be presented as

(3.17) $$A_t^* = a + bP_{t-1} + u_t$$

(3.18) $$A_t - A_{t-1} = \gamma(A_t^* - A_{t-1}) \quad 0 \le \gamma < 1$$

where

A_t^* = desired acreage

γ = adjustment coefficient

Equation (3.18) cannot be estimated as A_t^* is not observable. One way of solving this is to assume that the acreage actually planted in period t equals acreage planted in period $t-1$ plus a term that is proportional to the difference between the acreage farmers would like to plant now and the acreage actually planted in the preceding period. To obtain the estimating equation, simple algebraic manipulation is necessary.

From equation (3.17), A_t^* can be expressed in terms of observable variables.

(3.19) $$A_t^* = \frac{1}{\gamma} A_t - \frac{(1-\gamma)}{\gamma} A_{t-1}$$

substituting the value of A_t^* into equation (3.17)

(3.20) $$\frac{1}{\gamma} A_t - \frac{(1-\gamma)}{\gamma} A_{t-1} = a + bP_{t-1} + u_t$$

or

(3.21) $$A_t = a\gamma + b\gamma P_{t-1} + (1-\gamma)A_{t-1} + \gamma u_t$$

(3.22) $$A_t = a_0 + b_0 P_{t-1} + c_0 A_{t-1} + v_t$$

where

$a_0 = a\gamma$

$b_0 = b\gamma$

$c_0 = 1-\gamma$, and

$v_t = \gamma u_t$

Other determinants of the model can be incorporated very easily into the equation. If the price of wheat (P_{w-1}) were to be added, the equation would be

(3.23) $$A_t = a_0 + b_0 P_{t-1} + c_0 P_{w_{t-1}} + d_0 A_{t-1} + v_t$$

where a_0, b_0, d_0 and v_t are defined as before and $c_0 = c\gamma$, c being the coefficient of $P_{w_{t-1}}$ in the original equation.

3.6.6 Distributed lag model

The Distributed lag model has been applied to many areas of economics such as investment, consumption and supply response, because the model is more flexible in imposing different patterns of weight. A simple example of a distributed lag model with only one explanatory variable is:

(3.24) $$Y_t = \alpha + \beta_0 x_t + \beta_1 x_{t-1} \ldots + \beta_k x_{t-k} + u_t, \quad t = 1 \ldots T$$

where Y_t is the quantity supplied, x_t is the price and u_t is the disturbance term.

If the area equation is used, then it takes the form of

(3.25) $$A = \beta_1 + \sum_{i=1}^{\infty} \beta_2 P_{t-i} + \beta_3 Z_t + u_t$$

where

$A =$ actual area under the crop in period t

$P_{t-i} =$ actual price in period $_{t-i}$, where i varies from 1 to infinity; and

$Z_t =$ other factors influencing area.

The flexibility of this model is due to the fact that different sets of β_2 values describe different lag schemes. This model may be estimated using ordinary least squares (OLS). It may however suffer from multicollinearity and poor degrees of freedom. As such, the model causes estimation problems as it is not possible to estimate an infinite number of parameters from a finite data set. To overcome the multicollinearity problem, in practice, the model is estimated by assuming *a priori* structure for the set of β_2 values. Popular lag schemes that have been used include the inverted V lag scheme, the arithmetic lag scheme and the Almon polynomial lag scheme. Almon (1965) suggested restricting the β 's to lie upon an n-degree polynomial equation on time.

(3.26) $$\beta_1 = \gamma_0 + \gamma_1 t + \ldots\ldots + \gamma_n t^n,$$

3.6.6 Rational expectations hypothesis.

This hypothesis was developed by Muth (1961) in recognition of the fact that the polynomial distributed lag model was deficient as there was little evidence to suggest that the presumed relations bear any resemblance to the way the economy works. It is the most plausible hypothesis from a theoretical standpoint as far as the formulations of price expectations are concerned. The hypothesis states that since the expectations are informed predictions of future events, they are essentially the same as the predictions of the relevant economic theory. The implication is that the producers know the structure of the system in which they operate and so they make expectations in a rational or utility maximising manner.

McCallum (1980) criticised this model citing that it may be unrealistic to assume that the producers use all the information that is available. It may also be unrealistic to assume that the information is used as intelligently as the hypothesis claims.

It is therefore not certain as to how producers form their price expectations. The following section discusses the supply elasticities.

3.7 Supply Elasticities

Whereas supply schedules are important for theoretical analysis, supply elasticities are more important for policy analysis. This is because they show the magnitude of change in supply to the decrease or increase in the price of a commodity.

Supply elasticities are influenced by time and the availability of factors of production and other inputs (Killick 1989b).

3.7.1 Time

Elasticities are larger in the long run than they are in the short run. This is because in the long run, the decision makers can vary production to conform with the products that are profitable. In agriculture, the long run takes at least one season.

3.7.2 Availability of factors of production

Key factors of production include the prior existence of unused capacity, factor mobilities, the extent of competition in the industry, and availability of inputs,

(a) Existence of unused capacity

There is likely to be rapid and substantial response to improved profit opportunities if unemployed labour and capital can be brought into production. In agriculture, it may be rare for land to go completely uncultivated, but the intensity of cultivation can be substantially varied depending on the profitability of the produce.

(b) Factor mobilities

This is influenced by the efficiency of the factor markets and the degree of specificity of the factors of production. Factor mobility therefore does not favour agriculture as a

casual labourer employed to apply fertiliser on maize cannot be readily employed elsewhere.

(c) The extent of competition

Elasticities of supply are larger in competitive firms and tend to be so in competitive industries. A firm with monopoly power can get away with unnecessarily high cost structures (X-inefficiency) and can postpone the discomfort of change.

(d) Availability of material output

Inputs must be delivered on time, otherwise they will not be of much use. Late input delivery is obvious in most marketing boards in developing countries. Drawing from Fernado (1987), Krueger (1992) says:

> Stories are common of fertilisers being delivered after harvest, of collection points for agricultural commodities being far away from the farm gate so that producers could not deliver, of shortages of storage facilities so that part or all of the crop rotted, and other breakdowns of the distribution system.

The state of the infrastructure therefore has a direct bearing on the mobility of labour and the structural flexibility of an economy as it helps to integrate markets and raise their efficiency.

The conclusion is that supply relationships for individual farm commodities are often complex. This is firstly because yields are subject to unpredictable elements that may cause actual production to deviate substantially from planned production. Connected to this is the assumption that producers seek to maximise net returns as per the supply theory. However, whereas producers have control over how much input to use, they do not have control over output, therefore producers do not maximise returns but utility.

The second reason responsible for the complexity is the biological nature of production, which results in the time lag between a change in prices and when the farmers can respond by changing their production techniques. Lastly, because of the decentralised decision making, supply may not immediately follow price change as producers may not all have profit maximisation as their major aim of production.