

Food production in Zambia: The impact of selected structural adjustment policies

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List of abbreviations

AFC	Agricultural Finance Company
CSA	Census Supervisory Area
DCU	District Cooperative Union
ERP	Economic Recovery Programme
ESAF	Enhanced Structural Adjustment Facility
FEMAC	Foreign Exchange Management Committee
GDP	Gross domestic product
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IMF	International Monetary Fund
NAMBOARD	National Agricultural Marketing Board
NERP	New Economic Recovery Programme
NGO	Non-government organization
OGL	Open general licence
PFP	Policy framework paper
PRSP	Poverty reduction strategy paper
PSIP	Potato and Sweet Potato Improvement Programme
RAP	Rights accumulation programme
RTIP	Root and Tuber Improvement Programme
SAP	Structural adjustment programme
SADC	Southern African Development Community
SMIP	Sorghum and Millet Improvement Programme
UNSTATS	United Nations Statistics (database)
WB	World Bank
ZRA	Zambia Revenue Authority

Abstract

The paper examines the impact of selected structural adjustment policies on food production in Zambia. Using a four-year panel of post-harvest data, a system of six crops, two variable inputs and three fixed inputs is estimated. The resulting supply responses suggest a negatively sloped supply curve for sorghum and millet, which is attributed to the presence of credit constraints. Simulations are conducted to assess the impact of the removal of subsidies and exchange rate controls. The results indicate that these policies have led to increased food production although the magnitude of the increase is in general not very large. The results also indicate a significant fall in fertilizer use. Information, credit and distance to markets are also very important variables for food production. Deliberate efforts are needed to develop both input and output markets and to provide more formal credit institutions targeted at small-scale farmers.

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1. Introduction

For over two decades, the Zambian economy was dominated by government ownership. The government regulated commodity and food prices and food consumption was heavily subsidized. The mainstay of the economy was mining, with revenue from the export of copper used not only to finance domestic expenditure but also to import food in years of shortages. The impact of the oil crises of the 1970s, falling copper prices and the resulting general economic deterioration shifted the focus to agriculture as a possible source of growth, export revenue and increased food availability.

To recover from the economic problems that the country was experiencing, the government turned to borrowing both domestically and internationally. With no significant recovery in either copper revenues or agriculture, the balance of payments and fiscal deficits became enormous and ultimately the country started to get conditional loans, which was the beginning of structural adjustment programmes (SAPs) in Zambia. The general objectives in the agricultural sector were the reduction of government intervention in the market, the promotion of agricultural or non-traditional exports, and the improvement of food production. In practice, macro level implementation involved freeing the exchange rate, liberalizing trade, freeing interest rates, removing subsidies and all forms of price controls, and abolishing state agricultural companies and marketing boards.

More than a decade later, the expected benefits of these reforms do not seem to be very visible in the agricultural sector. The objective of this study is to look at the impact of some of the policies that were implemented as part of the SAPs in Zambia. Supply responses of food production amongst small-scale farmers are estimated and used to simulate the effects of the removal of subsidies and exchange rate controls. Six food crops (maize, sorghum, millet, groundnuts, sweet potatoes and cassava) are included in the system. Of these, maize is the most rain-fed, while sorghum, millet and cassava are quite drought resistant and are a potential substitute in making *nshima*, the staple starch for almost the whole country. Sweet potatoes are also a major food crop grown and consumed almost all over the country.

The paper is organized as follows. Section 2 presents the background on the agricultural sector in the backdrop of the macroeconomic environment. This is followed by the discussion of the methodology and empirical model in Section 3 and presentation of the results in Section 4. Section 5 concludes with a summary and policy implications.

2. Agriculture and the macroeconomic environment

The changes in both the agricultural sector and the macro economy as a whole resulting from the implementation of SAPs in Zambia have obviously had a significant effect on agricultural and food production. Take the exchange rate, for example. The dependence of Zambian maize production on imported fertilizers and other chemicals means that the liberalization of the exchange rate affects the cost of production for maize. Where agricultural produce is exported, this also affects the price farmers receive for their crop. Trade liberalization will also affect the farmers because of changes in terms of trade between traded and non-traded goods for both agricultural and manufactured goods.

Liberalization of the credit market has also had significant effects on the agricultural sector. Before the reforms, the agricultural sector was a major beneficiary of low-interest loans. When this situation changed, access to credit declined, which may have contributed to the fall in agricultural output. It is clear that both macroeconomic and agriculture specific reforms have a potentially significant impact on agricultural output and food production in particular. In this section, we look at the evolution of the general macro economy in post-independence Zambia. We then proceed to look in more detail at the reforms that have been implemented in the agricultural sector.

Macroeconomic reforms

During the early years of independence, Zambia benefited from high copper prices on the world market. Copper constituted over 90% of the foreign exchange earnings, about 70% of the government budget and over 40% of GDP. The revenue from copper was used to finance the provision and expansion of free social services such as education and health. Many consumption commodities especially those in agriculture were subsidized. The rationale was that the urban population was large and it was important to provide enough and affordable food to everyone. The output and prices of copper continued to be good and real GDP grew at an average of 2.3% per year (World Bank, 1984). Because of this, exports were generally greater than imports and there were no major problems with the external balance. The shortfall in food supply was met by increased imports, while an import substitution strategy was put in place to encourage local manufacturing. Most firms were highly dependent on imported inputs, however, and the import bill continued to be high. Again the export revenues from copper provided the needed foreign exchange. Administrative controls were also put in place as part of broader development policies. Commercial banks were required to give a percentage of their lending to agriculture at preferential interest rates. The public sector played a very

big role in economic development with most of the key firms being parastatals.

In the mid 1970s, copper prices on the world market began to decline. This was believed to be a short-run situation and the government made no effort to adjust national consumption.¹ Instead, the financing gap was met by borrowing from both the domestic and international markets, a move that shielded public consumption from the effects of economic decline. The oil shock of 1973/74 and the resulting world recession reduced the demand for copper and led to reductions in export revenue. The reliance of the manufacturing industry on imported raw materials and spare parts also led to reduced capacity utilization and a fall in real GDP. The result was a shortage of foreign exchange and a negative current account. With no improvement in copper receipts and no attempt at serious diversification of the economy, the country accumulated large arrears on loan repayments. The government responded by increasing borrowing and putting more trade barriers and other controls in place.

During this period, Zambia operated a fixed exchange rate system. Between 1964 and 1968, the official currency in Zambia was the Zambian pound, which was pegged to the British pound and fully convertible. In 1968, the currency was changed to the kwacha and de-linked from the pound and linked to the US dollar and later to the special drawing rights (SDR) in 1976. Despite the pressure on the exchange rate, the kwacha remained fixed and the exchange rate was maintained through administrative controls such as import licensing and through monetary expansion. Licensing was based on a priority list of goods and services determined by the government's development objectives. Import quotas and high tariffs were also used.

By the early 1980s, however, it was apparent that Zambia was an economy under pressure. Its borrowing options narrowed and in 1983 Zambia received the first conditional loan from the International Monetary Fund (IMF). The World Bank and the IMF increasingly influenced the implementation of economic policy. The government embarked on a programme to reduce the current account deficit and its external payment arrears, decontrol domestic prices, reduce subsidies on basic food and fertilizer, and relax interest rate ceilings.

In response, the institutionally set interest rates were increased. Between January 1983 and January 1987, when the reforms were briefly abandoned, the lending rate increased by 154 percentage points while the Treasury bill rate increased by about 195% – from 9.5% to 28%. In 1983, a basket of the currencies of Zambia's five major trading partners was introduced. The kwacha was now adjusted within a narrow range and set to depreciate at 1% per month, a percentage that was increased to 2.5% by 1984. The intention was to let the kwacha settle to a realistic market value. The foreign exchange auction was introduced in October 1985 with the official exchange rate at 2.2 kwacha per dollar; by the beginning of 1987 the exchange rate had increased to 15 kwacha per dollar.

Despite these reforms, the economy continued to decline although the decline slowed down. In response, the government put in place much sterner measures. In 1985, the foreign exchange weekly auction was started to put the exchange rate on a path to being market determined. The trade and payments systems were also to be liberalized. Treasury bill auctions were introduced to help free the interest rates and mop up excess liquidity in the economy. Prices were deregulated and subsidies removed for all crops and commodities except maize and fertilizer.

In 1986, a price decontrol for breakfast maize meal was announced. The ensuing devaluation and price decontrols led to marked increases in inflation. Between 1983 and 1987, the consumer price index (CPI) inflation more than doubled from 19.6 to 43. During the same period, there was significant growth in monetary aggregates, which also contributed to increases in inflation. In 1987, as the economy wide reforms progressed, maize subsidies were also removed.² Coupled with the effects of the auction of the kwacha, which increased consumer prices, riots erupted in the country especially on the Copperbelt.³ As a result, the auction was suspended in early 1987 and the kwacha was revalued. Price controls were also re-introduced. By May, the government succumbed to the domestic pressure and broke ties with the IMF and World Bank.

The government embarked on a new development initiative – the New Economic Recovery Programme (NERP). One of the major issues was to influence consumption patterns to change in favour of local products. There was emphasis on internally generated resources to finance growth and development rather than relying on aid. Imports were controlled and key products were rationed. Consumption of locally produced goods and services was encouraged.

When the reform programme was abandoned, the foreign exchange auction was replaced by a foreign exchange allocation system under a Foreign Exchange Management Committee (FEMAC) and the exchange rate was re-valued from 21 to 8 kwacha to the dollar. In February 1987, the interest rates were also revised downwards. Aid stopped flowing from the IMF and the World Bank and the plan was to rationalize the use of foreign exchange so that it could compensate for this loss of funds through net export earnings. Repayment of the existing debt was limited to 10% of net export earnings.

Many members of the donor community withdrew and the country experienced an acute shortage of foreign exchange. This led to a chronic shortage of imported inputs and consumer goods. However, there was improved economic growth. Net exports were positive mainly due to a significant fall in imports. The resulting pressure and the escalating external debt forced the government to return to IMF/WB sponsored programmes in 1989. These were re-implemented with increased intensity. The kwacha was devalued, minimum reserve requirements increased and maize meal prices increased. The new programme was formalized through a policy framework paper (PFP) whose immediate goal was to reduce inflation and create a stable macroeconomic climate for growth and diversification. There was renewed emphasis on the role of agriculture and small-scale industries, the two sectors believed to be labour intensive and therefore having potential to generate needed employment. They were also expected to provide a lot of forward and backward linkages for the more established manufacturing industry.

Another initiative, dubbed the New Economic Programme, was put in place in 1989. The features of this programme were basically the same as those under NERP except that they were implemented with more intensity. The key monetary action was to mop up liquidity in the economy. The minimum reserve requirements of commercial banks were increased and government bonds were introduced.

Nominal interest rates were also increased. Between the reintroduction of the reforms in 1989 and September 1992, when the interest rates were liberalized, the lending rate increased from 18.4% to 58.5% while the Treasury bill rate increased from 18.5% to 47%. The exchange rate was devalued and later the fixed exchange rate was abandoned for a crawling peg. In 1990, a two-tier exchange rate system was introduced with the

official tier determined by the Bank of Zambia under FEMAC and the second tier operated with a market determined rate and used for imports under the open general licence system (OGL). Exporters of non-traditional exports were allowed to retain 50% of their export earnings in foreign exchange. Under the new intensified reform programme, the inflation rate began to fall. The introduction of multiparty politics in Zambia in 1991 disturbed the programme as the then ruling government began to backtrack on its commitments as a campaign strategy in the run up to the presidential elections.

Then, in October 1991, a new government was ushered into power. The programme implemented by the new government differed from the previous one only by the pace and rigour with which it was implemented. From 1992, Zambia entered a Rights Accumulation Programme (RAP) meant to facilitate the clearing of arrears on debt to the IMF. After proper completion, Zambia would be entitled to a concessional loan facility with only 0.5% annual interest. The new programme required tight monetary and fiscal policies. But the new government had a strong domestic mandate and was able to implement the reforms without much resistance or social unrest.

The Zambia Revenue Authority (ZRA) was formed to implement tax reforms and improve revenue collection. The government tried to implement the cash budget strategy started in 1993. This strategy required that revenue had to be raised before it could be spent. Cutting the domestic budget entailed the withdrawal of government from economic business, the majority of which was agricultural. Many parastatals were either privatized or liquidated. The introduction of the auctioning of government debt in March 1993 allowed Treasury bill rates to be market determined and marked the end of preferential lending to the agricultural sector. By 2001, the cash budget policy was abandoned because of constrained government funding.

In December 1995, the RAP was successfully completed and the IMF approved loans totalling \$1.313 billion and admitted Zambia to the enhanced structural adjustment facility (ESAF). The major part of the loan (\$1.047 billion) was provided under a three-year ESAF arrangement and the remainder under a one-year structural adjustment facility (SAF) arrangement in support of the government's economic and financial reform programme. The aim of the new programme was to strengthen macroeconomic stabilization efforts while consolidating and advancing the structural reforms begun under RAP (IMF, 1995).⁴ Macroeconomic policy in the last ten years has not seen much change from these goals. The poverty reduction strategy paper (PRSP) brought renewed emphasis on poverty reduction and subsequently more emphasis on agriculture.

Agricultural reforms in Zambia

One of the main arguments in favour of market liberalization in the agricultural sector is based on the benefits of market prices. It has been argued that controlled prices are in favour of the consumer and are a tax to the producer. The removal of these subsidies and controls would lead to higher output prices, which would in turn act as an incentive for increased production (GRZ, 1995). To this effect, liberalization attempts were made in the early 1980s and fully embarked on in 1991.

In the early 1980s, subsidies on crops such as sorghum, millet and cassava were removed. Because of the importance of maize in the consumption basket of most

Zambians, the maize subsidies were to be removed gradually over the years. In 1984, maize subsidies were just 5.5% of domestic expenditure but by the late 1980s had become as high as 16% (World Bank 1994). The pressure to remove the subsidies was very strong and in 1986 they were removed. This together with increases in the exchange rate resulting from the exchange rate auctioning sparked major food riots. The government then abandoned the reforms and re-introduced the subsidies in 1987. By 1989 when the reform programme was restarted, maize subsidies accounted for as much as 40% of the domestic deficit. With the election of a new government in 1991, agricultural reforms were fully implemented beyond just removal of subsidies.

In addition to subsidies on grains, agricultural inputs were also subsidized. Fertilizer and seed were subsidized and inputs were delivered to the farmers via several National Marketing Board (NAMBOARD) depots located in all the districts. These were also the depots where farmers delivered their crop output for the government to sell. The government operated a policy of “pan-territorial” and “pan-seasonal” pricing that entailed same prices throughout the country and through the year. The margins set by the government between the buying and selling prices were small and often the gains were felt in deficit rather than surplus areas.

A number of issues arise from this. First, farmers had no need or indeed incentive to look for a market for their produce. Transport and accessibility issues did not arise. The government both delivered inputs and collected output. In addition, the government set the prices for both inputs and output. Second, the system provided an incentive to move away from the production of other food crops such as sorghum, millet and cassava. These crops are drought resistant and are more of the traditional crops in certain parts of Zambia than is maize. All four crops can be used to make *nshima*, the traditional staple food in the country. In effect, the existing marketing policy tended to encourage inefficiency and lack of entrepreneurship on the part of the farmers.

Agricultural finance was provided in two main ways. The first was through loans provided by the government-owned Agricultural Finance Company (AFC). This company provided both cash and input credit. Second, commercial banks were required by law to give a percentage of their lending to the agricultural sector. The lending provided to the farmers was also subsidized. Repayment of these loans was very poor, however, and monitoring was inadequate. This tended to increase the government deficit, which often had to bear the losses of the parastatals. In the face of these policies, the government experienced serious financing constraints and continuously incurred debt.

With the implementation of the SAPs, marketing boards and other parastatals such as the AFC were abolished and all subsidies removed on inputs. By 1992, the dismantling of the marketing boards was under way. Prices were liberalized, subsidies removed and all active government participation in agribusiness withdrawn. On the wider macro level, interest rates were liberalized, administrative controls on banks removed and the exchange rate floated.

Liberalization of financial markets and the removal of controls on credit and its pricing meant that farmers have to compete for credit with other potential borrowers in the country. Where farmers do not have adequate collateral and are high risk (especially for small-scale farmers), access to credit has reduced significantly – the situation of the majority of medium- and small-scale farmers. In cases where farmers have obtained

credit and had a bad harvest, they have lost almost everything they have in loan repayments. The result is that many small- and medium-scale farmers have no access to credit. A number of non-government organizations have made efforts to lend inputs but the coverage of these programmes is limited. Existing outgrower schemes mainly focus on cash crops and are limited to less than a third of the whole country. Initiatives attempted by the government have not worked (Mwanaumo, 1999). Most of these attempts have not particularly targeted medium- or small-scale farmers and in effect have had the same failures as the private sector credit.⁵ This failure has the potential to reduce food production because a lot of these farmers depend on credit for input supply.

The abolition of NAMBOARD affected the transportation of both inputs to the production centres and output to the consumption centres. Most of the small-scale farmers growing grains are in remote areas of the country that are not easily accessible and far from the urban areas that are the main consumption centres. The state of the roads in most of these areas is bad and hence access to the market is even more constrained. Without proper or organized marketing arrangements in rural areas, as was the case before the reforms, output is likely to fall because of limited access to both output and input markets. Mwanaumo and Preckel (1997) simulate possible effects of liberalization on maize marketing and find that there are likely to be some welfare gains despite the increases in transport costs. The reality, however, is that access to markets by small-scale farmers has declined significantly. This has been compounded by inconsistent and contradictory local government policies. For example, many local governments have imposed a tax on the movement of maize from surplus to deficit areas where prices are higher. This has also compounded food insecurity. The taxes imposed are often prohibitive and farmers would rather keep their maize. In many cases, private grain traders either have to pay a bribe to the local council or buy the maize from the farmers at a very low price in order to maintain their margins.

The dependence of Zambian maize production on imported fertilizers and other chemicals means that the liberalization of the exchange rate had an affect on the cost of production for maize. Where agricultural produce is exported, the exchange rate also affects the price farmers receive for their crop. Combined with other trade liberalization measures, changes in terms of trade between the tradeable and non-tradeable goods will also affect the farm gate prices that farmers receive. The removal of exchange rate controls can be a mixed blessing for food producers, however. While liberalizing the exchange rate implies the removal of the implicit taxation of agriculture due to an over-valued exchange rate, higher exchange rates imply higher production costs due to imported inputs. For example, Jansen (1990) estimates that domestic maize prices were about 77% of border prices at the official exchange rate. On the one hand, if maize production is responsive to output prices as suggested by some studies, removing these controls implies significant gains in maize production. On the other hand, the same process may significantly increase the cost of inputs such as fertilizer to a point of wiping out the gains made due to price increases.

Reforms also pose the possibility of shifting farm activity into cash crops. This shift would mainly be amongst commercial farmers, leaving food production to small-scale farmers whose access to export markets and possibly required technology is limited. For most of the period since the reforms, Zambia, along with other southern African

countries, has experienced severe droughts. As a result of this, there has been a shift towards more traditional and drought resistant crops such as cassava, millet and sorghum. The removal of pan-territorial pricing may also have contributed to this shift by removing the surplus gains provided by these implicit subsidies. These crops are also less demanding chemical fertilizers and the increased fertilizer prices arising from the liberalization of the exchange rate may have had an effect.

The role for the government under the reformed agricultural sector is mainly to formulate policy and provide an enabling environment for the private sector. The enabling environment entails provision of support services such as roads and information. Although there have been attempts at improving feeder roads, most of the remote areas are no better than they were before the reforms and the major beneficiaries of the reforms are those farmers located along the line of rail. The limitations of the market have also led the government to get involved again in the provision of inputs such as fertilizer. In some places, the government has re-implemented subsidies although these are under a gradual reduction programme. The government also sets floor prices, especially for maize, due to underhanded methods used by grain traders to buy maize at very low prices from the small-scale farmers. In many cases, however, there is no enforcement of these floor prices and farmers still have to sell their crops at very low prices.

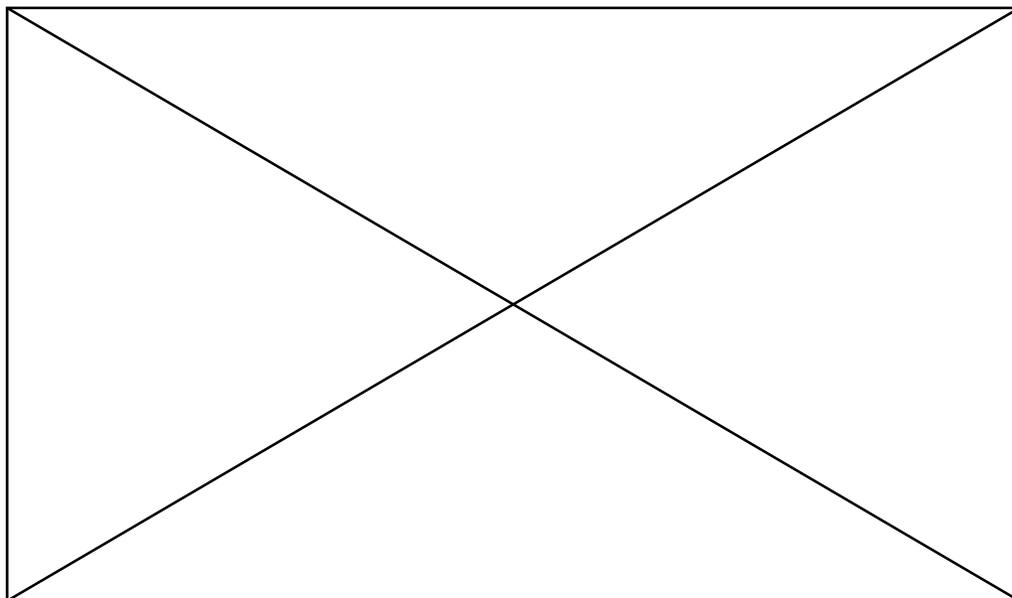
An agricultural market information service was started in 1993 with the creation of an information department under the Ministry of Agriculture, Food and Fisheries (MAFF – now the Ministry of Agriculture and Cooperatives). This department was to disseminate market information on prices and quantities of various agricultural products. But, the dissemination and use of information has been limited (Mwanaumo and Preckel, 1997). The extension officers are the point of contact with the farmers and in many cases they do not have enough resources to do their job. Information from the local farmers to the department does not flow very well either. There have been instances where the government provided subsidized fertilizer through the extension officers who ended up selling the fertilizer at higher prices to the farmers. The farmers buy this fertilizer because they have no knowledge that it is subsidized. There have been other information constraints at the farm level mainly due to lack of dissemination and monitoring. Although radio programmes are run by the Ministry of Agriculture and Cooperatives, most small-scale farmers have no access to radios and their best source of information remains the extension officers.

Food production trends in Zambia

Despite the reforms, food security has not improved in the country. In 1994, a third of the population (33%) was said to be vulnerable to food insecurity (Shawa and Shuba, 1994). By 1997, this figure had risen to 82% in some areas of the country (CSO, 1998). The drought in the 2000/01 farming season brought more than 25% of the population face to face with complete starvation. Without the copper revenues for importing food, the country was at the mercy of foreign donors hence the controversies that arose over genetically engineered maize.

Figure 1 shows three indexes of agricultural production in Zambia between 1985 and 2000. There has not been much change in food production since the reforms. In fact, we see a general decline especially in per capita food production, which is much lower in 2000 than it was before the reforms. A number of factors discussed above could account for this. Increases in production costs especially arising from the removal of subsidies and increases in the exchange rates could have contributed to this fall. It could also be due to the fall in credit access as most small- and medium-scale farmers rely on credit for the supply of inputs. The severe droughts for most of the last decade also contributed to the fall in the output of maize, which is chiefly rainfed.

Figure 1: Agricultural production indexes



Even though food production is not improving, the export of non-traditional crops such as cut flowers is increasing. Such exports are mainly from commercial farms. The dependence of maize production on fertilizer and other imported inputs could have proved its undoing, leading to many commercial farmers shifting into the production of cash crops. The continual increase in the exchange rate since the reforms may have had a negative effect on maize production (which is mainly consumed locally) while increasing the export receipts from the sale of flowers, hides, fruit and other agricultural exports. Net exports of cereals have declined but still remain at high levels.

Economic reforms have now been in place for over a decade. The exchange rate has been floating since 1992 and food subsidies were abolished by 1995. The interest of this paper is to look at the effect on food production of changes resulting from the implementation of policies under SAP. We estimate price elasticities and use these to simulate effects of policy on the production of several food crops in Zambia.

A number of studies have shown the responsiveness of both small-scale and large-scale farmers to prices in developing countries. A few studies that were accessible on

Zambia show that supply response to output prices is not very strong. Mwanza (1992) in a study of maize and cash crops found that crop supply responds to prices. The same conclusion was reached by Hamusankwa (1997) in a study on the responsiveness of maize and sorghum. An earlier study by Mwanza (1989) shows that although farmers are responsive to own prices, they are more responsive to non-price factors such as the performance of the non-agricultural sector and prices of other crops. A study by Krapft and Mwape (1990) found that maize supply was more responsive to fertilizer prices than to own prices.

Despite these studies, a substantial knowledge gap remains in the area of factors that affect food production in Zambia. First, all the accessible studies have focused on maize. Although maize is still the most important staple for the country, it has become quite important to explore the possibility of diversification into more drought resistant and less input demanding crops. Second, except for the study by Hamusankwa (1997), all these studies covered periods before structural adjustment was fully undertaken. Our study also differs in that we take account of the simultaneous decision making process of the farmer where a household grows more than one of the grains in question. We include a number of non-price factors as well. Studies in other African countries have shown that most reform programmes in the agricultural sector have not yielded the expected results because of some non-price factors, whose constraining influence may not be relaxed through improved price incentives (Oyejide, 1990; Cheru, 2002).

3. Methodology

It has been argued that macroeconomic performance under a programme should be compared with the counterfactual, defined as the macroeconomic performance that would have taken place in the absence of the programme (see Khan, 1990). Although it is the most appealing yardstick by which to assess programme performance, the counterfactual cannot be measured or observed and therefore must be estimated or approximated. Three approaches have been used widely in assessing the effect of IMF funded adjustment programmes to approximate the counterfactual. These include the *before-and-after* approach, which compares the performance of the economy before and after the programme; the *with-and-without* approach, which compares economic performance of an adjusting economy against a non-adjusting one; and the *actual-versus-target* approach where performance targets are set for the economy and the impact of the programme is judged on the basis of how well it performs against the preset targets.

It is important to point out that all these methods are plagued with difficulties and none is superior to the others. Results obtained using any one of them must therefore be interpreted within the caveat of their limitations (Killick, 1995; Gibbon, 1996). The problem with the before-and-after approach, for example, is that all outcomes are assumed to be due to the programme. There is no way of controlling for exogenous variables. The with-and-without approach is a variant of the before-and-after approach. The performance of adjusting countries is compared with those of similar but non-adjusting countries before and after adjustment. The difference in performances is then attributed to the programme policies and the performance of the non-adjusting country is used as the counterfactual.

Although the with-and-without approach allows the identification of exogenous shocks and resulting possible effects, it requires stringent assumptions to implement realistically. Most important of these assumptions is that the country chosen as the control must closely describe the counterfactual for the country that is being analysed. Furthermore, the countries that adjust self-select so that the performance of such a country post adjustment is a combination of the impact of the programme and the country's own characteristics. Isolating the effects of adjustment policies by using a non-adjusting country as a control, therefore, becomes very difficult. Where both countries are adjusting, this comparison would still be problematic because programmes tend to be country specific. Moreover, even where programmes are very similar, their implementation is likely to differ. In some cases, countries may not implement programmes completely, making the analysis even more difficult. Goldstein and Montiel (1986) discuss ways of modifying this approach to obtain more robust results.

Noorbakhsh and Paloni (1998), Dicks-Mireaux et al. (2000), and Hutchinson (2003), amongst others, implement these modifications.

The third method used is the actual-versus-target approach. In this approach performance targets are set for the economy and the impact of the programme is judged on the basis of how well it performs against the preset targets. The main shortcoming of this approach is that programme targets are often not available to the public. Targets may also be over ambitious and failure to achieve them may not signal failure of the programme. Likewise, the achievement of under-ambitious targets does not necessarily signal the programme's success. Furthermore, the observed results may be affected by exogenous shocks whose effects may not easily be isolated from those of the programme.

The analysis in this study is done in the spirit of the *actual-versus-target* approach. Targets are defined loosely as the achievement of the general objective of the reforms in the agricultural sector, which is to improve agricultural output and food production. Supply responses are estimated and these are used to evaluate whether food production has improved since the reforms. The counterfactual therefore is seen in broad terms, as improved food production.

The empirical model

We start by assuming that the farmers are optimizing economic agents whose motive is to maximize profits. Let π be a vector of output prices, w a vector of input prices, x a vector of variable input and z a vector of fixed inputs. Let q be planned output, so that we can write the farmer's problem as below (for strict profit maximization).

$$\begin{aligned} \max \quad & pq - wx \\ (x, q, z) \geq & 0 \\ \text{st} & \\ f(xz) \geq & q \end{aligned} \tag{1}$$

where $f(x, z)$ is the production function. The function is assumed to be continuous, strictly increasing and quasi-concave. Since the function is assumed to be strictly increasing, we can replace the inequality in the constraint with an equal sign and rewrite Equation 1 as:

$$\begin{aligned} \max \quad & pf(xz) - wx \\ (x, q, z) \geq & 0 \end{aligned} \tag{2}$$

The solution to this maximization problem is a set of input demand and output supply functions that can be written as:

$$x = x(p, w, z)$$

$$q = q(p, w, z)$$

Substituting these functions into the profit function gives us the optimal profit function. Let π be the profit function. Then

$$\pi = pq(p, w, z) - wx(p, w, z) \quad (3)$$

This profit function must be non-decreasing in output prices and non-increasing in input prices. It must be of homogenous degree one, convex in prices and continuous. Once we have our profit function, we can differentiate with respect to prices and by Hotelling Lemma's (1932) obtain the supply and input demand functions. Hence

$$\frac{\partial \pi}{\partial p_i}(p, w, z) = q_i \quad (4)$$

The obtained supply function must be homogenous and the substitution matrix symmetric and positive semi-definite. The specific form of the function used in the study is the translog. This form is a second order function in prices and fixed in factors and a good approximation of any arbitrary functional form. Because of its flexibility, the estimated parameters can be tested to see if the relevant restrictions imposed by theory are satisfied.

If we take a second-order Taylor approximation of the equation and differentiate with respect to prices, we obtain:

$$\frac{\partial \pi}{\partial p_i} S_i = a_i + \sum_{ij} b_{ij} \ln p_j + \sum_{ik} b_{ik} \ln w_k + \sum_{im} b_{im} \ln z_m \quad (5)$$

where S_i is the profit share of crop i in total profit. The share equations are easier to estimate than the profit functions since they are less demanding in information. If information on some observations is missing, share equations can be estimated by dropping the corresponding equations. Moreover, if we assume that the behaviour of the farmers is stable over the estimation period and we can aggregate over them, supply functions can exist independent of profit maximization (Sadoulet and de Janvry, 1995).

To ensure homogeneity:

$$\begin{aligned} \sum_i a_i = 1, \sum_k b_k = 1, \sum_m b_m = 1 \\ \sum_{ij} b_{ij} = \sum_{ik} b_{ik} = \sum_{im} b_{im} = \sum_{kl} b_{kl} = \sum_{mn} b_{mn} \sum_{mk} b_{mk} = 0 \end{aligned} \quad (6)$$

With the restrictions given above, the obtained share function will be homogeneous of degree zero in prices. We can impose this property by using one of the prices as a numeraire so that the last item in each row and column in the parameter matrix is dropped. The coefficients of the eliminated equations are identifiable from the restrictions. The estimation equation is a stochastic form of Equation 5 for a panel data set. From the share equations, we will compute the elasticities of choice. To do this we use a method due to Weaver (1983), where the subscript ij represents cross elasticities and ii represents own elasticities:

$$\hat{\eta}_{ij} = \left(\frac{\hat{b}_{ij}}{\hat{s}_i} \right) + \hat{s}_j \quad (7)$$

$$\hat{\eta}_{ii} = \left(\frac{\hat{b}_{ii}}{\hat{s}_i} \right) + \hat{s}_i - 1 \quad (8)$$

Data

We use data from several national post-harvest surveys (1996/97–1999/00) carried out by the Central Statistics Office. Conducted every year after the harvest season,⁶ the surveys interview over 7,000 households each year. The sampled households over the study period have remained unchanged.

The data show that Southern Province moved from being the country's largest producer of maize to being second to Eastern Province (CSO, 2000). The shift in the rain belt has led to most maize farmers shifting from Southern to Central Province, increasing Central Province's share in total national output. The post-harvest survey of 2000 shows that Southern and Eastern provinces account for 62% of total maize production (29.6% for the former and 32.4% for the latter), while Northern Province alone accounts for 21% of sorghum production and 57% of millet production.

4. Estimation

The results of the study are outlined and discussed in this section. The system estimated includes six crops – maize, sorghum, millet, groundnuts, sweet potatoes and cassava – with fertilizer and labour as the variable inputs. The wage rate is calculated as the average rate paid per acre of land for weeding, planting and land preparation. Precipitation (measured as average annual rainfall), distance to the main market and an information index are the fixed inputs. The information index is a simple average of visits by an extension officer, access to crop marketing information and membership in a farmers club or association. A stochastic form of Equation 5 was used to obtain estimates of profit shares. A number of households did not produce all the crops in the system.

We estimated a Heckman selection model for each equation in which the mean function in the second stage is dependent on the selection process in the second stage (Heckman, 1979). In the selection model, a probit regression is estimated with a binary choice model as shown in Equation 9:

$$D = H\Theta + u \tag{9}$$

where D is an unobserved latent variable determining the farmer's choice whether to grow any of these crops and/or use fertilizer. H is a set of characteristics of the households hypothesized to affect their choice of crop to grow and u is the error term. D equals one when the CSA in question grows the crop, and zero otherwise. The resulting Θ vector is used to compute the inverse Mills ratio, which is then used in the regressions. A likelihood ratio test is performed to check if bias is significant.⁷ We found that for all crops, the bias was not significant and therefore did not make any correction.

The equations are estimated using Zellner's seemingly unrelated regression (SUR) with symmetry constraints imposed. The wage rate is used for normalization and its equation is dropped in the estimation due to linear dependency. The parameters are recovered using the restrictions shown in Equation 6. The results are given in Table 1 where standard errors are in parentheses. We show the χ^2 values for the test that $\rho = 0$ at the bottom of the table.

Five of the six own-price supply elasticities are significant. Of these, two are positive (maize and groundnuts) and the other three negative (millet, sorghum and cassava). The

Table 1: Estimated supply and demand system

	Output supply						Input demand			Fixed inputs		
	Constant	Maize	Millet	Sorghum	Ground-nuts	Potatoes	Cassava	Fertilizer	Labour	Info	Rain	Distance
Maize	3.98 (2.86)	0.461 (0.024)	0.011 (0.011)	-0.013 (0.006)	0.022 (0.04)	-0.039 (0.012)	0.034 (0.033)	-0.228 (0.12)	-0.248 (0.121)	0.471 (0.531)	-0.298 (0.412)	-0.47 (0.204)
Millet	-0.048 (0.097)		0.03 (0.006)	0.001 (0.003)	-0.26 (0.007)	-0.003 (0.005)	-0.001 (0.007)	-0.004 (0.008)	-0.008 (0.005)	-0.066 (0.018)	0.025 (0.014)	0.011 (0.001)
Sorghum	3.5 (0.053)			0.025 (0.003)	-0.002 (0.004)	-0.008 (0.003)	-0.0004 (0.004)	-0.001 (0.005)	-0.002 (0.003)	-0.02 (0.01)	-0.014 (0.008)	-0.012 (0.004)
Groundnuts	-0.3 (0.56)			0.06 (0.02)	0.002 (0.007)		0.021 (0.011)	-0.026 (0.025)	-0.05 (0.024)	0.04 (0.102)	0.08 (0.079)	-0.073 (0.04)
Potatoes	-0.207 (0.11)				0.006 (0.008)		-0.005 (0.007)	0.044 (0.01)	0.003 (0.006)	0.018 (0.021)	0.036 (0.016)	-0.011 (0.008)
Cassava	-2.028 (0.35)						0.23 (0.024)	-0.073 (0.022)	0.001 (0.018)	-0.177 (0.066)	0.317 (0.051)	0.072 (0.025)
Fertilizer	-0.372 (1.672)							0.102 (0.074)	0.185 (0.071)	-0.213 (0.311)	-0.076 (0.241)	0.269 (0.12)
Labour	-0.37 (1.32)								0.12 (0.577)	-0.054 (0.328)	-0.047 (0.255)	0.217 (0.126)
i=0		0.22 (0.64)	0.0 (0.998)	0.11 (0.74)	0.01 (0.93)	0.0 (0.98)	0.06 (0.81)	0.24 (0.627)				

Table 2: Own and cross price elasticities

	Prices									
	Maize	Sorghum	Millet	Groundnut	Potatoes	Cassava	Fertilizer	Labour		
Maize	0.37**	0.02**	0.07	0.1	0.01***	0.23	-0.22*	-0.27**		
Millet	0.8	0.07	-0.36***	0.46***	0.02	0.15	-0.08	-0.007		
Sorghum	0.24**	-0.32***	0.09	0.01	-0.13**	0.16	0.15	0.1		
Groundnuts	0.95	0.005	-0.4**	0.09***	0.1	0.52*	-0.28	-0.7**		
Potatoes	0.06***	-0.07**	0.01	0.08	-0.84	0.09	0.76***	0.2		
Cassava	0.79	0.04	0.04	0.18*	0.04	-0.69	-0.26***	0.15		
Fertiliser	-0.8*	0.03	0.03	-0.10	0.34***	-0.27***	-0.21	1.28***		
Labour	-0.58**	0.04	0.003	0.05**	0.19	0.31	0.61***	-0.01		

* significant at 10%; ** Significant at 5%; *** significant at 1%.

negative elasticities for millet, sorghum and cassava can be explained by the relationship between output prices and seed prices plus the increase in organizations promoting these crops as drought resistant alternatives. This point is discussed in more detail in the following section.

The own and cross price elasticities are calculated from the estimated parameters at mean values; these are shown in Table 2.

Out of the ten significant cross price elasticities, six are positive, reflecting complementary relationships. The magnitudes for most of these are similar to those found in studies on other African countries.⁸ The lack of competition in the crops reflects the way in which these crops are used. In most districts, sorghum, millet and cassava are grown both for beer brewing and for home consumption. For both uses, maize is combined with one or more of the other three crops. However, maize is more commercialized than the other three crops. In areas where sorghum and millet are consumed as the staple food, maize is not traditionally grown and its importance in these areas began with the introduction of maize subsidies in the late 1960s, making it mainly a commercial rather than a subsistence crop.⁹ It is interesting to note that some of the cross price elasticities with respect to maize are almost as high as own-price elasticities and that for others, the price of maize is more important than the crop's own price. Again this is indicative of the commercial nature of maize production even amongst small-scale farmers. The complementary relationships imply that as maize prices rise, there is a tendency for new inputs to be drawn into the general production process. Subject to the net effect, there seems to be a potential for improving food supply through improved maize prices.

The own-price input demand elasticities are -0.21 for fertilizer and -0.01 for labour; neither is significant. The cross input demand elasticities show that the two inputs are gross substitutes. It often happens that when farmers cannot afford to buy fertilizer, they attempt to increase output by increasing acreage hence increasing their demand for labour. The supply elasticities with respect to input prices are generally negative while the input elasticities with respect to output prices are generally positive. The fertilizer elasticity with respect to the price of maize is surprisingly negative. Since maize is a commercial crop, it was expected that an increase in the price of maize would increase fertilizer use. It is worth noting, however, that this elasticity is significant only at the 10% level.

Perverse supply response

Although perverse supply response is rarely observed in empirical studies, under certain circumstances, it not only obtains but is in line with rational economic behaviour. Since the seminal study by Shultz (1964) in which he presented his view of a rational but poor peasant, it has been understood that peasants are price conscious and price responsive within the technological constraints they face. This was shown by shifts in production between various crops as their relative prices changed. With this is implied a positive supply response even amongst peasant farmers. However, several empirical studies (for example see Fulginiti and Perrin, 1990, for linseed; Abrar, 2002, for barley; Danielson, 2002, for cashew, coffee and cotton) have found perverse supply response even amongst commercial farmers (Ozanne, 1999). Askari and Cummings

(1976), Rao (1989), and Ozanne (1999) provide a detailed survey of the empirical literature.¹⁰

The idea of an upward sloping supply curve is based, amongst other things, on the idea that commodities can be divided into distinct inputs and outputs. In a peasant agriculture household, this distinction is not clear. Production and consumption decisions are intricately tied. When growing crops, seed is often a produced input retained from surplus output. In the case of Zambian peasants, it is not only a produced input but a residual input. If a family produces enough to eat, then they will save some for planting. If not, they will consume everything and buy from surplus neighbours during the planting season. The sign of the supply response therefore depends on the relative magnitude of the substitution and income effects. There are two possible reasons why we observe a negative supply response for sorghum and millet here. The first is that because the cost of seed and price of output are tied, increases in the output price will inevitably increase the cost of producing the crop. Depending on the demand elasticity of the seed input, price increases may reduce the output of the crop. Second, a negative response may be observed if supply is increasing against falling prices. We explore each of these possibilities in turn.

Over 80% of the seed used by the households in the sample is retained seed – either grown by the household or purchased from surplus households (CSO, 2000). The price of cereals increases over the post-harvest season as supply dwindles especially between November and May. By the time planting begins, cereal prices are almost 50% higher than at the beginning of the harvest season.¹¹ The implication is that households that must buy seed will spend more per kilogram of grain than what they received when they sold their crop.¹² The increased cost of production would then lead to a fall in marketed surplus as households increase their subsistence retention. Output may also fall as production shifts to “less expensive” crops.

A negative supply response can also result when output is increasing despite the falling prices. We use real 1994 prices in the study and the data show that apart from the period between 1997 and 1998, average real prices of the two crops moved downward. On the other hand, both output and acreage increased over the same period (CSO, 2000). This could in part be explained by the presence of many organizations that encourage the growth of these crops and the non-monetary incentives attached. Examples of such initiatives are the Sorghum and Millet Improvement Programme (SMIP) under the Southern African Development Community (SADC) and the International Crop Research Institute for Semi-Arid Tropics (ICRISAT), the Root and Tuber Improvement Programme (RTIP), and the Potato and Sweet Potato Improvement Programme (PSIP).

In response, a number of non-government organization (NGOs) put in place programmes for small-scale farmers to increase the production of these crops. Since the late 1990s most such programmes have taken the form of outgrower schemes where the farmers receive seed and other inputs such as lime. They are then required to pay back a certain amount of their output with little or no interest, an approach that has proved to be very popular amongst farmers who have no collateral for formal credit. In some areas, such programmes are available for maize as well but these are very few. This tends to push the farmers off their preferred supply curves, however, as subsistence is of primary importance in these households.

The data show that there is most likely an interplay of the two scenarios set above when other crops are included. Maize and groundnuts are the preferred commercial crops amongst small-scale farmers in Zambia, which in many cases are inter-cropped with sorghum and millet. Higher prices for these crops would mean that deficit households will not be able to afford seed and would therefore shift into the production of sorghum and millet as a subsistence strategy despite falling prices.¹³

Impact of reforms

Agricultural reforms implemented in Zambia over the past decade have led to significant changes in factors affecting grain production. Most of these have been price policies that have raised both input and output prices. Other significant changes include the liberalization of the grain market, which in turn has implications for the prices farmers get for their produce. The provision of services by the government to small-scale farmers also has a significant effect on agricultural output. In this section we use results from the estimated food supply system to discuss the possible policy effects of liberalizing the exchange rate and removing consumer subsidies.

For the purpose of the simulations, a policy change is described as a percentage price change resulting from the implemented policy. In the discussion, we focus on the possible effects of the removal of exchange rate controls and price subsidies. Food production in Zambia is dependent on the exchange rate in several ways. One is through the impact of input prices, of which the bulk is fertilizer. The other is through the price of imported food crops that compete with domestically produced crops. An over-valued exchange rate reduces the amount paid to domestic producers in local currency. It also makes exports uncompetitive on both the world and the domestic markets, leading consumers to substitute for imported food crops. To the extent that devaluing or floating the exchange rate will lead to the elimination of this implicit tax on agriculture, output of food crops should therefore increase. The dependence of Zambian food production, especially maize, on imported inputs implies that potentially there is a possibility that the increases in input prices could offset the benefits of improved producer prices. Jansen (1990) estimates that the domestic price of maize was only 76% of the border price at the official exchange rate and 52% at the equilibrium exchange rate. Using these figures, we will assume that the effect of the over-valued exchange rate is 24%, a figure quite close to the estimate reached by Fulginiti and Perrin (1990) of the price wedge due to export taxes in Argentina.

Input subsidies were also widely used in agriculture in Zambia. It has been argued that food subsidies in Africa did not benefit poor farmers, but rather provided cheap food for urban residents (Sahn, 2004). Input subsidies were often in form of input credit or cheap fertilizer. The removal of such subsidies therefore was commensurate with a credit squeeze and an increase in production costs, the implication being a negative impact on small-scale food production. Mwanaumo (1999) suggests that maize subsidies in Zambia had reached 16% of the price of maize by the late 1980s, while Deininger and Olinto (1999) placed the estimate at 70%. We use the more conservative figure from Mwanaumo (1999) as our price wedge due to maize price subsidies. The removal of price subsidies on sorghum and millet was begun in the early 1980s and so we assume

a zero price wedge due to subsidies on these crops. We have not accessed clear estimates of the fertilizer subsidies and we assume the same percentage as that of maize. Cassava, sweet potatoes and groundnuts have not been under any subsidies. They are generally traded locally and use almost no imported inputs. The main price effect would therefore come through cross price effects.

Estimated price effects

To run the simulations, we use a linear model similar to that of Fulginiti and Perrin (1990) shown in Equation 10. These results must be seen in the light of the limitations of the methodology.

$$\delta q = \Phi \delta \ln p \quad (10)$$

where δq is the vector of quantities, Φ is the matrix of elasticities and $\delta \ln p$ is the vector of price changes as surmised above.

Table 3: Simulated policy effects

	% rate	% subsidy	% effect of rate	% effect of subsidy	% total effect
Maize	24	16	5.8	2.4	8.2
Sorghum	24	0	3.8	6.2	10.1
Millet	24	0	14.2	14.1	28.3
Groundnuts	0	0	4.2	9.1	13.3
Potatoes	0	0	18.3	13.1	31.4
Cassava	0	0	14.9	8.5	23.4
Fertilizer	24	16	-22.8	-16.2	-39.0

From the simulations, freeing the exchange rate alone would lead to a meagre 5.8% rise in maize output. This reflects the effect of increases in prices of all the three crops and fertilizer prices. Subsidy removal increases output by 2.4% only, giving a net increase of 8.2%. Others have noted this sluggish response of maize production to price reforms. See CSO (2000) and Mwanaumo (1999), for example.

The effect on sorghum and millet is higher than that on maize, with a net effect of 10% and 28.2%, respectively. Output for groundnuts, sweet potatoes and cassava would increase by 13.3%, 31.4% and 23.4%, respectively, due to the increase in maize and fertilizer prices. These crops are generally grown without the use of chemical fertilizers and an increase in the price of fertilizer prices would tend to shift production towards these crops. Fertilizer demand falls by 39%, mainly because of the removal of subsidies and exchange rate controls. A significant fall has been observed in fertilizer use since the reforms (Mwanaumo, 1999; Deininger and Olinto, 1999), a phenomenon not uncommon in other African countries (Robbins and Ferris, 2003).

It is also important to note that the linear model used for the simulations tends to overestimate the effect of price changes. Although we cannot take the quantitative values as they are, we can definitely say that without other constraints in production, price

changes resulting from the removal of exchange rate controls and subsidies have led to increases in food production with the caveat that this positive outlook is mainly due to the more traditional non-commercial food crops like millet, cassava and sweet potatoes.

Non-price factors

The results show a sluggish response in maize output. This crop is still the major food staple in the country and the most commercialized of the food crops. This means that it is more dependent on structural variables such as information, distance to market and credit than the other crops. It is also the most rain-fed food crop in the country. These factors may explain why significant increases in maize output have not been realized. Our estimations show that maize has a negative response to the distance to the market. This variable is also significant for most of the other crops, underscoring the need for improved and efficient markets. Several studies have stressed the need for complementary policies and investments (Sahn et al., 1997; Robbins and Ferris, 1999; Hammond, 1999).

Output for crops like cassava whose markets are mainly local increases the longer the distance to the market. Markets for most of these crops are basic, on the spot and with almost nonexistent market-based risk management. Deliberate efforts to develop better markets for these crops need to be put in place to persuade farmers to grow them commercially. Providing consumers with information about these crops as alternatives to maize would also assist in developing a sustainable market for them.

The rainfall variable is not significant for maize. This may be explained by the persistent drought over all the four years included in the sample. Irrigation projects can be introduced that encourage water capture for use during drought periods. The information variable is significant in the sorghum, millet and cassava equations. These crops are drought resistant and can be used as substitutes for maize. However, they are traditionally grown for complementary use with maize. Studies have shown that one of the major constraints in using sorghum and millet as maize substitutes is that they take considerable effort to de-hull and process into the meal used to prepare the national staple, *nshima*. Modern techniques have been developed that make de-hulling easier. Nevertheless, many small-scale farmers continue to use traditional de-hulling methods because of lack of either knowledge or resources. Information provision for both producers and consumers would help commercialize these crops and increase the gains from their production. In addition, such improved de-hulling methods would improve both the quality and market value of the crops if they are sold on the market as ready-to-use meal.

5. Conclusion and policy implications

In the study, we look at the impact on food production of policy reform measures implemented under structural adjustment programmes in Zambia. A system of six crops and two variable inputs is estimated. Elasticities are calculated and used to conduct simulations to look at the impact of the reforms. The results indicate that food production in general is responsive to prices although the magnitudes are not very large. We find a negative supply response for sorghum and millet and we posit two possible reasons. The first is that increased prices increase the cost of production since the seed prices are a function of the output price. Second, credit constraints may lead farmers into growing crops that have non-monetary credit available, which allows them to make repayments in a form that is easy for them. This moves the farmers from their preferred supply curve and could result in inefficiency. Coupled with information provision, credit could also enhance the use of high yielding varieties, and the correct use of inputs such as fertilizers. There is need to improve credit provision for small-scale farmers. The obvious problem is how to design credible, farmer-friendly forms of repayment.

We also find that almost all the crops in the system are more responsive to the price of maize than to their own prices. The maize response is more sluggish, however, and we surmise that this is due to structural factors such as bad roads, undeveloped markets and poor rainfall. Although the maize markets are limited, their existence allows this crop to be grown commercially even by small-scale farmers. Development of markets for other crops is needed. Deliberate initiatives such as the Sorghum and Millet Improvement Programme (SMIP) could be put in place to promote the consumption of these crops as alternatives to maize and thereby create a market for them.

The fixed factors discussed above have remained relatively unchanged since the reforms and in some cases have deteriorated. Given the central role that maize seems to play in increasing total food production, it is very important for the government to remove the constraints surrounding the production of maize. Rainfall continues to be a problem for the production of maize and irrigation projects that enhance water capturing should be encouraged. We conclude that although the price incentives provided by reforms have contributed to some increase in food production in the country, greater increases have been hampered by lack of improvement in structural variables.

The results obtained in the study are important to the development of small-scale agriculture in Zambia, but they must be presented with a few caveats. First, reforms in the agricultural sector are still going on and there has been a lot of going forth and back in policy. Although fertilizer subsidies were officially removed by 1994, there have been intermittent reintroductions and withdrawals over the last ten years. It is also important to mention that the method used for the simulations is linear and may lead to

overestimations. The results must therefore be interpreted with the caution that it is the whole picture that is more important rather than the actual magnitudes estimated. A lot more work needs to be done to identify factors that can improve not only food production but small-scale agriculture as a whole. Credit design, development of input markets and the role of institutions in enhancing small-scale agriculture are just a few of the areas needing further research.

Notes

1. The World Bank and the majority of the donor community also perceived this as a short-run problem and therefore made no attempt to push the country to change its development strategy (West, 1989; Bonnicksen, 1997).
2. Maize is the staple food in Zambia and had thus far been heavily subsidized by the government. When price controls were removed on other food crops such as cassava and sorghum, maize subsidies were maintained with the view to remove them gradually.
3. The Copperbelt is one of the largest and most urbanized provinces in Zambia. It holds almost all of Zambia's copper mines.
4. Zambia had a three-year ESAF programme starting in 1999 and completed in 2001. The ESAF programme was renamed the Poverty Reduction Growth Facility in November 1999. These are more based on country-owned poverty reduction strategies drawn by each country with IMF assistance, and the participation of local civil society and development partners.
5. There was an attempt at a credit import facility in 1996, a market credit revolving fund and the agricultural credit management programme, none of which have yielded any substantial results.
6. The data for analysis are aggregated over farmers in the same Census Supervisory Area (CSA). These are sub-areas of a district consisting of several households living close to each other.
7. ρ shows the correlation between the selection equation and the equation of interest. When ρ differs significantly from zero, the bias is large and the selection model should be used.
8. See Govinda and Babu (2001) and Abrar (2002), for example.
9. Apart from maize, which is generally consumed everywhere in the country, millet, sorghum and cassava are considered to be traditional foods in some parts of the country. In these areas, these crops are used alongside maize to make *nshima*, the main staple in the country. For example, in the 1999/2000 season, Eastern (32%), Southern (29%) and Central (14%) provinces accounted for 75% of all maize production, and Northern (20.6), Southern (19) and Western (14) provinces for 63.6% of all sorghum produced. Northern (57%), Western (18%) and Central (9%) accounted for 84% of all millet produced and Luapula, Northern and Western provinces accounted for over 75% of all the cassava grown.

10. Ozanne argues that empirical evidence does not support this view, often because such evidence tends to confirm the preconceptions of the researchers and thus empirical results that do not have the “correct” sign tend to be rejected and therefore go unreported in academic publications. In the studies cited here, the negative elasticities are either just highlighted or overlooked with no discussion.
11. See WFP (2005).
12. Households will sell some of their output even when they are not surplus households to get money for other goods such as education, health, soap and transport.
13. See Robbins and Ferris (2003) for more discussion of the impact of liberalization and non price factors on African agriculture.

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