FOOD SECURITY RESEARCH PROJECT

IS THE GLASS HALF-EMPTY OR HALF FULL?

AN ANALYSIS OF AGRICULTURAL PRODUCTION TRENDS IN ZAMBIA

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IS THE GLASS HALF-EMPTY OR HALF-FULL? AN ANALYSIS OF AGRICULTURAL PRODUCTION TRENDS IN ZAMBIA

1. INTRODUCTION

The year 1991 heralded a new political-economic dispensation in Zambia. Pluralistic politics were reintroduced and the MMD[1] government, with local and international goodwill, pursued the economic reform process towards liberalization initiated by the previous regime at an aggressive pace. The effect of these reforms on the agricultural sector relative to the pre-liberalization era has been a subject of much debate in Zambia. The conventional tone in the local Zambian press and the general public opinion is that the sector is in decline. However, this notion is rarely backed by scientific data, and is often simply asserted based on anecdotal or partial evidence. For example, declining maize production over the past decade has sometimes been extrapolated to conclude that the entire agricultural sector is in decline.

Another school of thought, also often presented on the basic of anecdotes, asserts that the sector is actually experiencing a boom and that the decline in maize production has been fully compensated for and surpassed by the increased production of other food and cash crops. It is therefore important that an attempt be made, using available scientific data, to shed some light on the issue.

One objective of this paper is to examine the trends and changes in crop production before and after the implementation of the partial market liberalization policies starting in the early 1990s. Another objective of the paper is to assess agricultural production performance and its implications for household food security. These issues are examined on the basis of the Crop Forecast Survey (CFS) data, Post Harvest Survey (PHS) data, Central Statistical Office (CSO) price data, data from the Agricultural Market Information Centre (AMIC) at the Ministry of Agriculture, Food and Fisheries (MAFF), and other data. We confine our analysis to selected crops covered under these surveys and as such the inferences should be not be associated with other sub-sectors of agriculture, namely: livestock and fisheries, even though the performance of these sub-sectors, especially the former, is related to the crop sector's performance.

Section 2 of the paper describes the data used in the analysis and the rationale for using these data. Section 3 of the paper discusses the production trends based on the value of crop production for commercial and small-scale agriculture. This section uses values from the Post Harvest Survey (PHS) and the Crop Forecast Survey (CFS). Another aim of Section 3 is to briefly analyze the relationship between of the two surveys' production estimates. Section 4 discusses smallholder crop production trends expressed as human energy, and the relative importance of the various crop types. Section 5 uses the 1997/98 PHS household data to shed some light on the land allocation to agricultural production among the small and medium scale farmers in Zambia. The section also uses household data to elucidate what the different landholding types contribute to the value of crop output. Section 6 concludes with the policy and research implications of the findings.

[1] MMD stands for Movement for Multi-party Democracy

2. DESCRIPTION OF AGRICULTURAL AND FOOD SECURITY DATABASES IN ZAMBIA

Apart from the 1990 agricultural census, agricultural statistics in Zambia are derived from the PHS and CFS. Both surveys are carried out by CSO, with MAFF providing the funding during recent years. Although there is scope to improve the reliability and accuracy of these survey data, the two surveys are the only comprehensive and statistically valid exercises aimed at producing annual agricultural statistics. Table 1 shows the agricultural time series available in Zambia.

CFS and PHS use the same sample frame and sample size (in excess of 6,000 households) but are based on different methods of generating production estimates. The CFS has typically been conducted before harvest, and is based on respondents' ability to predict or forecast what their crop production is likely to be, based on crop conditions up to the point of the CFS interview. By contrast, the PHS is conducted after the harvest and is based on the respondent's ability to "recall" what crop production and area were. Ideally, PHS data are considered to be more reliable than CFS data because they are based on realized production "after the event" and should form the basis for any concrete research and policy inferences. Yet, the PHS time series is not readily available before the 1992/93 crop season, and excludes the large scale farming sector[2]. PHS data are published in collated hard copy form only for 1992/1993 and1996/1997. For all the other years, the data (1994/1995, 1995/1996, 1997/98) are published only as electronic summary tables obtainable from CSO by request. Provincial-level crop production estimates from CFS and PHS are attached in Appendix 1 and 2 respectively.

For the discussion of the long term production trends, CFS data are used because they are available for a longer time frame (from 1980). As opposed to the PHS, the CFS includes the large scale (commercial) farming sector[3]. To assist in the interpretation of the PHS and CFS production data, indicative numbers of large-scale farmers in each province (as per the 1990/92 Agricultural Census) are indicated in Appendix 1.

In general, PHS and CFS data are reasonably correlated[4] as shown by Figure 1 (scatter plot, representing value of production) with a linear regression line representing conditional means. The PHS and CFS data also clearly move in the same direction from one year to the next as shown in Figure 2. However, as is shown in both figures, we can see that CFS estimates are normally higher than PHS estimates, the most probable reason being that PHS data excludes the large scale commercial sector. The differences also can be partly attributed to the fact that the two surveys do not always cover the same crops.

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[2] The large scale farming sector has started to be included in the PHS as from 1997/98 onwards. However, due to response problems, the data are not used and have not been included in this report.

[3] According to CSO and MAFF, households cultivating 5 hectares and below are categorized as small scale; households between 5 - 20 hectares are labeled medium scale (emergent); and those above 20 hectares are categorized as large scale (commercial).

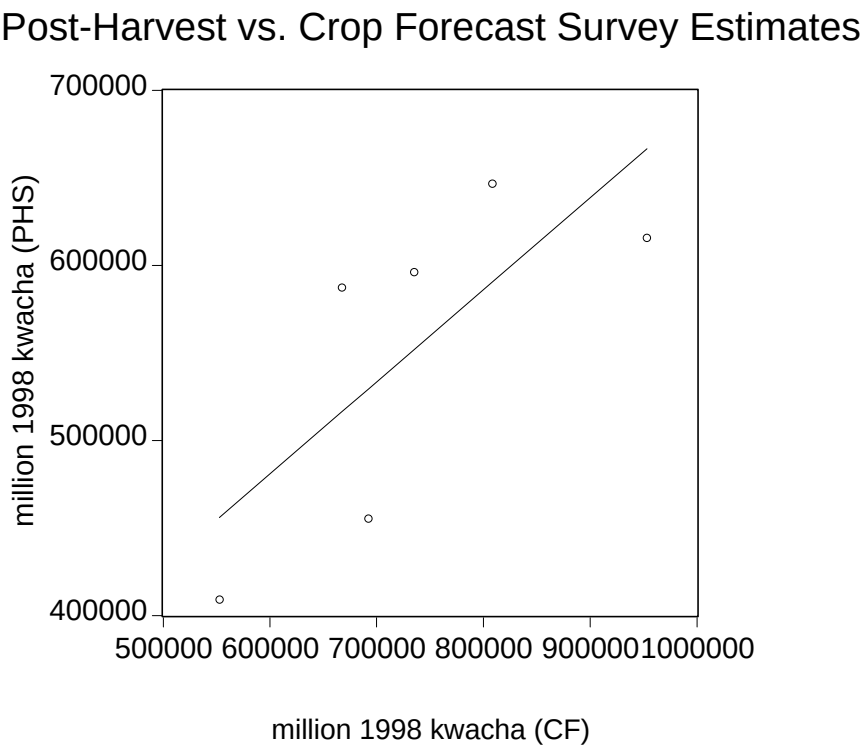
[4] The correlation coefficient over the 1992/93 - 1998/99 period is 0.84.

Table 1. Agricultural Time Series Data Available in Zambia

	Crop Forecast Survey (CFS)	**Post Harvest Survey (PHS)**	**Living Conditions Monitoring Survey (LCMS)**	**Food Health & Nutrition Information System (FHANIS)**
Time Frame	1970/71 to 1998/99. MAFF & CSO started conducting a joint CFS in 1989/90. Previously there were two "crop forecasts". One from CSO and another from MAFF	1992/93-1998/99. Data from previous years were collected but are not available to the public. PHS surveys have been conducted by CSO since 1971/72 with the exception of the 1977/78 to 1982/83. BUCEN surveys began in 1985/86	1996 & 1998 (preliminary report only)	Monitoring of Household Food Security, Health and Nutrition in Urban Areas Reports
Crops Covered & other Agricultural activities	Maize, rice, sorghum, millet, wheat, sunflower, groundnuts, soyabeans, seed cotton, Irish potatoes, Virginia tobacco, Burley tobacco, mixed beans, ground beans, cowpeas, cassava, paprika[5], castor beans	Maize, rice, sorghum, millet, sunflower, wheat, groundnuts, soyabeans, seed cotton, Irish potatoes, Virginia tobacco, Burley tobacco, mixed beans, ground beans, cowpeas, sweet potatoes, cassava, castor beans Livestock & poultry	Cassava, millet, maize, sorghum. Livestock and poultry	None
Sectors Covered	Large scale, medium scale & small scale	Medium scale and small scale from 1992/93 to 1998/99	Rural and urban household level-subdivisions of small, medium & large scale although considered only for rural households is not used in the reporting	Urban households
Types of Information	Crop production, sales, retention	Crop production, sales, retention, purchase & sales of input, labor input by crop	Food production, demographic characteristics, migration, education, health, income generating activities	employment, expenditures, food prices, house ownership and mobility, savings, food consumption, water & sanitation, health, nutrition,
Sampling Design	Approximately 8,000 households stratified into small, medium & large scale	Approximately 8,000 households stratified into small and medium scale	16,710 households (8487 rural & 8223 urban)	

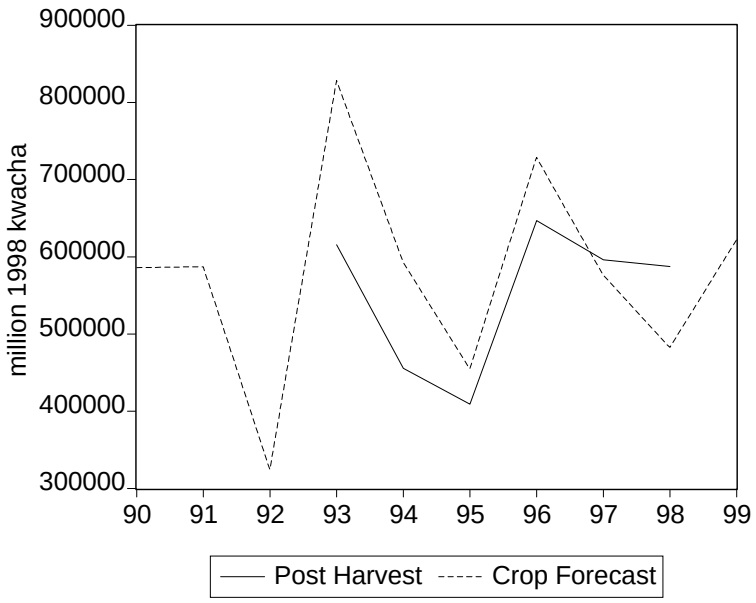
[5] Collected from 1997/98 onward

Figure 1. **Post Harvest Data Versus Crop Forecast Data**



Source: MAFF, CSO

Figure 2. Comparison of Crop Forecast and Post Harvest Crop Production Estimates



Source: MAFF, CSO

3. PRODUCTION TRENDS USING VALUE OF CROP PRODUCTION

This section assesses the performance of the agricultural sector in real gross value terms. Crop production estimates from the Crop Forecast Survey (CFS) and the Post Harvest Survey (PHS) were converted into value terms based on mean Consumer Price Index-adjusted wholesale prices over the1994/95 - 1998/99 marketing seasons (1998/99=100).

For the CFS-derived trends, annual national crop production value, in million1998 kwacha, was computed for 13 crops. The crops covered were maize, soyabean, sunflower, groundnuts, sorghum, millet, cassava, mixed beans, cotton seed, paprika, burley tobacco, virginia tobacco, and sweet potatoes. Price data were obtained from CSO, and AMIC (MAFF) for all crops except paprika, tobacco and seed cotton, which were obtained from respective crop buying firms, and the Tobacco Association of Zambia (TAZ).

For PHS-derived trends, crop production estimates from the PHS were multiplied by the same average real prices over the 1994/95-1998/99 period as described above. The national trend consists of values of production for 12 crops: maize, sweet potatoes, soyabeans, sunflower, groundnuts, sorghum, cassava, seed cotton, mixed beans, millet, burley tobacco, and virginia tobacco. The PHS provincial trends exclude burley and virginia tobacco as the production data provided by TAZ were only available at national level.

Appendix 1 and 2 provide a summary of CFS and PHS provincial production data. Appendix 3 contain the real 1994/95 - 1998/99 prices that were used to compute production values as well as CPI values. A comprehensive price data set has not been included in this report, but will be available in a forthcoming publication on agricultural price trends from AMIC/MAFF and FSRP.

3.1. National Trends

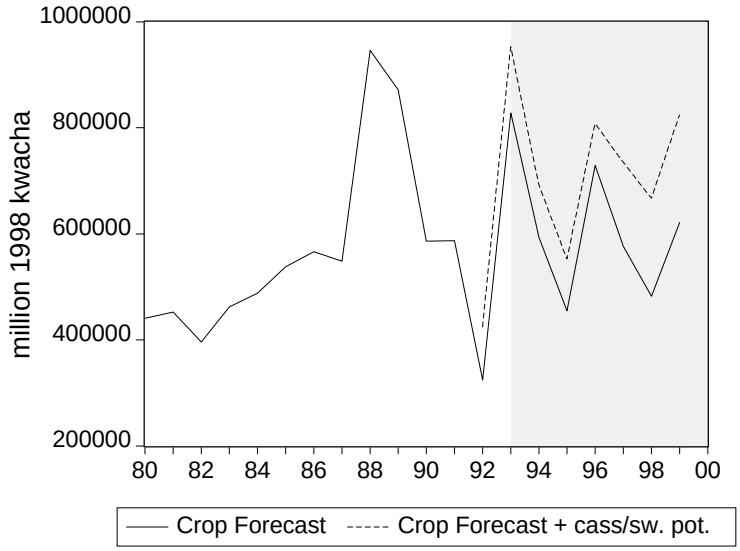
3.1.1. General

Figure 3 shows the value of agriculture production of 13 food and cash crops from 1980 to 1999. The solid line represents value of production using CFS production data and the broken line is derived from CFS plus PHS production data for cassava and sweet potato (which are excluded from the CFS survey).

The data suggest that the mean value of crop production has remained fairly constant (in that there is no significant long-term upward trend) but there are substantial fluctuations from one year to the next. If one adds sweet potatoes and cassava production to the picture the trend tilts slightly upwards after 1991 (broken line).

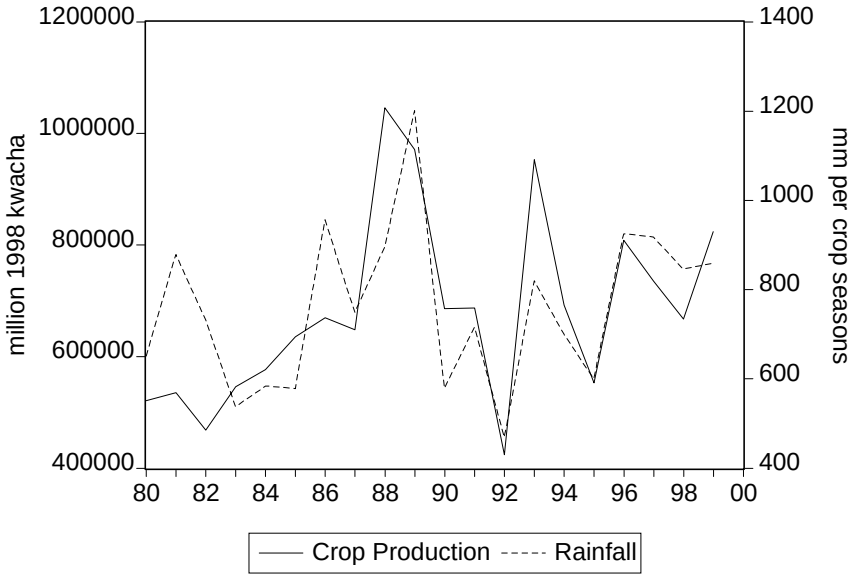
If we use PHS-derived trends (shown in figure 4), the data suggest that the national value of small-holder crop production is stable or gradually increasing. However, there is variation in the actual value of production which decreased in 1994 and 1995. The value then increased in 1995/96 and remained somewhat constant after that. The effect of virginia and burley tobacco on the total value of production is more pronounced after 1995/96 which could mean that there is a resurgence in the production of tobacco. If a linear trend line is fitted in this rather small data set, it shows an annual increase of 2.15%. Due to the shortness of the time series used to determine the trend, one may only conclude that, during the 6 seasons covered by the PHS production data, the value of crop production shows no clearly discernable rise or fall during the mid to late 1990s.

Figure 3. Value of Zambia Crop Production, CFS



Source: CFS, PHS, CSO, AMIC

Figure 4. Crop Production and Rainfall



Source: CFS, PHS, CSO, AMIC

3.1.2. Per Capita Value of Production

The national population growth rate in Zambia was estimated to be at 3.7% in the 1990 Census (CSO 1990). With the advent of the HIV/AIDS pandemic it has become apparent that the

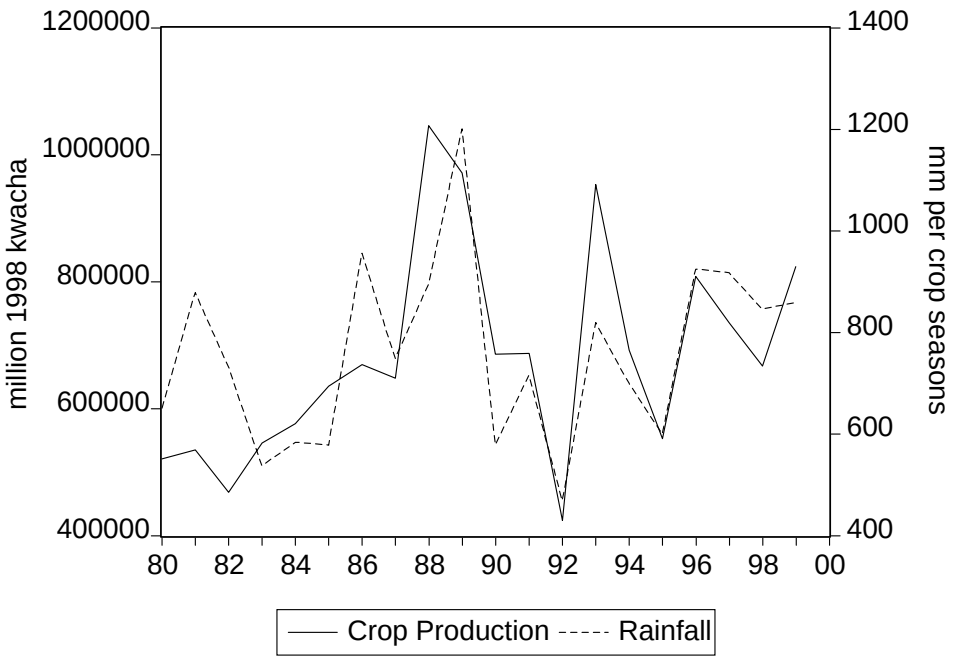
population growth rate has declined. A review of existing population growth estimates readjusted the growth rate figure to 3%, using findings of various health surveys conducted in the 1990s (Appendix 4).

At a population growth rate of 3% the per capita, the value of agricultural production per capita in Zambia appears stable or may be declining slightly. However, comparing production trends with population growth rates does not provide any indication regarding trends in agricultural labor productivity because we have no information on how labor has shifted between crop production and other activities such as non-farm and livestock over time. A question for further analysis is to examine to what extent the rural labor force is moving from the agricultural sector to other sectors that present economic opportunities.

3.1.3. Value of Crop Production and Rainfall

The value of agriculture production in the post 1991 era was prone to fluctuations largely due to extreme weather conditions (rainfall). There was a country-wide drought in 1992, a partial drought in 1995, and the El Nino phenomenon in 1998. This is shown in Figure 5 which shows the relationship between average rainfall for a number of meteorological stations throughout the country (broken line) and production (solid line). (Rainfall data are provided in Appendix 5.) The graph shows that, policy environment notwithstanding, rainfall is a crucial factor in crop performance especially since the country's agricultural production system's water requirements are largely rain-fed.

Figure 5. Crop Production and Rainfall



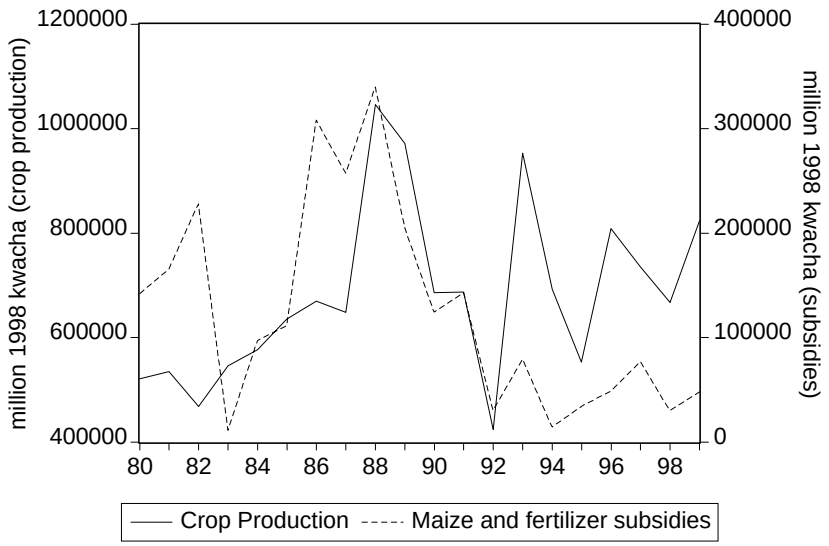
Source: CFS data (CSO/MAFF), AMIC for price data (MAFF), Meteorological Department for rainfall data.

3.1.4. Value of Crop Production and Maize and Fertilizer Subsidies

The value of agricultural production in constant 1998 kwacha terms has remained stable despite substantial reductions in government subsidies to the maize sub-sector since the 1980s. Figure 6 shows the value of production (solid line) and government subsidies to maize and fertilizer (broken line). Maize and fertilizer subsidies reached their peak in the late 1980s and have declined substantially since 1992. The value of crop production has remained basically constant despite the major subsidy reductions.

The data on government subsidies also allow us to examine the association between subsidies and the value of agricultural production. Using the OLS regression technique, we regressed the value of crop production on a time trend, a spline time trend after 1993 when major crop market reforms were initiated, annual mean rainfall from provincial rainfall stations, and the inflation-adjusted value of government fertilizer and maize subsidies. Based on this simple regression, presented in Appendix 6, the data indicate that, on average, an additional kwacha in subsidies to farmers generated an additional 0.48 kwacha in agricultural output.[6]

Figure 6. Crop Production Value and Government Subsidies to Maize and Fertilizer



Source: CSO, MAFF, AMIC, TAZ

3.1.5. Land Use Patterns and Production

There has been an apparent shift in crop production at the national level from maize to other crops. According to the Crop Forecast Survey data, maize area has decreased by 165,007 hectares from 1990 to 1999, a 22% decline. Soyabeans and sunflower areas have decreased by 18,100 (a 60% decline) and 30,933 hectares (a 70% decline) respectively. These crops have been partially

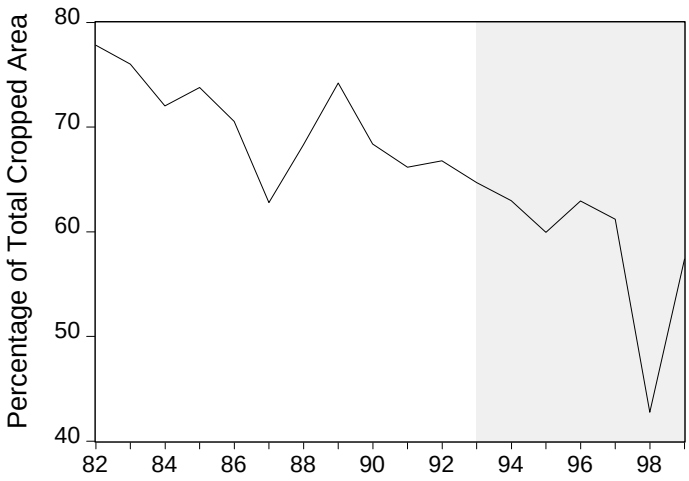
[6] As shown in Appendix 6, this effect was only significant at the 12% level.

substituted by a 55,000 hectare increase in cotton area since 1990 (+65%); a 40,000 hectare rise in groundnut area (76% increase), a 130,000 hectare increase in cassava area (65% increase), and an increase in sweet potatoes by 7,000 hectares (54 % increase).

According to CFS data, soyabean production has only gone down by 3% despite a 60% reduction in the land area. This appears to be suspect because for production to have remained roughly constant, as indicated by the data, then productivity per hectare must have risen exponentially. There is no accompanying evidence, even anecdotal, to support such a phenomenon.

One conclusion suggested by the data in Figure 7, is that Zambian farmers have diversified considerably away from maize in the past decade, most likely in response to the decline in heavy subsidies on maize production and marketing in the 1990s. In the 1980s, maize accounted for roughly 70% of total cropped area. In the past five years, this share has declined to about 55%. The largest decline in maize area has been in Northern Province, which has simultaneously experienced a large increase in cassava production.

Figure 7. Maize Area as a Percentage of Total Cropped Area, Crop Forecast Estimates



Source: CFS, MAFF/CSO

With regard to PHS (smallholder) derived trends, the data reveal that at the national level area under maize has increased marginally (5%) over the six-year period while there is a downward trend in production (about - 2.2% annually). Cotton area has gone up by 145% over the six-year period from about 32,000 ha to about 79,000 ha. Production has been increasing at an average annual rate of 7.3% and has increased by 214% from 1992/93 to 1997/98. Other crops that have gained in area and production are sweet potatoes, groundnuts, cassava and tobacco (burley and virginia). The crops which have experienced area declines are soyabeans, mixed beans, sorghum (marginally) and sunflower. Table 2 shows the general trend in area and production of the mentioned crops over the six-year period.

Table 2. General Trends in Area and Production of Selected Smallholder Crops Between 1993 & 1998

Crop	Trend in Area	Trend in Production
Cassava	Upward	Upward
Cotton	Upward	Upward
Groundnuts	Upward	Upward
Sweet Potatoes	Upward	Upward
Tobacco (burley & virginia)	Upward	Upward
Maize	Upward	Downward
Millet	Upward	Downward
Mixed Beans	Downward	Downward
Sunflower	Downward	Downward
Sorghum	Downward	Downward

Source: Derived from PHS and TAZ data

The cumulative effect of the trends depicted in Table 1 in money value terms has been to slightly increase the value of production over the six-year period.

3.2. Provincial-Level Trends

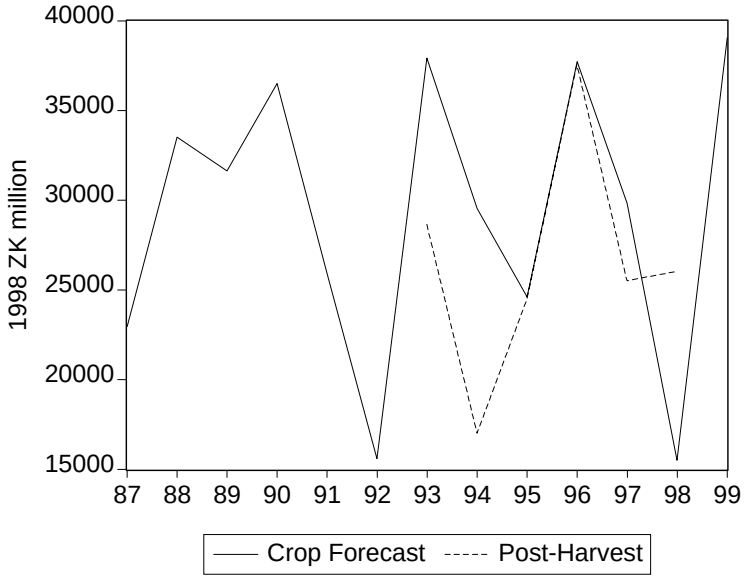
Figures 8 to 16 show provincial-level trends in the value of crop production, based on both the CFS and PHS data. The general picture is again one of high variability from one year to the next, but with indications that the value of production over the past 6-7 years has been either steady or rising in most districts.

3.2.1. Copperbelt Province

According to PHS data, maize appears to be the main engine behind the province's positive trend. Area under maize is generally on the rise increasing by more than 40% over the six-year period. Maize production, although generally on the increase, has declined in 1997 and 1998. This decline in the last two years is reflected in the decline in the total value of production in 1997 and 1998 (Figure 8). The general increase in maize production in the province could be a reaction to the liberalization of the market which gives incentives to produce low value high bulk crops near the consumption centers. With 1.5 million consumers in the Copperbelt's mining areas, it is not surprising that food production has increased in the nearby farming areas of this province. Another crop on the rise in the province is sweet potatoes.

The CFS derived trend is generally in agreement with the PHS data, although the drop in value of production after 1991 occurs earlier with PHS data (1994) than it does with CFS data (1995). The drop in the value of production from 1996 is also more severe for CFS data. The PHS trend tilts upwards earlier than CFS data.

Figure 8. Values of Crop Production, Crop Forecast and Post Harvest Survey Estimates, Copperbelt Province



3.2.2. Eastern Province

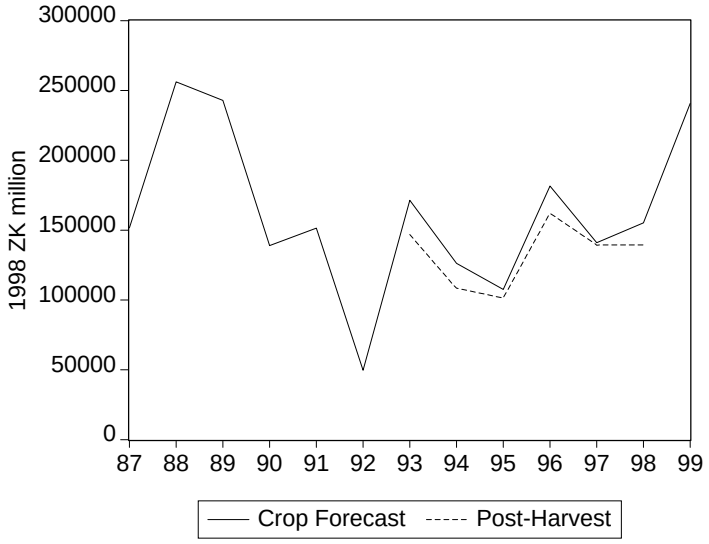
According to PHS data, the rise in the value of production in Eastern Province could largely be attributed to the rise in cotton production in that province (Figure 9). Area under cotton production increased by 109% from 13,843 ha in 1992/93 to 49,094 ha in 1997/98. Cotton production increased by 284% from 1,288MT in 1992/93 to 49,506MT in 1997/98. Maize area has remained somewhat the same around 170,000 ha while production has dropped by 31% to 198,256MT over the same period suggesting reduced productivity in maize production. Groundnut production is also making a resurgence in the province and has gone up by 70% over the six-year period.

Value of production derived from CFS data is almost completely in agreement with the PHS derived trend. The only noteworthy difference is that the CFS production estimates, which include large-scale production, shows higher values than the PHS trend. The only difference in the two trends is after 1997 where the PHS trend declines and the CFS trend rises.

3.2.3. Luapula Province

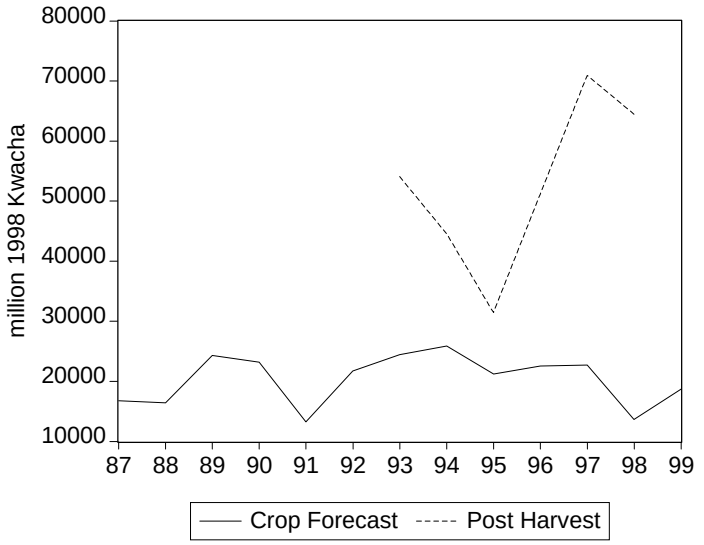
The PHS data reveal that there has been a gradually declining trend in area under maize in Luapula province (27% over the six-year period). Production of maize has followed a similar trend and is on the decline. From 1992/93 to 1997/98 maize production had dropped by 60% to 10,124 MT. This indicates not only a reduction in land area but also in productivity with the yield level decreasing faster than the reduction in land area. Area under sorghum has risen by 41% from 1992/93 to 1997/98. Sorghum production has gone up by the same margin over the same period to 1006 MT. Area under cassava has increased by 100% from 1992/93 to 1997/98 while production has increased by 37% over the same period to 8,996MTof flour. There is a general increase in the area and production of all other crops apart from mixed beans where there is a decline.

Figure 9. **Values of Crop Production, Crop Forecast and Post Harvest Survey Estimates, Eastern Province**



Value of production derived from CFS data appears to be completely unrelated to the PHS trend (both are depicted in Figure 10), the latter (which excludes the large scale sector) depicting higher values than the CFS trend. The difference can be explained by the exclusion of cassava production estimates in the CFS until the 1997/98 cropping season.

Figure 10. Values of Crop Production, Crop Forecast and Post Harvest Survey Estimates, Luapula Province

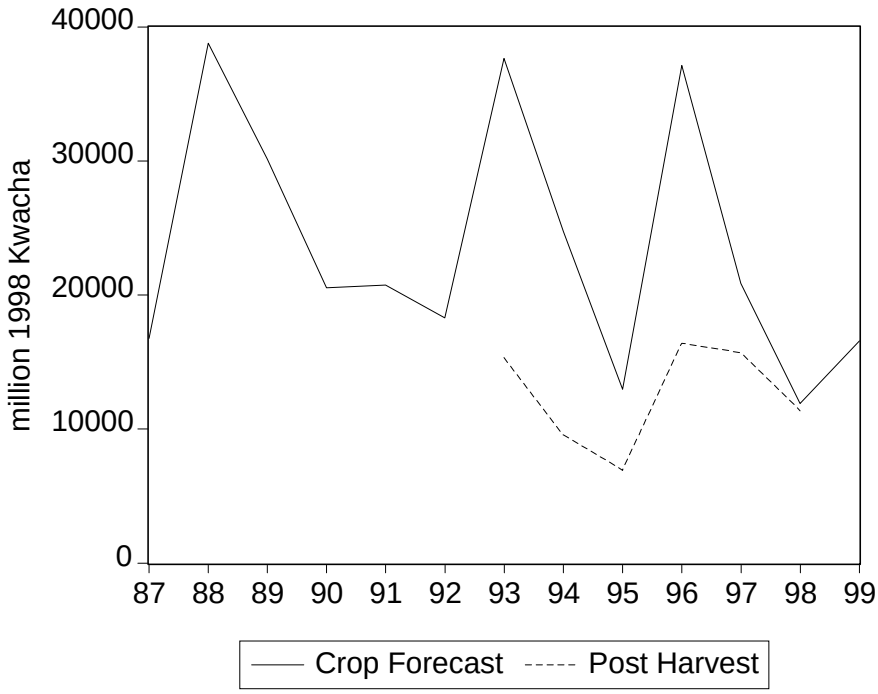


3.2.4. Lusaka Province

According to PHS data, the main determinant of an upward trend, followed by a downward trend of production value in Lusaka is maize production. Amidst variations, maize production has been on the upswing peaking at around 38,000 MT in 1995/96 before decreasing to about 24,000 MT in 1997/98. However, maize area has generally been going down gradually over the six years, decreasing by 40%. Is this reduction in land area while production is generally going up an indication of improvements in productivity in the province? Other crops showing positive trends in area and production are cotton and groundnuts. Area has gone up by 30 % for cotton and 98% for groundnuts and production has gone up by 223% and 71% respectively. All other crops decline in area and production apart from mixed beans which is relatively small in quantity.

Value of production derived from CFS data is generally in agreement with PHS trend although the movements in the CFS trend are more accentuated. The CFS values are also, as expected, higher than the PHS values. (Both trends are depicted in figure 11).

Figure 11. Values of Crop Production, Crop Forecast and Post Harvest Survey Estimates, Lusaka Province



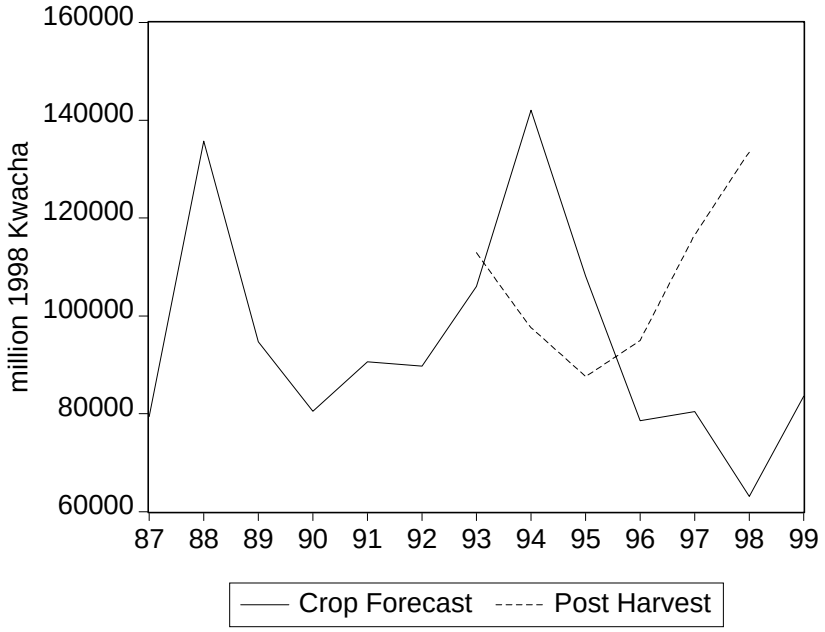
3.2.5. Northern Province

Inferring from the PHS data, the increase in the value of production could mainly be attributed to the rise in cassava production. Area under cassava has increased by 116 % over the six-year period with production increasing by 117%. Maize area and production have been on the decline decreasing by 41% and 71% over the six-year period. The higher reduction in production points at

loss in the productivity of maize production. All other crops have had positive developments in area and production apart from mixed beans and sunflower which have been on the decline.

Value of production derived from CFS data is at odds with PHS values (depicted in figure 12). For 1993 and 1994, value of production derived from the CFS is on the decline, but, whereas the PHS derived value is on the increase from 1995, the CFS-derived value continues declining until 1998. This is, as in the case of Luapula Province, attributed to the exclusion of cassava production estimates in the CFS until the 1997/98 cropping season.

Figure 12. Values of Crop Production, Crop Forecast and Post Harvest Survey Estimates, Northern Province

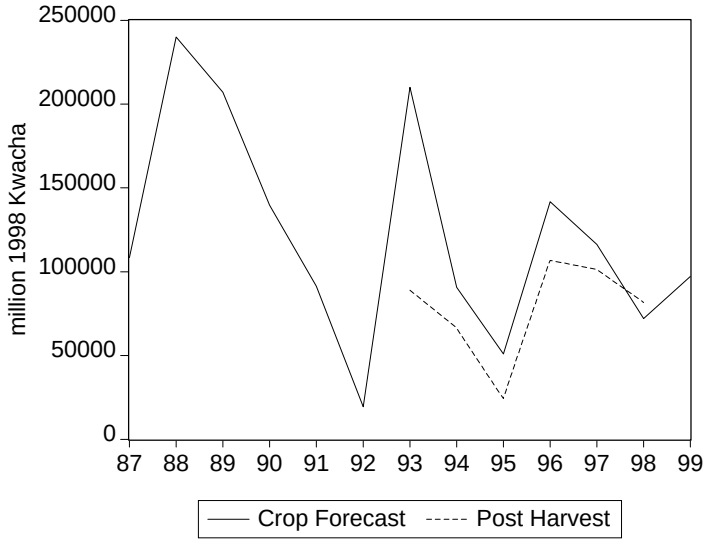


3.2.6. Southern Province

PHS data suggest that the general upward trend in the value of production in Southern Province has been largely due to maize and cotton production. Maize production has been on the increase apart from the last two years. Between 1993 and 1996 maize area and production went up by 35% and 14% (almost 3,000 MT) respectively (amidst variations). Maize production has been declining slightly in 1997 and 1998. Cotton area under and production have increased by180% (to 11,515 ha) and 400% (to 9,319 MT) respectively. Groundnut area and production have gone up by 120% (to 215,528 ha) and 60% (to 625 mt) respectively. There is no discernible trend in sweet potato production which has fluctuated from year to year. Area and production of millet and sorghum have been on the decline.

The CFS and PHS value of production trends for Southern Province (depicted in figure 13) are generally moving in the same direction until after 1997 when the PHS value of production exceeds the CFS value of production.

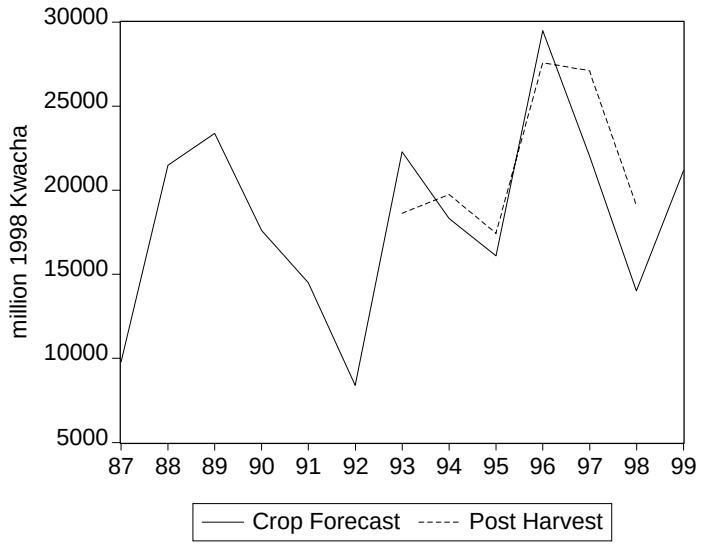
Figure 13. Values of Crop Production, Crop Forecast and Post Harvest Survey Estimates, Southern Province



3.2.7. Western Province

According to PHS data, area under maize in Western Province increased by 85% between 1992/93 and 1998/99 from 29,831 ha to 55,075 ha while production increased to 50,742 MT and 47,905 MT in 1995/96 and 1996/97 respectively. Maize production declined to 30,956 MT in 1997/98. Production of other crops such as millet and cotton has been going up. Millet production has gone up by 90% from 4381 MT to 8329 MT Cotton is also on the rise in the province. From 1992/93 to 1996/97 production of cotton rose by more than 400% before falling in the 1997/98 year by 35% from the 1996/97 year.

Figure 14. Values of Crop Production, Crop Forecast and Post Harvest Survey Estimates, Western Province

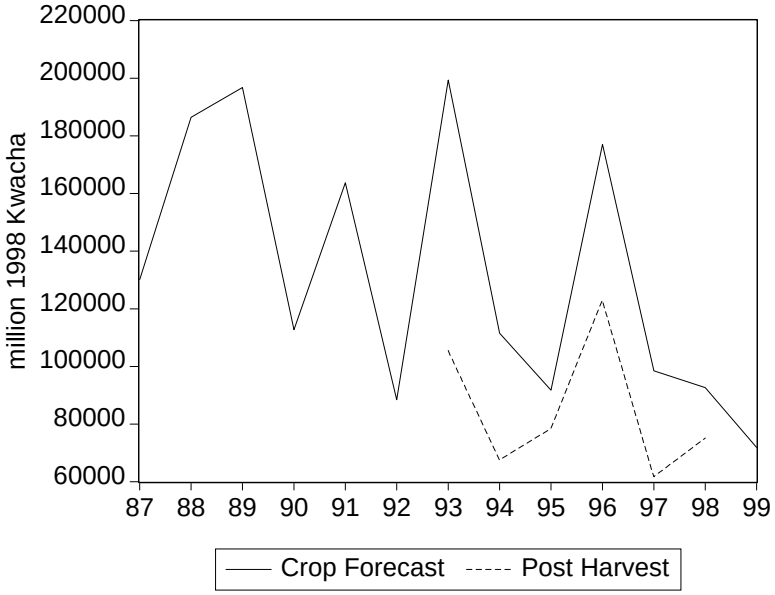


The general movement of the CFS and PHS values (depicted in figure 14), are similar although the PHS value of production, which excludes the large scale sector, is higher than the CFS value of production in some years, contrary to what is expected. Western Province is, like Northern and Luapula provinces, an important cassava growing province. Therefore, the exclusion of cassava in the CFS until 1997/98 could be the main reason behind this discrepancy.

3.2.8. Central Province

PHS data reveal that area under maize in Central Province has been stable, averaging 65,000 ha per year, apart from 1995/96 where it rose to 133,536 ha. However, over the six-year period maize area has decreased by 10%. Production of maize has decreased by 41% over the same period to 113,212 MT suggesting losses in maize productivity. Cotton production had been on the rise from 1993/94 until 1995/96. From 1995/96 cotton production has been on the decline.

Figure 15. Values of Crop Production, Crop Forecast vs. Post Harvest Survey Estimates, Central Province



Area under sorghum in Central Province decreased by 41% from 1992/93 to 1993/94 and stayed roughly stable for the next four years. Production followed a similar pattern falling by 48% between 1992/93 and 1993/94 and staying stable for the next four years. Millet production had been going down from 1992/93 to1995/96 but has been going up since. Area and production of groundnuts have increased by 100% and 67% respectively over the same period. Overall, it would seem that the effect of the decrease in maize production has not been matched by the increases in other crops.

The CFS and PHS values of production (depicted in figure 15) are generally moving in the same direction with the only major difference being after 1997 where the PHS value of production begins to increase as the CFS value of production continues to decline.

3.2.9. Northwestern Province

Northwestern Province's maize area has been steadily decreasing from 19,100 ha in 1992/93 to 15,633 ha in 1997/98 (a drop of 18%). Maize production has dropped by 50% over the same period to 17,208 MT. There has also been a general decline in the area and production of all other crops apart from sorghum and sweet potatoes. Production of sweet potatoes has increased by almost 40% from 236 MT in 1992/93 to 328 MT in 1997/98 while production of sorghum has increased by slightly more than 100% from 2157 MT to 4388 MT during the same period. There is a resurgence of groundnut production from 1993/94 onwards but not to the 1992/93 level of 2,700 ha and 1135 MT. The 1997/98 production was around 1000 MT.

The CFS and PHS production value trend lines are not only moving in completely separate directions, the value of production derived from PHS data, which exclude the large scale sector, is also higher than the value of production derived from CFS data. Both these trends are depicted in figure 16. The discrepancy is consistent with other provinces where cassava is a main staple diet, often more important than maize.

Figure 16. Values of Crop Production, Crop Forecast and Post Harvest Survey Estimates, Northwestern Province

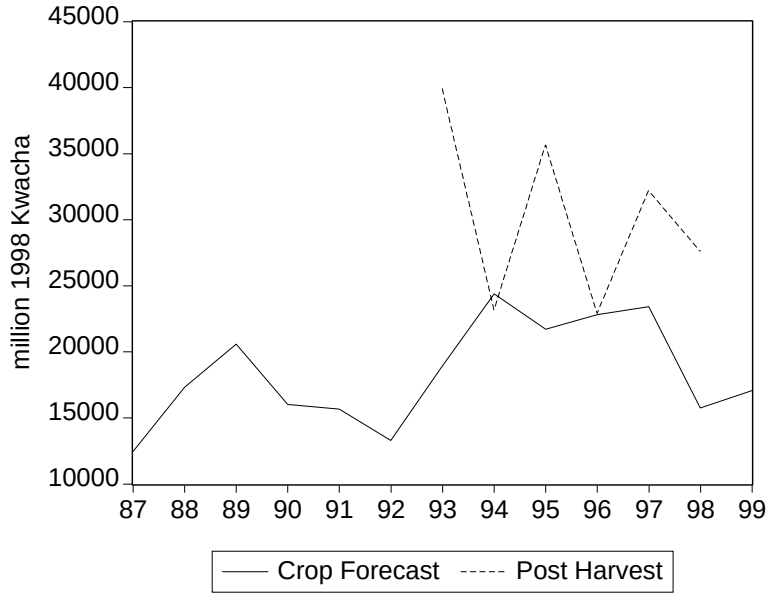


Table 3a. Total Value of Crop Production by Province, CFS Estimates, 1987-1998.

Harvest Year	Zambia	Central	Copper-belt	Eastern	Luapula	Lusaka	Northern	North-western	Southern	Western
1987	548,277	130,116	22,943	151,552	16,767	16,769	79,423	12,469	108,454	9,785
1988	945,831	186,398	33,511	256,153	16,407	38,779	135,700	17,328	240,076	21,479
1989	871,487	196,706	31,635	242,895	24,326	30,144	94,688	20,597	207,121	23,375
1990	585,835	112,753	36,504	138,952	23,205	20,549	80,530	16,008	139,720	17,613
1991	587,136	163,619	25,927	151,446	13,246	20,746	90,647	15,663	91,344	14,497
1992	324,363	88,347	15,587	49,566	21,723	18,296	89,714	13,302	19,428	8,399
1993	828,085	199,382	37,933	171,387	24,443	37,640	106,023	18,929	210,067	22,281
1994	593,127	111,499	29,535	126,084	25,878	24,729	142,098	24,381	90,612	18,312
1995	455,039	91,736	24,613	107,573	21,211	12,979	108,166	21,714	50,956	16,090
1996	728,671	177,083	37,725	181,503	22,533	37,135	78,589	22,825	141,795	29,483
1997	568,226	98,486	29,823	141,127	22,726	20,869	80,421	23,415	116,293	22,012
1998	470,700	92,565	15,498	155,152	13,629	11,896	63,087	15,760	72,050	14,019
1999	605,959	71,791	39,065	240,817	18,715	16,574	83,584	17,070	97,175	21,169

Notes: figures are in millions of CPI-adjusted kwacha (1998=100). Figures include crops reported by CSO only: maize, soybeans, groundnuts, sunflower, mixed beans, millet, sorghum, seed cotton, and virginia and burley tobacco. Crops missing from these figures include cassava, sweet potato, horticulture, and paprika.
Source: MAFF/CSO, CFS.

Table 3b. Total Value of Crop Production by Province, PHS Estimates, 1993-1998.

Harvest Year	Zambia	Central	Copper-belt	Eastern	Luapula	Lusaka	Northern	North-western	Southern	Western
1993	628305	105496	28651	146814	54610	15328	112914	55511	89030	19952
1994	463926	67482	17008	108528	44929	09554	97573	32099	66313	20439
1995	423285	78448	24483	101216	32699	06922	87545	49134	24352	18485
1996	650681	122997	37562	162015	52429	16406	94982	26969	106737	30584
1997	604668	61651	25509	139140	72152	15684	116528	43648	101193	29161
1998	594602	75078	26028	139287	66007	11363	133488	39088	81567	22696

Notes: figures are in millions of CPI-adjusted kwacha (1998=100). Figures include crops reported by CSO only: maize, soybeans, cassava, sweet potatoes, groundnuts, sunflower, mixed beans, millet, sorghum, and seed cotton.. Crops missing from these figures include horticulture, paprika, virginia and burley tobacco.
Source: MAFF/CSO, PHS.

3.2.10. Summary of Value of Production Growth Rates at Provincial Level

Table 4 shows the value of production growth rates for Zambia and other provinces using PHS data. The provinces with the highest growth rates are the provinces where cassava is the main food crop, which are Luapula (7.82%) and Northern (5.8%) provinces. In these provinces crop diversification

has been mainly from maize to cassava. Luapula and Northern provinces are followed by the Copperbelt and Lusaka provinces. These urban provinces have demonstrated sustaining to increasing trends in maize production, a commodity that is consumed mainly in the two provinces. This suggests that liberalization is encouraging the growth of this high bulk low value crop near its consumption areas. In Eastern and Southern provinces, which are important cotton and maize producing areas in Zambia, lower growth rates are noted, despite diversification into cotton and other crops. The provinces with the lowest growth rates are Western (0), Central (-2.2) and North-Western (-6.2). According to the data, these provinces show no substantial diversification or intensification in any of the crops, particularly cash crops.

Table 4. Value of Production Growth Rates 1992/93 to 1997/98

Region	Value of Production Average Growth Rate %
Zambia	2.2
Luapula Province	7.8
Northern Province	5.8
Copperbelt Province	5.7
Lusaka Province	5.4
Eastern Province	2.1
Southern Province	1.7
Western Province	0
Central Province	-2.2
Northwestern Province	-6.2

Source: PHS Data, MAFF/CSO

4. RECENT TRENDS IN THE PRODUCTION OF NUTRITIONAL ENERGY IN RURAL AREAS

4.1. Human Energy Calculations

With the available Post Harvest Survey food crop production data, it is possible to convert quantities of food produced into human energy values, expressed as calories. Expressing food production in energy terms allows us to combine the different food categories and examine to what extent total food production, as well as each individual food item, contributes to the provision of human sustenance. However, since little or no information is available on livestock production, fisheries and aquaculture, vegetable and legumes production, or non-food crops grown for cash sale, it is not appropriate to compare these per capita food production energy values to specific recommended energy intake levels. The main purpose of this section is rather to examine trends using an energy (kilocalorie) numeraire to examine the consistency with money value trends in the previous section.

The food categories used for this analysis are as follows:

- Maize
- Other grains: rice, sorghum, millets
- Tubers: cassava, sweet potato, Irish potato
- Legumes: groundnuts, cow peas, beans
- Oil seeds: sunflower, soya

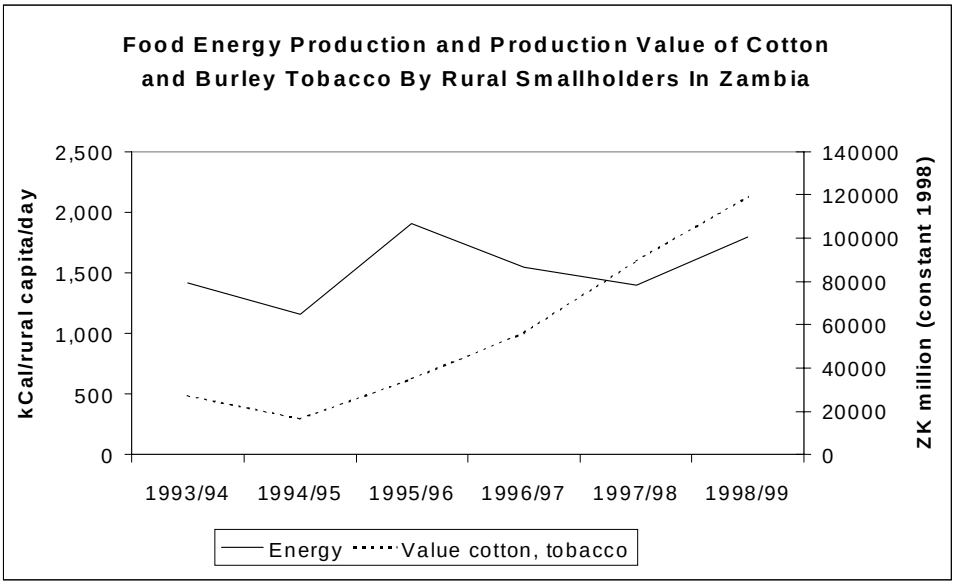
As PHS data relate to smallholder farmers only (cultivating less than 20 ha), caloric values have been computed for all food crops covered by the PHS, and expressed as energy available in rural areas on a per capita basis. In this way, trends in energy production among the entire rural population in Zambia have been examined, as well as the trends on a provincial basis. Post Harvest Survey production data for the above mentioned crops are used for the seasons 1993/94 through 1997/98. In addition, 1998/99 Crop Forecast Survey data are used for smallholder farms only (i.e., excluding commercial farm production). Energy values, computed using available data on caloric values and population estimates, are graphically presented in Appendix 7.

Although oil seeds, such as sunflower and soya, are not necessarily consumed by the producing household, these crops do represent a source of nutritional energy which finds, at least partly, a market among the rural population. Similarly, energy from maize is not consumed entirely by its producers; a proportion of that energy can be classified as surplus and would eventually be marketed among other rural and urban consumers. Since it is not possible to determine rural food consumption from PHS data, the scope of the analysis is limited to describing the production of energy derived from food crops produced by smallholder (excluding commercial) production.

4.2. Trends in Energy Levels From Food Crops in Rural Areas

At a national level, rural per capita energy from food crops produced by smallholders appears to be stable, and may even exhibit a moderately increasing trend (Figure 17). This would suggest that overall smallholder food production has increasingly had the potential to contribute positively towards achieving household food security among rural households. However, given that a proportion of food produced is marketed and not necessarily retained within the rural areas, it is

Figure 17. Energy Production and Value of Cash Crops



difficult to draw any further conclusions as to the actual utilization of the available energy by rural versus urban consumers[7].

In addition to food production, increased smallholder cash crop production adds to many rural households' purchasing power. Figure 17 illustrates how the value of seed cotton and burley tobacco produced by smallholders has increased substantially during recent years and has potentially increased households' ability to acquire additional food or other necessities.

When food production statistics and subsequent energy data are disaggregated at provincial level, a number observations can be made (for additional graphic illustrations, see Appendix 7):

Perhaps not surprisingly, Central, Eastern and Southern provinces (of which Southern Province is included in Figure 19 below) exhibit relatively high per capita levels of energy production with high peaks, confirming substantial food surpluses and distinct production peaks. Copperbelt and Lusaka provinces show similar patterns, although Lusaka at a lower level, confirming the fact that less food surplus is produced among smallholders in that province.

Of the more remotely located provinces, Western and Northwestern show per capita energy production levels which have remained remarkably constant during recent years. Per capita energy levels are low as compared to other provinces, which would seem to underline the relative

[7] The data on sales and retention of crops produced by smallholders from Post Harvest Surveys are insufficient to be used for disaggregating rural and urban food availability. In addition, no reliable data sets exist on large scale production of food crops which form a significant source of urban food supply.

importance of other agricultural activities, such as livestock rearing, and other agricultural and non-agricultural activities.

Northern and Luapula provinces, which include some of the most remote rural areas in Zambia, show increasing levels of energy production, indicating a relatively high dependence on local food crop production and a seemingly high adaptability to maintain and increase household food security following the withdrawal of market support mechanisms from 1993 onwards. Figure 19 illustrates how energy production has developed in Northern and Southern provinces, the former being increasingly cassava-oriented, the latter remaining relatively focused on maize production.

4.3. Contribution of Main Food Crops to Energy Production in Rural Areas

As was concluded earlier, a process of crop diversification is ongoing whereby maize production is increasingly being substituted by the production of other cash and food crops. Given that the overall levels of energy among the rural population appear to be increasingly positive in most areas, crop diversification would seem to be having a positive impact on household food security. To examine the relative importance of the different food crops and their respective contribution to available energy, proportionate energy levels have been computed for the various food categories at national and provincial levels.

At national level, it can be observed that the importance of maize exhibits a strongly declining trend when taken as a proportion of energy produced from food crops. Cassava and sweet potatoes increasingly supply the necessary energy, along with increasing amounts of groundnuts and grains other than maize (see Figure 18). Overall, smallholders in rural areas seem to return to more traditional diversified cropping and consumption patterns which were in place before the widespread introduction of maize.

Figure 18. Proportionate Energy Production From Smallholder Food Crops by Crop Type in Zambia

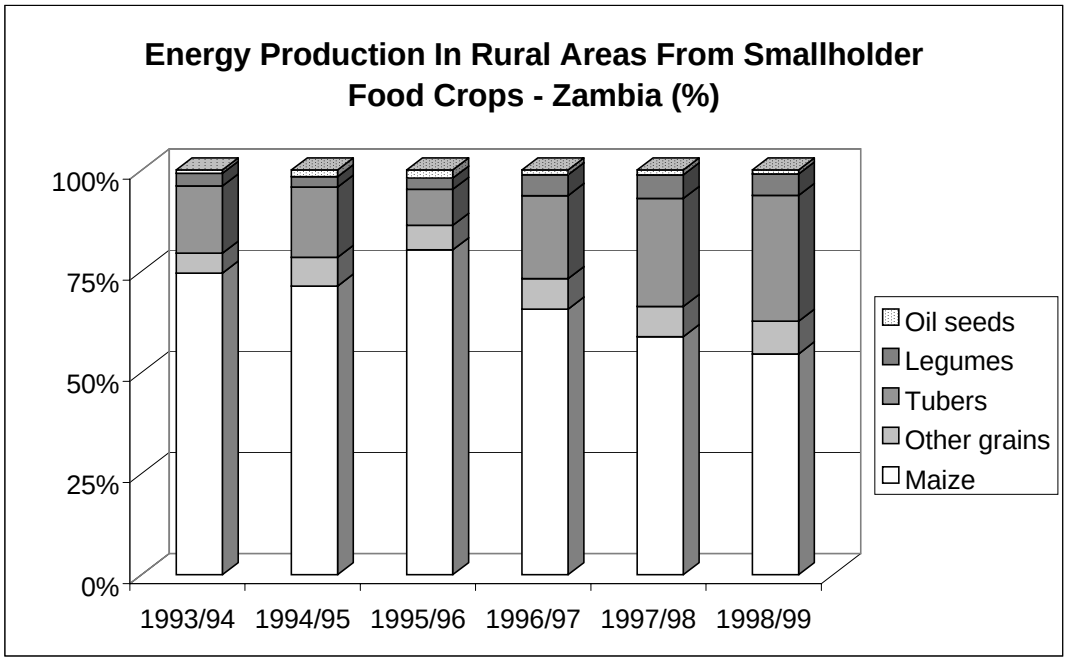


Figure 19. Energy Production From Smallholder Food Crops in Northern and Southern Provinces

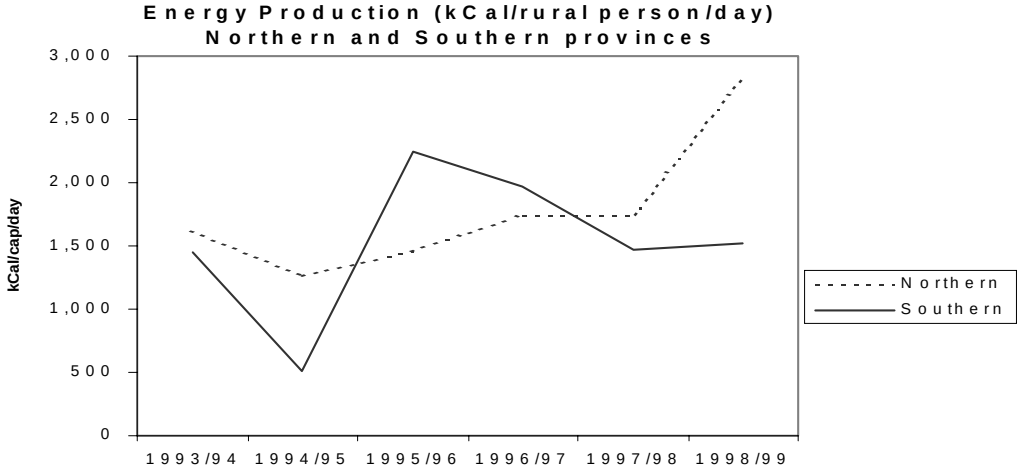


Figure 20. Proportionate Energy Production from Smallholder Food Crops by Crop Type, Central Province

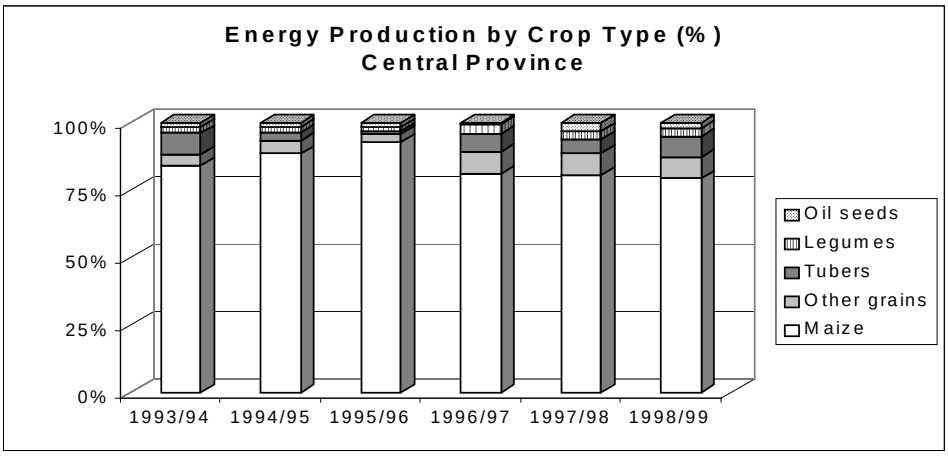


Figure 21. Proportionate Energy Production from Smallholder Food Crops By Crop Type, Luapula Province

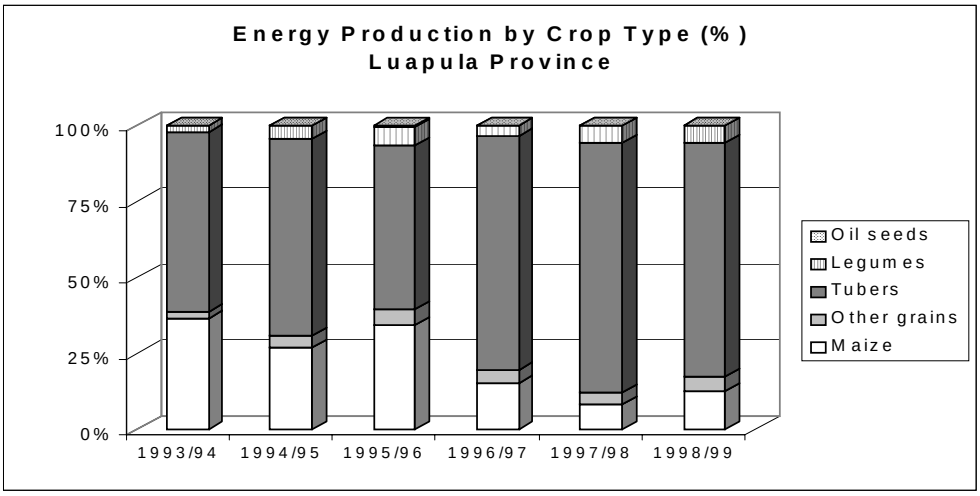


Table 5. Share of Maize as Part of Total Energy Produced from Smallholder Food Crops in Rural Areas (%)

Season	Central	Eastern	Southern	Copper-belt	Lusaka	North-western	Western	Northern	Luapula
1993/94	84%	93%	90%	83%	98%	52%	66%	53%	36%
1994/95	88%	95%	86%	75%	92%	47%	66%	38%	27%
1995/96	93%	91%	94%	91%	97%	66%	70%	46%	34%
1996/97	81%	86%	92%	84%	98%	50%	68%	31%	15%
1997/98	81%	85%	92%	81%	96%	36%	59%	15%	8%
1998/99	79%	87%	92%	72%	98%	32%	47%	17%	12%

At provincial level, the following features can be highlighted when evaluating the importance of crops in energy terms (refer to Appendix 7 for additional graphic illustrations, and Table 5 above).

In Eastern Province, the importance of maize in energy terms has reduced but is still high in relative terms, underlining the fact that maize is a major cash crop and that it is likely to include surplus energy in most years. The importance of legumes has increased substantially, mainly groundnuts, as well as tubers. In Southern Province, maize remains an important crop, while tubers show a modest appearance. The importance of legumes is also increasing. Of the three main food surplus producing provinces, Central Province (Figure 20) shows the highest degree of change and overall diversification: The importance of maize shows a slightly downward trend, and the contribution of all other crop types towards the provision of energy has been steadily increasing.

The importance of maize in Northwestern Province is decreasing, while tubers and legumes gain importance. An even more pronounced trend is taking place in Western Province, where maize is strongly declining and increasing proportions of energy are derived from other grains, tubers and legumes.

In Northern and Luapula (Figure 21) provinces the contribution of maize to available energy has seen a tremendous decrease during the last six seasons. The main staple food crop that provides most of the energy is cassava, while legumes (groundnuts) are becoming increasingly important. To a lesser extent, other grains are gaining importance in the two provinces.

4.4. Nutritional Considerations

Energy levels were used in the above analysis to examine agricultural production trends of food crops. However, the effects of crop diversification on nutrient intake would require a separate study on food consumption patterns throughout Zambia. In rural areas, a general shift from maize to cassava may have nutritional implications, cassava meal containing less fat, protein and Vitamin B as compared to unrefined maize meal. At the same time, cassava contains more Ca, K and Vitamin C, and its leaves are consumed in addition to the tubers.

Cassava-based farming systems have a steady and secure supply of food. However, existing cassava-based farming systems in the northern part of the country have the highest levels of stunting (height-for-age measure of malnutrition) among children under five years of age. This can be caused both by dietary patterns and disease burden, the northern part of Zambia having a high incidence of malaria and worm infestations (Kanyangwa-Luma et al. 1999).

From the above it follows that, although Luapula and Northern provinces appear to gain in terms of per capita energy production, progressively less diverse cropping patterns in such traditional cassava-based systems could have a negative impact on nutritional status. One could argue that the opposite of crop diversification is occurring in Luapula and Northern provinces, whereby the already substantial cassava production is on the increase at the expense of maize and with very little evidence of a substantial production increase of legumes and grains other than maize. Therefore, in order to gauge the effect of crop diversification on nutrition, it is necessary to examine the actual diversity of crops available, rather than focus on the extent to which maize is being replaced by cassava or other crops.

5. DISTRIBUTION OF PRODUCTION AND LAND ALLOCATION AMONG SMALLHOLDERS

Having examined national- and provincial-level production trends, this section uses the 1997/98 PHS household data to examine how the value of crop production is distributed across small- and medium-scale farmers, and how this is related to the amount of land cultivated at the household level.

5.1. Distribution of Land Area Under Cultivation

Tables 6 and 7 summarize the distribution of land by quartile for each province. The quartiles are established by ranking small and medium scale producers by area cultivated per household (in the case of Table 6) and area cultivated per person (in the case of Table 7), and subsequently dividing the sample thus obtained into four equal groups. The reported numbers show how the amount of land per household and per capita varies, both across provinces and among land size quartiles within each province.

Table 6 shows that mean area cultivated per household is highest in Central, Eastern, and Southern provinces. These figures only take into account small and medium farms. Mean area cultivated is lowest in the Northwestern, Copperbelt, and Luapula. Table 6 also shows that there are large variations in land cultivated per household across each province. In the major agricultural provinces of Central, Eastern, and Southern, the top 25% farm 8 to 10 times more land than the bottom 25% of farmers. However, it is plausible that after taking into account differences in family size, the observed dispersion in land cultivated may shrink. The results in Table 7 show the per capita results.

Table 6. Land Cultivated Per Household in Zambia by Province, 1997/98.

	Quartile of Land Cultivated per household				
Province	**1st quartile bottom 25%**	**2nd quartile**	**3rd quartile**	**4th quartile top 25%**	**mean**
	---------- hectares per household ----------				
Central	0.42	0.97	1.9	4.89	1.64
Copperbelt	0.31	0.6	1.03	1.03	1.06
Eastern	0.53	1.01	1.69	3.4	1.52
Luapula	0.34	0.71	1.14	2.24	1.04
Lusaka	0.24	0.44	0.89	3.57	1.18
Northern	0.43	0.94	1.48	3.04	1.41
Northwestern	0.39	0.76	1.12	1.91	0.99
Southern	0.41	0.92	1.87	4.87	1.68
Western	0.32	0.66	1.08	2.38	1.07
National level	0.39	0.82	1.31	2.95	1.35

Note: All numbers are weighted. Source: Post-Harvest Survey data, 1997/98, Central Statistical Office.

Table 7. Cropped Area Per Capita by Province, 1997/98.

Province	----- Quartile of cropped area per capita ----			
	Quartile 1 bottom 25%	Quartile 2 2nd 25%	Quartile 3 3rd 25%	Quartile 4 top 25%
	---------- hectares per capita ----------			
Central	0.07	0.17	0.3	0.86
Copperbelt	0.07	0.13	0.21	0.55
Eastern	0.12	0.22	0.34	0.78
Luapula	0.07	0.14	0.23	0.56
Lusaka	0.04	0.09	0.16	0.54
Northern	0.09	0.19	0.3	0.67
Northwestern	0.07	0.14	0.21	0.44
Southern	0.07	0.16	0.3	0.79
Western	0.07	0.14	0.22	0.53

Source: PHS data, 1997/98, MAFF/CSO

However, the data reveal large variations in the amount of land cultivated even on a per capita basis. The bottom 25% of farmers in every province cultivate between 0.04 and 0.12 hectares per person (in Lusaka and Eastern Provinces, respectively), while the top 25% cultivate between 0.44 and 0.86 hectares per person (in Northwestern and Central Provinces). In every province, the top 25% of small and medium scale farmers cultivate six times more land per capita than the bottom 25% of farmers. These findings do not include the large-scale commercial sector. If large-scale farmers were included, the skewness of land cultivation would obviously be even greater.

The finding of large variations across households in the amount of land cultivated per capita equally holds when the analysis is done at the district level. This shows that the results are not due to differences in population density across provinces, but hold even at a relatively small geographic level of analysis. There are obvious reasons why land cultivated at the household level may vary from one household to the next (e.g., differences in family size, access to animal traction, the stage in the household life cycle, land quality), but the emerging picture is that these factors explain only a small portion of the total variation in household crop area, and that there may be important differences in households' access to land.[8]

The data also reveal that among the bottom 75% of farmers (the bottom, second and third quartiles in Table 7), farmers in Eastern Province cultivate more land per capita than any other province in Zambia. And for farmers in the top quartile, only Central and Southern provinces have higher cropped area per capita than Eastern Province. This is so despite the fact that Eastern Province has the highest population density of the three major agricultural provinces in Zambia, i.e.. Central,

[8] Land issues will be examined in a forthcoming FSRP Working Paper. For the preliminary analysis discussed here, ANOVA analysis of 97/98 PHS data revealed that total variation in land cultivated by households (dependent variable) is explained for 19% by village dummies; for 2.76% by no. of males; for 2.68% by no. of females; for 0.77% by female headed hhs; for 0.71% by hh head's age (number of observations: 6034).

Eastern and Southern provinces (Table 8). In fact, according to the 1990 Census, the population density in Eastern Province was greater than all provinces except the urban provinces of Lusaka and

Table 8. Area, Population Size, Population Density by Province and Census Year

	Area	1990 Census		1980 Census		1969 Census	
	(sq km)	Pop. size('000)	Density/sq km	Pop. size('000)	Density/sq km	Pop. size('000)	Density/sq km
Zambia	752612	7383	9.8	5662	7.5	4057	5.4
Central	94394	721	7.6	512	5.4	359	5.4
Copperbelt	31328	1427	45.6	1251	39.9	816	26.1
Eastern	69106	966	13.9	651	9.4	509	7.4
Luapula	50567	525	10.4	421	8.3	336	6.6
Lusaka	21896	987	45.1	691	31.6	354	16.2
Northern	147826	855	5.8	675	4.6	545	3.7
N/Western	125826	388	3.1	303	2.4	232	1.8
Southern	85283	907	10.6	672	7.9	496	5.6
Western	126386	607	4.8	486	3.9	410	3.3

Source: CSO

the Copperbelt with densities of 45.1 and 45.6 persons per square kilometer respectively. It is beyond the scope of this paper to investigate the reasons behind these observations, but the key point here is that there may be important region-level differences in the factors determining access to land.

5.2. Land Area and Value of Crop Production

The association between the amount of cropped area and the value of crop output in each province is shown in Table 9. The results indicate that the value of crop production at the household level varies closely with the amount of land cultivated per capita. The value of output in this table is computed by multiplying the provincial level mean crop prices[9], as reflected in the PHS data, by the reported production of the crops.

The fact that there is a strong link between area cultivated and crop output is not surprising. However, what may be surprising is the degree to which crop production varies among small and medium scale farmers. In Central, Eastern, and Southern, for example, the value of crop output per capita produced by the top 25% of farmers (ranked by land quartile) is eight to ten times higher than the value of crop output per capita produced by the bottom 25% of farmers. This large variation in crop income between the top and bottom land cultivation groups holds across every province in the country.

[9] These are the prices that farmers report they receive and not public market prices which are used in sections 3 and 4.

Table 9. Annual Value of Crop Production Per Capita by Farm Size, 1997/98

Province	----- Group ranked according to land cropped per capita ----			
	Quartile 1 bottom 25%	Quartile 2 2nd 25%	Quartile 3 3rd 25%	Quartile 4 top 25%
	---------- kwacha per capita ----------			
Central	32678	60162	112582	305160
Copperbelt	23946	46257	68393	178193
Eastern	36014	68023	105042	274013
Luapula	23407	39461	49490	110687
Lusaka	16790	38412	54327	149103
Northern	28432	50079	72222	138252
Northwestern	18028	34290	50934	96394
Southern	23493	45214	94645	229047
Western	14773	23630	37720	60226

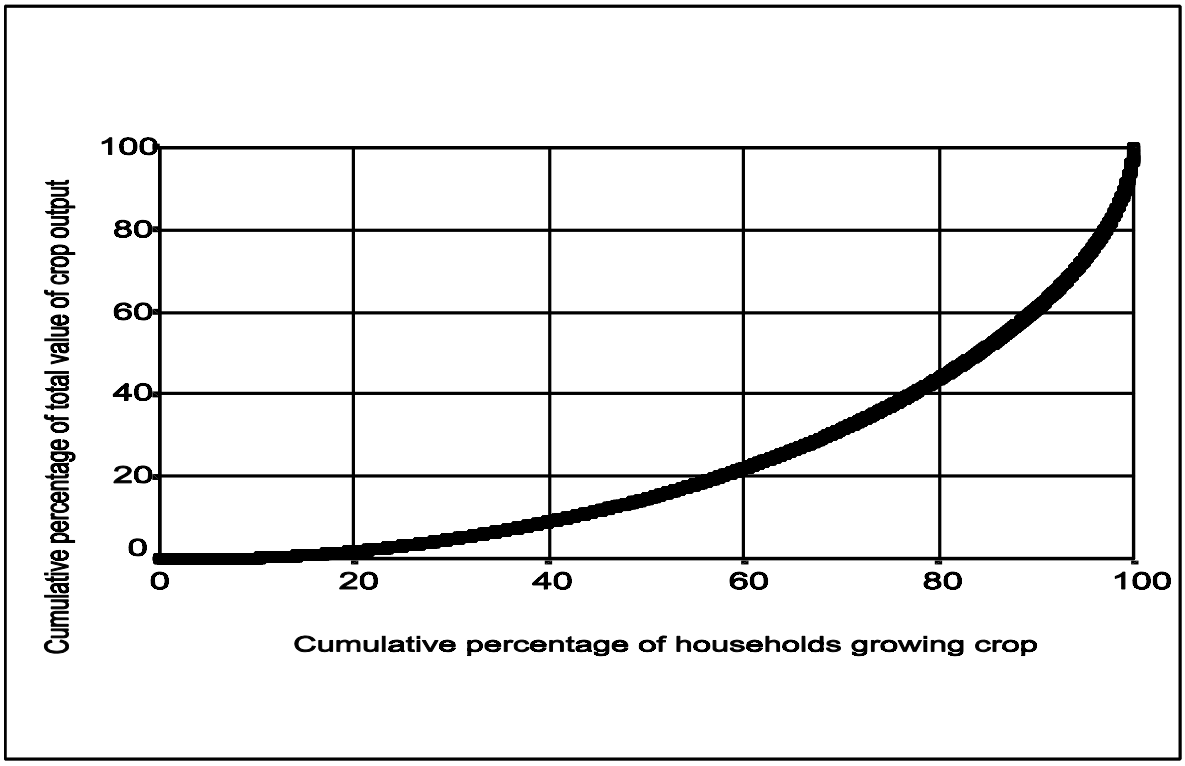
Source: PHS data, 1997/98, MAFF/CSO.

These results indicate that the value of crop production is highly related to the distribution of cropped area, i.e., the skewness of land allocation is driving the skewness of income derived from crop production. While data on household non-farm income are not contained in the CFS or PHS surveys, and such information must be obtained to make any firm conclusions, these findings begin to suggest that limited access to crop land at the household level may be a key factor associated with rural poverty. As mentioned above, the variation in land cultivated per capita holds even at the district level, as does the relationship between crop income and land cultivated, indicating that the determinants of rural poverty are perhaps a household-level phenomenon as much or more than a geographic one (i.e., related to geographic isolation and lack of access to infrastructure). This is the topic of ongoing research.

5.3. Concentration of Crop Production

Figure 22 shows the Lorenz curve for the value of crop output and the percentage of households growing crops. The vertical axis represents the cumulative percentage of total value of crop output and the horizontal axis represents the cumulative percentage of households growing the crops valued. If one looks at the figure where the curve (hyperbola dark line) meets the horizontal axis (80%) and the vertical axis (40%) the data reveal that 80% of all households produced about 40% of the value of all the whole crop output. This means that about 60% of the value of crop output is produced by only 20% of farming households. This could imply that many of the benefits of liberalization of the agricultural sector could be accruing to only a relatively small proportion of farming households.

Figure 22. Concentration of Crop Production in Zambia, 1997/98



Source: PHS data, 1997/98, MAFF/CSO

It could also be deduced that public intervention in the agricultural sector based on the conventional wisdom that agricultural production could be boosted mainly through improving farm yields, demonstrated in the various fertilizer programs over the last 30 years, could be, at least in part, an inaccurate diagnosis to the problem. The data suggest that there is an important link between production and land holding size, suggesting that programs aimed at increasing access to land for those households cultivating little area may be an important element in rural poverty reduction strategies.

From the above preliminary analysis, it appears that land use and land access among smallholder farmers is an important factor that influences production, income and, hence, food security. Further work on this topic will be carried out to gain more insight and to identify opportunities and possible interventions.

6. CONCLUSIONS

This broad assessment of crop production trends and developments using available national survey data has identified four key conclusions: (1) evidence of shifts in crop production from maize to other crops, (2) a slight upward trend in crop production amidst high weather-based fluctuations from one year to the next, (3) some indication that domestic food production expressed in energy terms is holding steady or increasing slightly, and (4) an important association at the household level between land area under cultivation and crop income. These issues are briefly elaborated upon.

6.1. Crop Diversification Evident

Agricultural cropping patterns are undergoing significant changes. A shift from maize to other food and cash crops can be identified, mainly cotton and cassava. The shift away from maize has mainly occurred in rural areas that are relatively distant to markets and most likely a result of elimination of direct government subsidies in support of maize production, marketing and consumption and price controls. Other crops that have gained importance are sweet potatoes and groundnuts.

6.2. Sector Growth Taking Place

Agricultural market liberalization can partially be credited with enabling the agricultural sector to maintain roughly similar levels of production value (in real terms) as during the 1980s, without requiring the massive subsidies that buoyed farm production during that period. This would point to the effectiveness of the market and its incentives in encouraging production in certain provinces. However, this conclusion is quite inconsistent with the prevailing general opinion voiced in the local press.

Certain provinces show stronger signs of growth than others since the liberalization process began in the early 1990s. The provinces where agricultural production value shows evidence of increasing or at least no sign of decreasing are Copperbelt, Eastern, Luapula, Lusaka, Northern, Southern and Western provinces. The provinces where agricultural production has clearly declined are Central and Northwestern provinces. For agriculture to have an appreciable effect on reducing poverty, the sector clearly must generate much greater gains in production and productivity to offset the growth in rural population.

6.3. Rural Food Security Improving

In terms of nutritional energy produced by rural smallholder farm production, it is evident that crop diversification is taking place and that overall energy levels per rural person are increasing in most provinces. Crops other than maize seem to have gained importance in providing energy, notably cassava, sweet potatoes, groundnuts, and sorghum and millets. On the other hand, the increasing production of energy from cassava in Luapula and Northern provinces point to a progressively less diverse cropping pattern.

Cash income from crop sales has shown a marked increase, adding to rural purchasing power. For the rural population, it would appear that the dependence on maize has been reduced, which also implies that farmers are becoming less dependent on high cost inputs.

Energy levels were used in this paper as an alternative numeraire to real monetary value to look at agricultural production trends of food crops. We find that these two measures of production value show a reasonably consistent picture. However, we cannot infer from these results how increased crop diversification has affected nutrient intake or nutritional status; this would require a separate study on food consumption patterns throughout Zambia.

6.4. Land Access Possible Constraint in Smallholder Income Growth Potential

Preliminary analysis suggests that household land cultivated per capita is closely associated with differences in the value of crop production. This association is to be expected to some extent. However, the noteworthy fact is that there is a large variation even within districts in the amount of land cropped by households that in turn generates the very large disparities in crop incomes observed across the smallholder population. In every province, the top 25% of small and medium scale farmers cultivate six to ten times more land per capita than the bottom 25% of farmers. These findings do not include the large-scale commercial farming sector. If large-scale farmers were included, the skewness of land cultivation would obviously be even greater.

It is estimated that 40% of all smallholders do not bring any crop or commodity to market. The majority of these farmers fall in the lowest land size category, farming less than 0.1 ha per capita. Also, a small group of relatively well-equipped farmers account for a large percentage of total crop output. In value terms, 60% of total crop output is produced by 20% of smallholder households. These households account for an even larger share of total crop sales.

6.5. Policy Implications

It can be concluded that the agricultural sector's performance, when measured in value and energy terms at national level, is not showing a negative trend, but rather a stable, if not slightly increasing one. Hence, the sector may be doing better than the local press and public opinion lead one to believe. However, it is also true that the agricultural sector has not been growing at a level required to pull most rural smallholders out of poverty. There is a pressing need to properly identify the key constraints on small farmer productivity and develop strategies to overcome them.

Public intervention in the agricultural sector has been based on the conventional wisdom that agricultural production could be boosted mainly through improving farm yields. This is demonstrated by the various programs over the past several decades designed to provide smallholders with fertilizer. However, the PHS survey findings indicate that fertilizer distribution subsidies may be an ineffective way to address rural poverty for many poor households that farm too little land to make a difference if fertilizer is applied on their small plots. Preliminary analysis suggests that there is an important link between production and land holding size which means that programs aimed at increasing access to land and area under cultivation may be an important component of boosting agricultural production and overcoming rural poverty.

Other efforts to increase agricultural sector productivity should focus on the commercialization of smallholders through encouraging continued private sector investment especially in the more remote areas, improving market linkages for inputs and outputs, and efficiently channeling public services and commercial transactions by developing demand driven producer organizations. Public investments in transportation and communication infrastructure could make a major contribution to these goals.

Land access, input- and output marketing, as well as farmer organizations are topics of on-going research in support of agricultural sector planning.

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APPENDIX 1. Crop Forecasting Survey Production Estimates

-----Metric Tonnes ----

MAIZE

Crop season	Zambia	Central	Copperbelt	Eastern	Luapula	Lusaka	Northern	N/western	Southern	Western
1986/87	1,063,449	281,822	48,253	319,635	17,912	35,438	101,412	15,168	225,697	18,111
1987/88	1,943,219	395,218	71,355	583,328	25,891	88,887	164,688	27,549	538,830	47,473
1988/89	1,843,180	438,339	60,026	540,326	42,758	70,987	150,776	33,932	456,082	49,954
1989/90	1,119,670	231,551	77,147	283,367	38,686	38,304	103,261	22,921	287,456	36,976
1990/91	1,095,908	326,790	62,092	316,108	17,756	46,285	85,602	26,230	185,707	29,338
1991/92	483,492	172,795	32,348	82,317	29,027	39,471	71,984	16,602	25,215	13,733
1992/93	1,597,767	396,539	79,421	339,391	37,669	85,715	120,274	29,317	462,637	46,805
1993/94	1,020,749	218,990	54,806	213,845	47,320	31,889	180,862	43,595	193,605	35,836
1994/95	737,835	172,177	50,288	197,936	31,362	19,329	117,828	33,565	84,455	30,897
1995/96	1,409,485	347,969	76,230	375,942	37,679	76,416	113,010	34,653	286,532	61,053
1996/97	960,188	153,325	53,102	248,093	33,807	44,453	97,251	38,258	251,936	39,963
1997/98	638,134	144,347	29,493	194,292	9,216	22,731	44,225	20,287	149,386	24,158
1998/99	855,869	134,677	64,145	284,360	21,117	32,909	62,388	23,365	200,574	32,336

Note: 1997/98 includes yellow maize

SUNFLOWER

Crop season	Zambia	Central	Copperbelt	Eastern	Luapula	Lusaka	Northern	N/western	Southern	Western
1986/87	12,431	2,051	96	1,978	99	1,191	27	17	6,966	7
1987/88	18,404	2,735	64	6,750	34	834	29	109	7,842	8
1988/89	15,023	1,720	60	4,254	48	709	25	62	8,131	14
1989/90	16,361	2,322	25	4,582	76	1,227	44	70	7,958	56
1990/91	10,645	1,959	12	3,054	71	984	8	84	4,473	3
1991/92	1,493	411	2	596	14	49	6	84	330	1
1992/93	15,479	4,194	39	1,851	17	530	30	60	8,756	1
1993/94	9,821	3,333	53	1,258	0	238	73	84	4,771	12
1994/95	13,649	4,885	38	5,165	0	263	100	130	3,062	7
1995/96	26,178	4,941	97	9,272	11	458	505	114	10,759	22
1996/97	7,433	361	50	2,780	29	307	243	122	3,521	19
1997/98	5,708	1,271	2	1,023	402	52	435	23	2,484	17
1998/99	6,748	1,645	825	1,663	44	31	933	16	1,588	3

SOYABEANS

Crop season	Zambia	Central	Copperbelt	Eastern	Luapula	Lusaka	Northern	N/western	Southern	Western
1986/87	13,462	2,330	2,078	1,824	294	2,440	1,154	648	2,642	50
1987/88	21,470	6,574	5,656	2,104	455	1,076	1,586	1,292	2,687	41
1988/89	20,578	4,897	5,982	2,304	409	1,272	1,364	1,888	2,435	29
1989/90	26,791	5,518	5,831	3,055	477	2,948	1,775	2,435	4,737	14
1990/91	25,676	14,519	176	387	237	1,614	2,088	1,735	4,910	10
1991/92	8,800	1,010	12	2,181	247	1,199	743	748	2,630	30
1992/93	26,001	9,912	4,611	2,135	68	1,211	115	125	7,801	23
1993/94	24,630	9,875	5,296	2,135	107	1,369	141	0	5,705	0
1994/95	21,129	9,551	20	1,226	0	2,381	316	44	7,590	0
1995/96	40,050	10,854	4,811	2,638	233	5,003	288	170	16,026	26
1996/97	29,292	5,837	9,335	5,663	35	3,950	96	68	4,299	8
1997/98	12,376	3,782	43	3,443	5	3,964	143	13	961	23
1998/99	26,696	140	17,954	1,311	19	4,123	176	37	2,937	0

GROUNDNUTS

Crop season	Zambia	Central	Copperbelt	Eastern	Luapula	Lusaka	Northern	N/western	Southern	Western
1986/87	47,426	3,226	1,376	15,699	5,624	170	16,551	1,213	2,465	1,102
1987/88	33,400	2,598	990	11,298	3,071	460	10,540	398	3,306	740
1988/89	30,104	1,164	437	13,947	1,339	29	4,075	224	8,130	759
1989/90	25,086	2,777	886	6,603	2,189	292	6,887	555	4,417	481
1990/91	28,188	2,346	558	12,307	2,478	19	5,601	603	4,008	267
1991/92	20,504	2,625	702	4,119	3,428	379	5,378	783	2,906	185
1992/93	34,301	2,610	1,359	14,144	4,285	555	6,059	916	3,382	990
1993/94	34,732	2,185	1,496	9,433	4,251	540	10,947	1,960	2,538	1,382
1994/95	36,119	3,007	1,600	11,961	5,727	213	9,660	656	2,695	599
1995/96	34,755	4,569	2,117	12,168	2,722	1,204	8,170	700	2,568	536
1996/97	45,859	4,764	1,997	16,091	5,372	453	8,557	1,180	6,232	1,215
1997/98	56,934	4,373	2,248	25,035	5,601	239	12,123	1,074	5,200	1,040
1998/99	50,965	3,141	1,246	19,562	6,662	0	12,266	1,766	5,085	1,237

PADDY RICE

Crop season	Zambia	Central	Copperbelt	Eastern	Luapula	Lusaka	Northern	N/western	Southern	Western
1986/87	8,242	44	75	1,058	330	3	3,281	470	0	2,982
1987/88	9,654	42	52	1,492	235	176	3,560	670	0	3,426
1988/89	11,734	28	61	1,886	411	200	4,351	557	0	4,240
1989/90	9,293	80	112	1,284	484	0	3,797	262	0	3,276
1990/91	14,186	42	33	2,074	462	533	4,605	848	0	5,590
1991/92	8,289	57	41	733	685	269	3,373	626	0	2,506
1992/93	13,993	55	43	2,054	685	53	5,165	846	0	5,092
1993/94	6,358	23	0	769	676	23	2,576	143	0	2,148
1994/95	12,110	19	0	1,245	653	0	7,838	720	0	1,634
1995/96	13,296	0	50	1,936	459	4	8,133	419	0	2,294
1996/97	12,473	0	1	1,042	643	0	5,612	15	0	5,160
1997/98	6,399	0	7	1,187	757	0	1,655	36	0	2,757
1998/99	14,700	0	15	0	2,296	0	6,783	0	0	5,606

WHEAT (irrigated)

Crop season	Zambia	Central	Copperbelt	Eastern	Luapula	Lusaka	Northern	N/western	Southern	Western
1986/87	27,408	2,515	4,050	403	0	12,449	0	0	7,991	0
1987/88	32,914	3,028	4,860	538	0	13,808	0	0	10,680	0
1988/89	46,614	3,317	7,238	540	0	20,174	0	0	15,346	0
1989/90	53,601	3,346	14,670	540	0	19,467	0	0	15,578	0
1990/91	58,732	3,265	15,394	617	0	20,341	0	0	19,116	0
1991/92	54,490	11,840	17,325	520	0	11,655	0	0	13,150	0
1992/93	69,286	14,220	16,560	720	0	16,186	0	0	21,600	0
1993/94	60,944	9,083	16,831	633	0	13,707	0	0	20,691	0
1994/95	38,019	8,318	15,430	270	0	5,271	0	0	8,731	0
1995/96	57,595	9,411	19,743	0	0	11,594	0	0	16,847	0
1996/97	70,810	8,737	18,850	0	0	16,433	0	0	26,790	0
1997/98	63,925	13,097	25,650	0	0	13,300	0	0	11,878	0
1998/99	39,346	3,579	23,670	540	0	6,993	0	0	4,564	0

SEED COTTON

Crop season	Zambia	Central	Copperbelt	Eastern	Luapula	Lusaka	Northern	N/western	Southern	Western
1986/87	20,156	9,961	69	3,566	1	454	3	0	6,061	40
1987/88	58,530	27,609	105	7,301	8	1,459	2	4	21,953	88
1988/89	34,154	11,140	62	8,019	28	538	3	2	14,314	48
1989/90	36,536	10,940	130	10,157	13	918	27	21	14,173	158
1990/91	48,721	22,271	6	15,322	17	816	52	7	9,899	331
1991/92	25,899	10,783	59	8,194	29	1,751	34	30	4,639	380
1992/93	47,901	23,047	139	15,758	20	1,523	30	0	7,361	23
1993/94	33,494	5,973	51	21,169	20	552	30	0	5,399	300
1994/95	16,979	5,374	51	8,841	20	348	30	0	2,016	300
1995/96	41,225	24,600	51	11,174	20	1,250	30	0	3,800	300
1996/97	70,000	32,000	51	31,000	20	500	30	0	6,000	300
1997/98	110,000	30,000	51	72,000	20	500	30	0	7,000	300
1998/99	140,074	10,718	32	120,559	20	540	30	0	7,880	295

SORGHUM

Crop season	Zambia	Central	Copperbelt	Eastern	Luapula	Lusaka	Northern	N/western	Southern	Western
1986/87	26,191	2,462	1,986	2,561	334	1,153	163	14,295	1,479	1,757
1987/88	22,774	3,132	2,581	2,931	92	3,285	246	5,535	2,222	2,751
1988/89	33,757	1,949	12,099	4,986	728	1,573	378	2,813	6,227	3,005
1989/90	19,591	2,141	1,670	4,763	769	715	770	3,985	2,484	2,293
1990/91	20,939	3,598	544	2,855	1,483	1,490	121	3,093	5,357	2,398
1991/92	13,007	3,241	1,738	1,581	1,191	643	124	2,916	136	1,438
1992/93	35,448	9,554	2,398	4,398	2,161	2,544	2,138	3,754	6,104	2,397
1993/94	35,068	11,904	8,252	2,581	332	500	577	991	6,466	3,465
1994/95	26,523	5,188	6,089	4,334	1,231	378	1,423	4,585	1,123	2,172
1995/96	35,640	6,417	6,355	1,379	774	1,301	2,230	3,513	8,592	5,080
1996/97	30,756	6,742	3,101	1,346	904	52	4,094	5,462	5,311	3,743
1997/98	25,399	5,645	3,060	1,851	804	0	4,846	4,423	2,455	2,316
1998/99	27,147	4,639	4,136	1,890	793	0	6,970	3,827	1,818	3,074

BURLEY TOBACCO

Crop season	Zambia	Central	Copperbelt	Eastern	Luapula	Lusaka	Northern	N/western	Southern	Western
1986/87	651	0	17	616	0	5	0	0	13	0
1987/88	0	0	0	0	0	0	0	0	0	0
1988/89	980	0	8	929	18	0	10	4	12	0
1989/90	1,550	54	16	1,375	23	37	16	9	21	1
1990/91	0	0	0	0	0	0	0	0	0	0
1991/92	1,050	64	66	814	0	0	0	5	103	0
1992/93	2,514	110	101	2,168	0	113	0	3	19	0
1993/94	1,083	0	0	844	0	239	0	0	0	0
1994/95	1,560	150	0	1,200	0	120	0	0	90	0
1995/96	1,892	324	0	1,508	0	39	0	0	22	0
1996/97	2,000	0	0	0	0	0	0	0	0	0
1997/98	3,500	0	0	0	0	0	0	0	0	0
1998/99	6,431	99	2	6,248	0	0	2	0	80	0

VIRGINIA TOBACCO

Crop season	Zambia	Central	Copperbelt	Eastern	Luapula	Lusaka	Northern	N/western	Southern	Western
1986/87	2,900	1,095	5	163	0	0	5	0	1,577	54
1987/88	0	0	0	0	0	0	0	0	0	0
1988/89	2,620	1,857	28	401	2	0	8	7	260	57
1989/90	3,488	1,015	180	562	2	477	18	20	1,129	86
1990/91	865	544	0	129	1	0	0	2	190	0
1991/92	1,258	680	0	127	0	0	0	1	412	38
1992/93	4,138	2,193	0	409	0	0	3	0	1,478	55
1993/94	5,015	0	0	2,525	0	2,490	0	0	0	0
1994/95	2,240	0	0	150	0	650	0	0	1,440	0
1995/96	1,950	354	0	137	0	274	0	0	1,184	0
1996/97	2,000	0	0	0	0	0	0	0	0	0
1997/98	2,000	0	0	0	0	0	0	0	0	0
1998/99	2,169	101	11	715	0	0	2	0	1,046	293

MILLET

Crop season	Zambia	Central	Copperbelt	Eastern	Luapula	Lusaka	Northern	N/western	Southern	Western
1986/87	30,262	139	41	2,404	13,236	0	10,882	420	858	2,282
1987/88	27,000	225	108	2,074	5,442	0	10,784	726	4,875	2,765
1988/89	27,260	271	64	3,130	4,202	0	10,566	516	3,578	4,934
1989/90	31,531	1,478	46	3,552	7,895	0	11,692	588	1,886	4,395
1990/91	25,573	686	65	1,087	3,994	0	14,395	405	646	4,295
1991/92	48,029	4,009	350	1,574	4,067	0	33,304	1,047	249	3,429
1992/93	37,394	2,496	198	1,517	6,398	13	18,506	653	934	6,679
1993/94	62,644	7,763	1,127	2,692	5,172	0	36,738	1,073	2,108	5,971
1994/95	54,501	3,692	393	3,398	5,659	0	31,443	966	459	8,491
1995/96	54,858	2,974	591	3,514	4,587	167	27,236	1,386	3,889	10,513
1996/97	61,129	4,795	151	1,603	4,251	110	33,259	623	2,846	13,490
1997/98	62,236	6,797	408	1,863	5,811	0	35,264	482	2,221	9,390
1998/99	69,617	6,114	971	2,497	5,157	0	44,131	684	1,025	9,040

MIXED BEANS

Crop season	Zambia	Central	Copperbelt	Eastern	Luapula	Lusaka	Northern	N/western	Southern	Western
1986/87	10,589	298	244	1,094	342	17	7,707	330	468	88
1987/88	24,415	354	82	1,360	614	22	20,562	1,254	64	103
1988/89	14,312	613	143	310	1,599	3	9,788	1,734	10	113
1989/90	14,123	433	157	572	1,133	59	10,410	1,303	15	41
1990/91	20,401	1,117	148	400	862	3	16,725	973	11	161
1991/92	23,534	1,399	463	865	2,033	36	16,777	1,593	21	347
1992/93	23,180	1,163	520	714	1,221	0	16,917	1,845	798	0
1993/94	23,751	2,086	288	922	666	0	18,050	1,707	32	0
1994/95	23,838	2,418	482	1,375	719	183	15,690	2,209	743	20
1995/96	13,728	1,438	311	957	1,290	85	6,500	2,481	643	24
1996/97	13,905	1,281	299	494	1,182	17	8,578	1,934	121	0
1997/98	13,905	1,281	299	494	1,182	17	8,578	1,934	121	0
1998/99	18,292	1,206	245	666	1,098	270	12,112	1,793	4	900

DISTRIBUTION OF LARGE-SCALE FARMS

Crop season	Zambia	Central	Copperbelt	Eastern	Luapula	Lusaka	Northern	N/western	Southern	Western
1990/92	2,052	859	63	241	52	116	137	41	453	90

Source: MAFF/CSO

APPENDIX 2. Post Harvest Survey Production Estimates

-----Metric Tonnes ----

MAIZE

Crop season	Zambia	Central	Eastern	Southern	Northern	N/Western	Copperbelt	Lusaka	Western	Luapula
1992/93	946,941	194,248	287,073	193,914	108,156	33,730	38,522	35,042	30,690	25,567
1993/94	718,058	113,265	224,782	140,559	97,225	25,655	29,520	21,977	31,785	33,288
1994/95	575,915	138,294	211,133	48,204	56,402	29,020	32,261	14,425	30,104	16,072
1995/96	1,098,500	245,766	304,412	242,791	80,576	31,176	70,946	38,399	50,742	33,691
1996/97	748,889	86,820	212,112	214,232	66,376	29,818	36,005	35,836	47,905	19,784
1997/98	625,015	113,212	198,257	165,596	31,791	17,209	33,378	24,493	30,955	10,125

SWEET POTATOES

Crop season	Zambia	Central	Eastern	Southern	Northern	N/Western	Copperbelt	Lusaka	Western	Luapula
1992/93	26,891	6,278	4,270	2,749	1,698	2,359	7,568	282	160	1,526
1993/94	16,902	7,182	1,582	1,445	2,019	605	2,054	297	246	1,471
1994/95	24,041	6,651	825	171	4,343	3,465	5,724	428	192	2,242
1995/96	16,875	1,698	836	386	4,110	2,253	3,401	7	318	4,183
1996/97	36,227	6,182	3,141	3,764	6,074	2,747	6,081	291	908	7,038
1997/98	37,842	7,590	1,611	1,564	13,343	3,277	7,284	60	83	3,030

SOYABEANS

Crop season	Zambia	Central	Eastern	Southern	Northern	N/Western	Copperbelt	Lusaka	Western	Luapula
1992/93	3,919	917	2,892	0	53	0	47	1	0	10
1993/94	836	139	570	9	29	17	72	0	0	0
1994/95	940	275	393	20	166	9	14	0	0	63
1995/96	1,365	281	1,141	33	140	5	36	7	0	4
1996/97	3,244	56	2,950	0	106	55	20	54	0	2
1997/98	2,110	20	1,836	56	80	5	40	13	0	59

SUNFLOWER

Crop season	Zambia	Central	Eastern	Southern	Northern	N/Western	Copperbelt	Lusaka	Western	Luapula
1992/93	10,506	3,231	2,504	4,484	0	31	81	176	0	0
1993/94	3,853	1,103	1,074	1,593	33	25	17	0	8	0
1994/95	6,705	1,326	2,115	3,020	98	9	16	112	2	8
1995/96	13,900	2,252	7,846	3,051	425	63	1	126	0	137
1996/97	6,222	391	1,952	3,608	161	43	35	25	0	7
1997/98	6,129	2,306	1,607	1,663	407	11	33	102	0	0

GROUNDNUTS

Crop season	Zambia	Central	Eastern	Southern	Northern	N/Western	Copperbelt	Lusaka	Western	Luapula
1992/93	29,547	1,989	13,006	3,507	5,571	1,276	789	311	468	2,628
1993/94	23,017	2,502	9,142	3,657	4,738	207	784	102	407	1,478
1994/95	15,123	2,297	2,346	677	5,742	174	1,211	545	184	1,948
1995/96	29,733	3,440	7,350	2,084	8,220	489	2,068	440	763	4,879
1996/97	46,273	2,786	21,180	5,809	9,577	707	1,398	392	978	3,445
1997/98	49,187	3,323	22,110	5,627	9,595	1,146	1,124	532	338	5,393

SORGHUM

Crop season	Zambia	Central	Eastern	Southern	Northern	N/Western	Copperbelt	Lusaka	Western	Luapula
1992/93	29,740	8,838	4,838	4,340	399	2,158	4,233	1,274	3,063	598
1993/94	18,561	3,286	1,223	4,352	789	3,401	3,137	231	1,853	287
1994/95	18,007	5,317	912	614	674	2,233	5,576	253	1,983	445
1995/96	25,348	4,851	2,639	4,413	2,505	4,499	1,504	319	3,706	913
1996/97	23,604	4,917	926	2,807	4,834	3,592	2,539	213	2,829	945
1997/98	23,697	5,477	1,244	1,473	3,766	4,388	3,143	55	3,145	1,006

SEED COTTON

Crop season	Zambia	Central	Eastern	Southern	Northern	N/Western	Copperbelt	Lusaka	Western	Luapula
1992/93	23,103	8,083	12,881	1,599	0	0	97	373	70	0
1993/94	18,384	5,495	9,078	3,615	0	0	4	192	0	0
1994/95	27,991	9,229	15,000	3,684	0	0	56	18	4	0
1995/96	63,858	20,091	36,607	6,373	0	0	10	706	71	0
1996/97	58,051	13,322	38,915	4,700	0	23	9	688	393	0
1997/98	72,560	12,258	49,506	9,318	0	0	18	1,208	254	0

MIXED BEANS

Crop season	Zambia	Central	Eastern	Southern	Northern	N/Western	Copperbelt	Lusaka	Western	Luapula
1992/93	14,887	1,383	586	68	9,493	2,057	168	4	50	1,078
1993/94	8,133	215	250	35	6,325	698	152	30	0	428
1994/95	11,061	580	438	84	7,549	1,779	262	2	0	366
1995/96	9,710	493	612	115	6,929	554	547	18	17	424
1996/97	9,722	617	446	23	6,643	1,207	243	24	0	519
1997/98	9,913	589	392	158	6,906	940	257	48	8	615

MILLET

Crop season	Zambia	Central	Eastern	Southern	Northern	N/Western	Copperbelt	Lusaka	Western	Luapula
1992/93	39,718	6,687	2,171	2,992	19,395	826	675	5	4,381	2,586
1993/94	22,790	1,543	2,003	1,548	12,577	426	59	23	2,910	1,703
1994/95	29,935	1,571	1,946	599	17,563	473	248	0	5,910	1,625
1995/96	46,709	2,502	3,307	1,193	27,375	444	35	35	8,132	3,685
1996/97	50,401	3,255	1,596	521	32,791	242	105	0	8,168	3,724
1997/98	44,730	4,777	1,407	1,612	25,335	136	343	0	8,329	2,791

CASSAVA FLOUR

Year	Zambia	Central	Eastern	Southern	Northern	N/Western	Copperbelt	Lusaka	Western	Luapula
1992/93	152,952	3,544	392	0	53,405	27,041	536	0	6,068	61,966
1993/94	131,549	6,919	382	489	53,231	15,455	695	0	8,736	45,642
1994/95	112,561	2,452	70	0	48,680	23,364	629	0	4,826	32,540
1995/96	98,069	1,411	9	0	39,000	7,014	1,572	0	4,933	44,131
1996/97	189,511	4,184	292	124	77,383	19,874	381	0	4,442	82,832
1997/98	231,253	4,414	597	21	116,206	19,851	135	0	5,093	84,936

Source: MAFF/CSO

APPENDIX 3. Constant 1998 Commodity Prices (ZK/kg) and Consumer Price Index 1980-1999

Crop	ZK/kg 1994/95	1995/96	1996/97	1997/98	1998/99	Average 94/5-98/9	Price relatives based on 1998/99 price of maize	
Maize	140	194	188	266	399	237	1.00	399
Sweet potato	454	891	881	580	1,262	814	3.43	1,367
Soybean	240	286	346	384	395	330	1.39	555
Sunflower	137	202	210	212	291	210	0.89	354
Groundnut	375	400	550	562	580	493	2.08	829
Sorghum	88	178	166	172	230	167	0.70	280
Raw cassava	289	535	506	488	295	423	1.78	710
Dried beans	779	1,039	1,607	2,389	2,471	1,657	6.98	2,785
Dried cassava chips	170	312	272	395	567	343	1.45	577
Virginia tobacco	1,077	1,757	2,767	2,899	2,896	2,279	9.60	3,831
Paprika	400	689	1,216	1,666	2,286	1,251	5.27	2,103
Seed cotton	235	360	429	570	562	431	1.82	725
Burley tobacco	848	1,297	1,778	1,825	2,167	1,583	6.67	2,660

sources: white maize, CSO retail, Lusaka, based on kw per 16 kg tin (20 litre can)
soybean: ACE wholesale, Lusaka
sunflower: ACE wholesale, Lusaka
groundnut: ACE wholesale, Lusaka
sorghum/millet: CSO retail, Mazabuka (no Lusaka data available)
raw cassava: CSO retail, Ndola (no Lusaka data available), based on price per raw kg
dried bean: CSO retail, Lusaka
cotton seed: Lonrho average prices, into-depot price
paprika: buy price, Cheetah Zambia
burley and virginia tobacco: TAZ, Tobacco Association of Zambia, producer prices + transport to Lusaka
sweet potato: retail Lusaka urban, CSO based on price per kg raw
dried cassava chip: AMIC, retail Northwestern - Solwezi, 1 kg unit

Year	CPI 1994=100	CPI 1998=100
1980	0.143	0.048
1981	0.162	0.054
1982	0.183	0.061
1983	0.219	0.073
1984	0.263	0.088
1985	0.361	0.121
1986	0.549	0.184
1987	0.785	0.263
1988	1.221	0.409
1989	2.398	0.802
1990	6.051	2.024
1991	11.658	3.900
1992	33.957	11.361
1993	65.876	22.040
1994	100.000	33.456
1995	134.900	45.132
1996	193.000	64.570
1997	240.200	80.361
1998	298.900	100.000
1999	378.500	126.631

Source: Ministry of Finance and Economic Development

APPENDIX 4. Zambia Population Estimates (adjusted for HIV/AIDS)

Population Total

Year	Zambia	Central	Eastern	Southern	Northern	N/western	Copperbelt	Lusaka	Western	Luapula
1992/93	8,482,000	839,000	1,079,000	1,074,000	1,012,000	482,000	1,597,000	1,075,000	678,000	601,000
1993/94	8,738,000	863,000	1,105,000	1,112,000	1,043,000	498,000	1,646,000	1,105,000	692,000	613,000
1994/95	9,001,000	887,000	1,131,000	1,152,000	1,074,000	514,000	1,697,000	1,135,000	705,000	626,000
1995/96	9,223,000	906,000	1,155,000	1,188,000	1,100,000	529,000	1,733,000	1,154,000	717,000	635,000
1996/97	9,450,000	925,000	1,179,000	1,225,000	1,127,000	544,000	1,771,000	1,174,000	728,000	645,000
1997/98	9,683,000	945,000	1,204,000	1,264,000	1,155,000	560,000	1,809,000	1,194,000	740,000	654,000
1998/99	9,921,000	965,000	1,229,000	1,303,000	1,183,000	577,000	1,848,000	1,214,000	752,000	663,000

Population Rural

Year	Zambia	Central	Eastern	Southern	Northern	N/western	Copperbelt	Lusaka	Western	Luapula
1992/93	5,281,000	598,000	985,000	830,000	877,000	416,000	235,000	180,000	592,000	511,000
1993/94	5,448,000	615,000	1,009,000	861,000	905,000	430,000	240,000	184,000	604,000	523,000
1994/95	5,620,000	633,000	1,034,000	893,000	933,000	443,000	245,000	189,000	616,000	534,000
1995/96	5,776,000	647,000	1,057,000	922,000	958,000	457,000	248,000	191,000	626,000	543,000
1996/97	5,936,000	662,000	1,080,000	952,000	983,000	471,000	252,000	195,000	637,000	552,000
1997/98	6,101,000	677,000	1,104,000	983,000	1,009,000	485,000	255,000	198,000	648,000	561,000
1998/99	6,270,000	693,000	1,128,000	1,015,000	1,036,000	500,000	258,000	201,000	659,000	570,000

Population Urban

Year	Zambia	Central	Eastern	Southern	Northern	N/western	Copperbelt	Lusaka	Western	Luapula
1992/93	3,201,000	241,000	94,000	244,000	135,000	66,000	1,362,000	895,000	86,000	90,000
1993/94	3,290,000	248,000	96,000	251,000	138,000	68,000	1,406,000	921,000	88,000	90,000
1994/95	3,381,000	254,000	97,000	259,000	141,000	71,000	1,452,000	946,000	89,000	92,000
1995/96	3,447,000	259,000	98,000	266,000	142,000	72,000	1,485,000	963,000	91,000	92,000
1996/97	3,514,000	263,000	99,000	273,000	144,000	73,000	1,519,000	979,000	91,000	93,000
1997/98	3,582,000	268,000	100,000	281,000	146,000	75,000	1,554,000	996,000	92,000	93,000
1998/99	3,651,000	272,000	101,000	288,000	147,000	77,000	1,590,000	1,013,000	93,000	93,000

Source: Food Reserve Agency/FAO, based on CSO 1990 Census

APPENDIX 5. Annual National Average Rainfall

Year	Aggregate Rainfall	Average Rainfall
	---- mm ----	
1961	1134	
1962	1332	
1963	1172	
1964	1033	
1965	971	
1966	1017	
1967	1005	
1968	1053	
1969	1216	
1970	981	746
1971	1137	577
1972	1018	847
1973	903	337
1974	1224	761
1975	1091	947
1976	1159	1095
1977	975	514
1978	1324	1090
1979	1155	767
1980	1140	651
1981	1136	1026
1982	889	732
1983	960	538
1984	960	584
1985	1105	578
1986	1108	956
1987	933	749
1988	976	615
1989	1168	1201
1990	1030	579
1991	954	716
1992	716	469
1993	1037	820
1994	900	700
1995	800	600
1996		925
1997		918
1998		846
1999		859

Source: Meteorological Department
Unweighted average of Chipata, Choma, Mongu, Solwezi, Lusaka, Kabwe, Mansa, and Kasama.

APPENDIX 6. OLS Regression Results on Crop Forecast Survey Crop Production Value

Dependent Variable: VALUE OF CROP PRODUCTION
Method: Least Squares
Date: 04/04/00 Time: 04:04
Sample(adjusted): 1980 1999
Included observations: 20 after adjusting endpoints

Variable	Coefficient	T-Statistic	Significance level
Constant	**110105**	**0.79**	**0.43**
Rainfall	**433.41**	**2.13**	**0.05**
Maize/Fertilizer Subsidies	**0.48**	**1.77**	**0.12**
Time Trend	**20975.11**	**2.7**	**0.01**
Spline Time Trend 1993 (Initiation of Reform Process)	**-14730.4**	**-1.42**	**0.17**

R-squared	**0.58**
Adjusted R-squared	**0.47**
S.E. of regression	**122 512**
Log likelihood	**-259.82**
Durbin-Watson stat	**2.23**

Data sources: National Meterological Department (rainfall); Kalinda-Chilumbu, 1993 (pg. 242 for maize and fertilizer subsidies up to 1992; calculations from MAFF and FRA data files from 1993-99).

APPENDIX 7. Energy Produced From Smallholder Food Crops (kCal/rural person/day)

ZAMBIA

Season	Maize	Other grains	Tubers	Legumes	Oil seeds	Total
1993/94	1,059	70	236	44	11	1,421
1994/95	823	82	200	30	19	1,154
1995/96	1,528	115	169	53	38	1,903
1996/97	1,014	116	317	80	17	1,544
1997/98	823	105	374	82	16	1,399
1998/99	978	145	557	95	17	1,792

CENTRAL PROVINCE

Season	Maize	Other grains	Tubers	Legumes	Oil seeds	Total
1993/94	1,480	69	138	40	28	1,755
1994/95	1,755	96	63	37	33	1,985
1995/96	3,052	100	30	53	54	3,288
1996/97	1,054	108	87	44	9	1,301
1997/98	1,344	132	89	50	53	1,667
1998/99	1,351	134	129	53	37	1,704

EASTERN PROVINCE

Season	Maize	Other grains	Tubers	Legumes	Oil seeds	Total
1993/94	1,790	31	8	89	18	1,935
1994/95	1,641	32	3	23	33	1,731
1995/96	2,314	51	3	69	117	2,554
1996/97	1,578	26	11	192	34	1,840
1997/98	1,443	27	9	196	26	1,700
1998/99	1,980	18	68	194	23	2,284

SOUTHERN PROVINCE

Season	Maize	Other grains	Tubers	Legumes	Oil seeds	Total
1993/94	1,312	60	9	42	29	1,452
1994/95	434	12	0	8	53	506
1995/96	2,116	54	1	22	51	2,244
1996/97	1,808	31	11	61	59	1,969
1997/98	1,353	27	5	57	26	1,468
1998/99	1,403	25	15	56	24	1,522

NORTHERN PROVINCE

Season	Maize	Other grains	Tubers	Legumes	Oil seeds	Total
1993/94	863	136	563	64	1	1,627
1994/95	486	198	505	75	2	1,265
1995/96	676	281	395	97	7	1,455
1996/97	543	336	759	108	3	1,748
1997/98	253	257	1,120	106	6	1,743
1998/99	470	461	1,729	152	14	2,826

NORTHWESTERN PROVINCE

Season	Maize	Other grains	Tubers	Legumes	Oil seeds	Total
1993/94	479	85	344	8	1	917
1994/95	526	59	520	11	0	1,117
1995/96	548	96	168	13	2	827
1996/97	509	73	414	20	2	1,017
1997/98	285	84	407	27	0	803
1998/99	364	80	657	47	1	1,148

COPPERBELT PROVINCE

Season	Maize	Other grains	Tubers	Legumes	Oil seeds	Total
1993/94	988	119	48	33	2	1,190
1994/95	1,058	213	80	50	1	1,402
1995/96	2,298	56	93	85	0	2,532
1996/97	1,148	94	72	56	2	1,373
1997/98	1,052	122	73	45	2	1,294
1998/99	1,155	176	176	55	50	1,611

LUSAKA PROVINCE

Season	Maize	Other grains	Tubers	Legumes	Oil seeds	Total
1993/94	960	12	4	6	0	982
1994/95	613	12	5	28	9	668
1995/96	1,615	17	0	23	10	1,665
1996/97	1,477	10	4	20	3	1,512
1997/98	994	2	1	27	8	1,032
1998/99	786	0	8	3	2	799

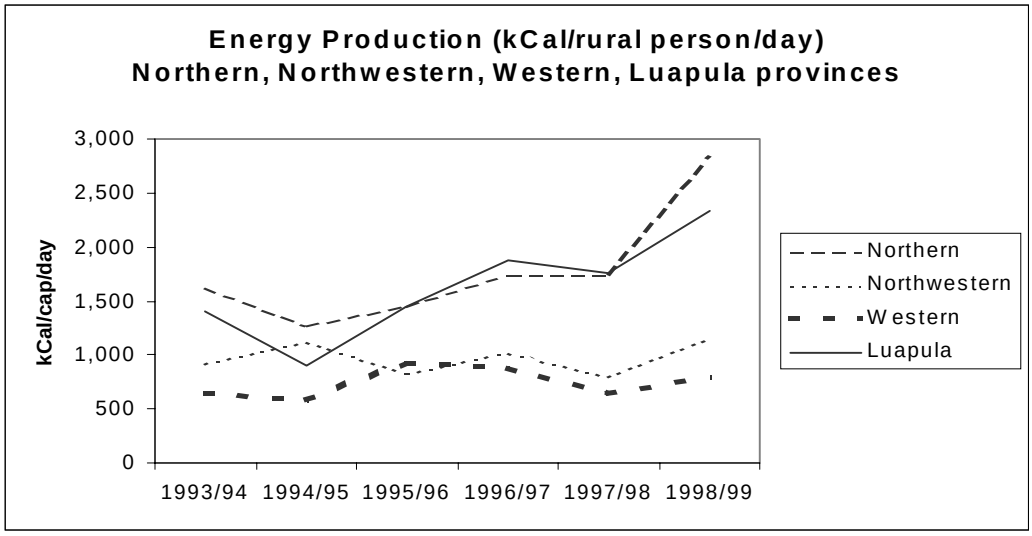
WESTERN PROVINCE

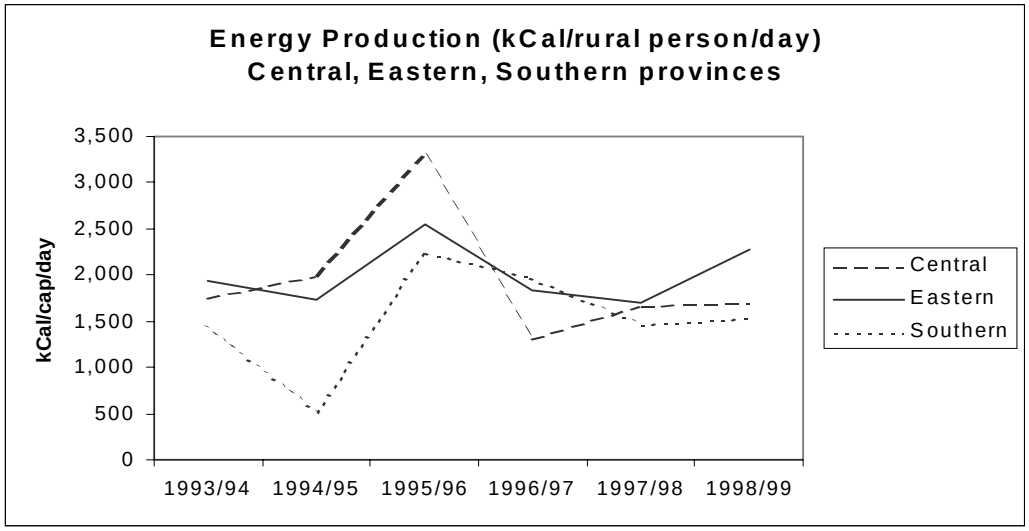
Season	Maize	Other grains	Tubers	Legumes	Oil seeds	Total
1993/94	423	77	138	7	0	645
1994/95	393	120	75	3	0	591
1995/96	651	197	74	12	0	934
1996/97	604	198	69	17	0	888
1997/98	384	188	75	5	0	652
1998/99	379	215	183	22	0	799

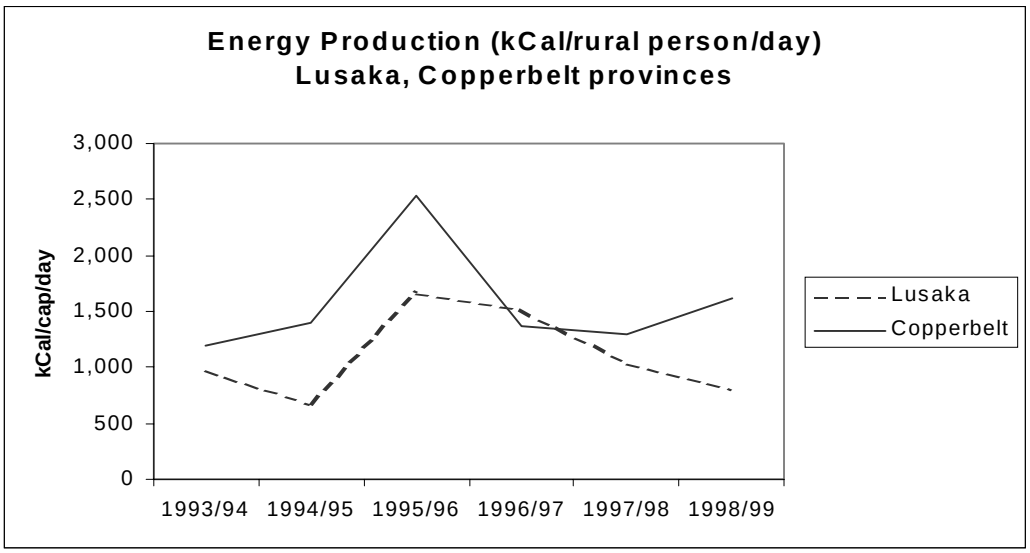
LUAPULA PROVINCE

Season	Maize	Other grains	Tubers	Legumes	Oil seeds	Total
1993/94	511	34	831	29	0	1,406
1994/95	242	35	586	37	0	900
1995/96	498	77	786	89	4	1,455
1996/97	288	79	1,449	66	0	1,882
1997/98	145	70	1,444	97	0	1,756
1998/99	290	116	1,796	132	1	2,335

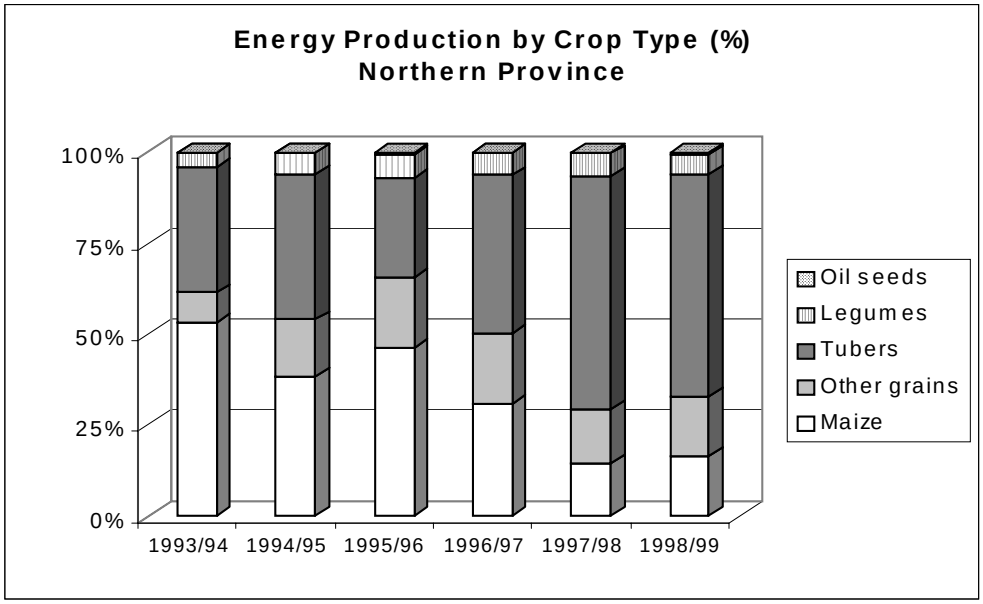
Energy Production in Rural Areas from Smallholder Food Crops (kCal/rural person/day)

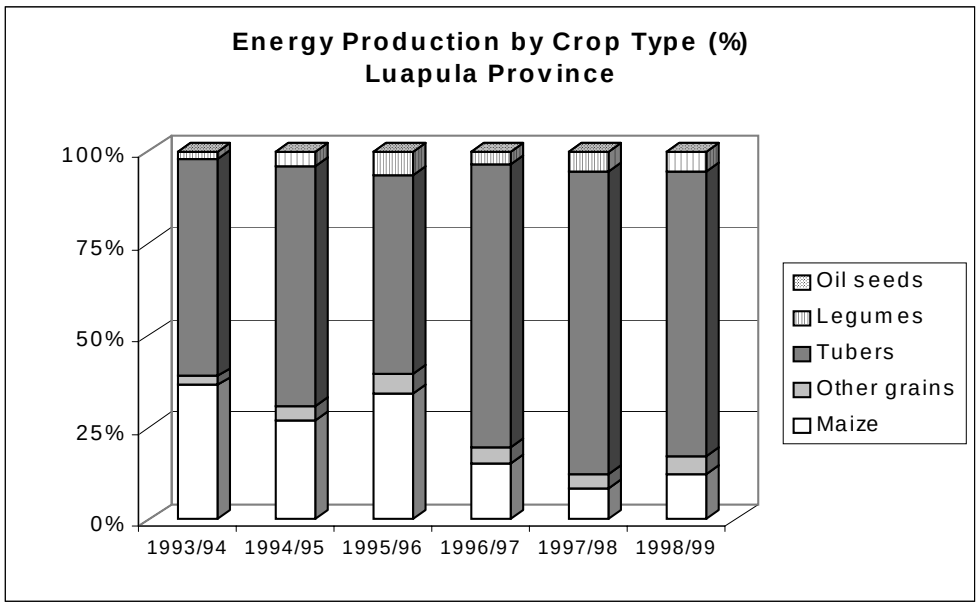


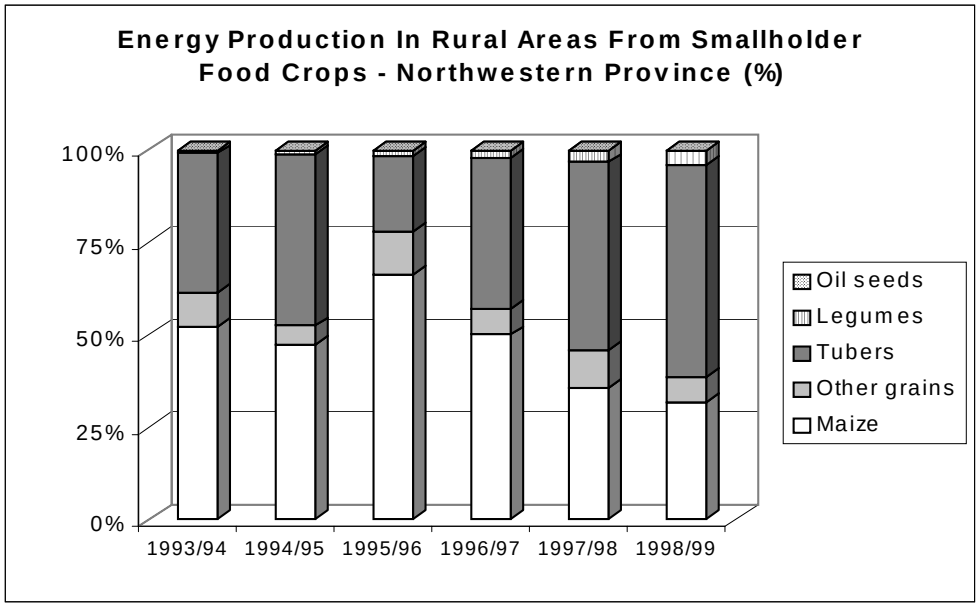




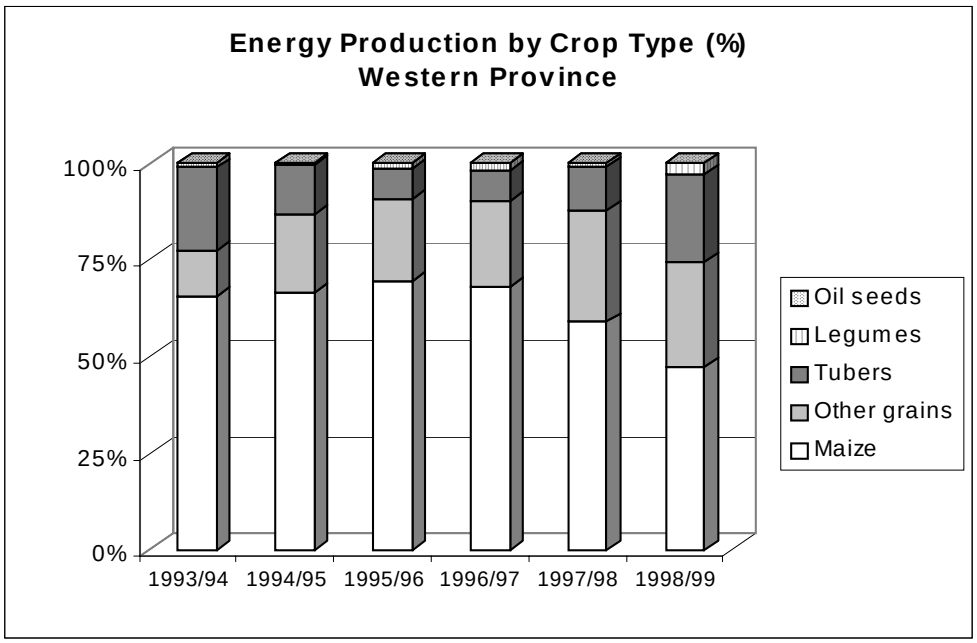
Proportionate Energy Production in Rural Areas from Smallholder Food Crops by Crop Type (%)

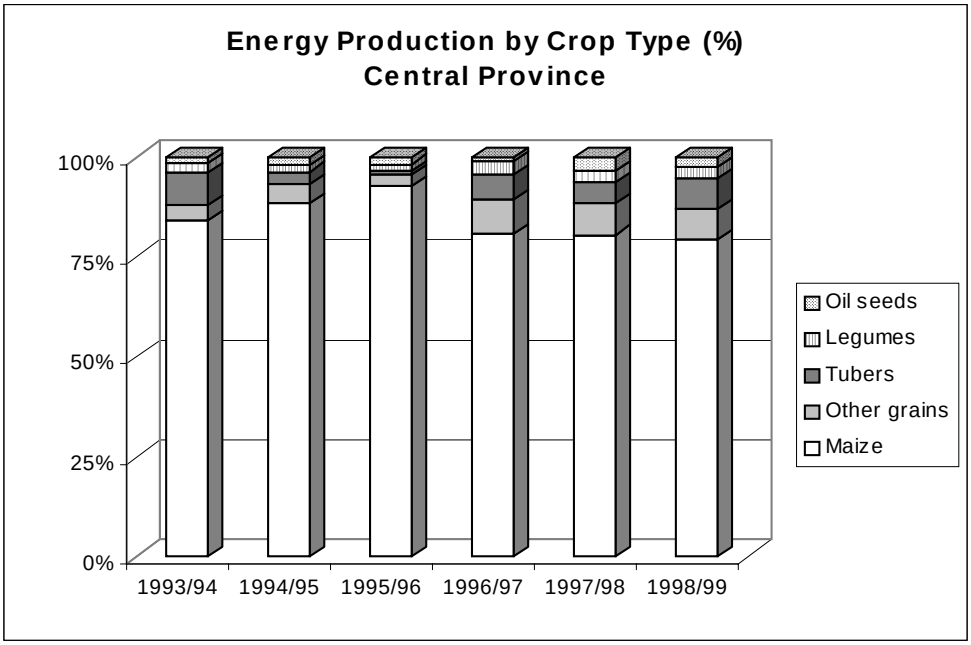
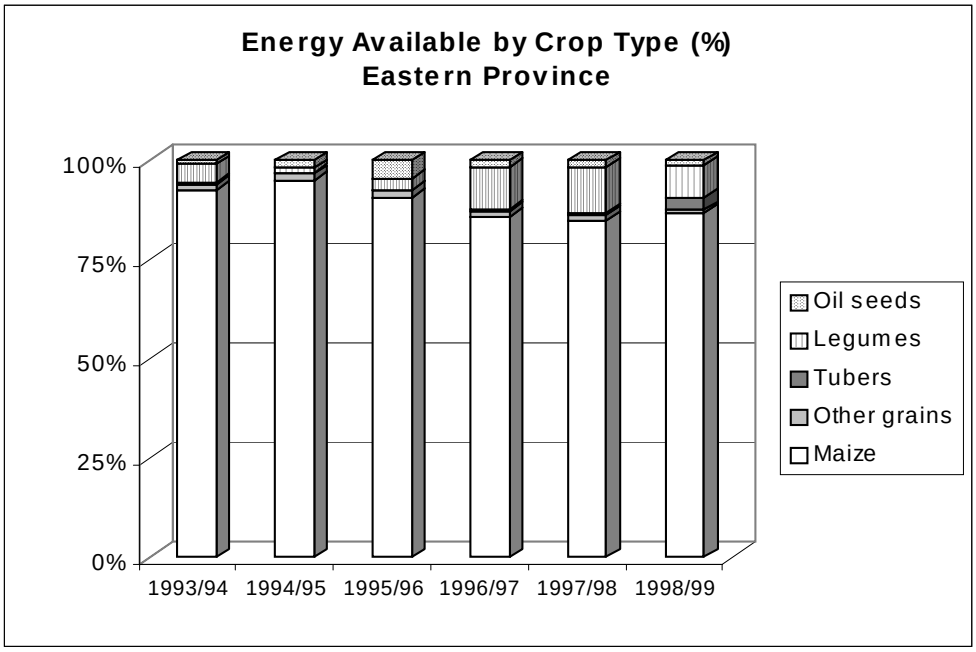
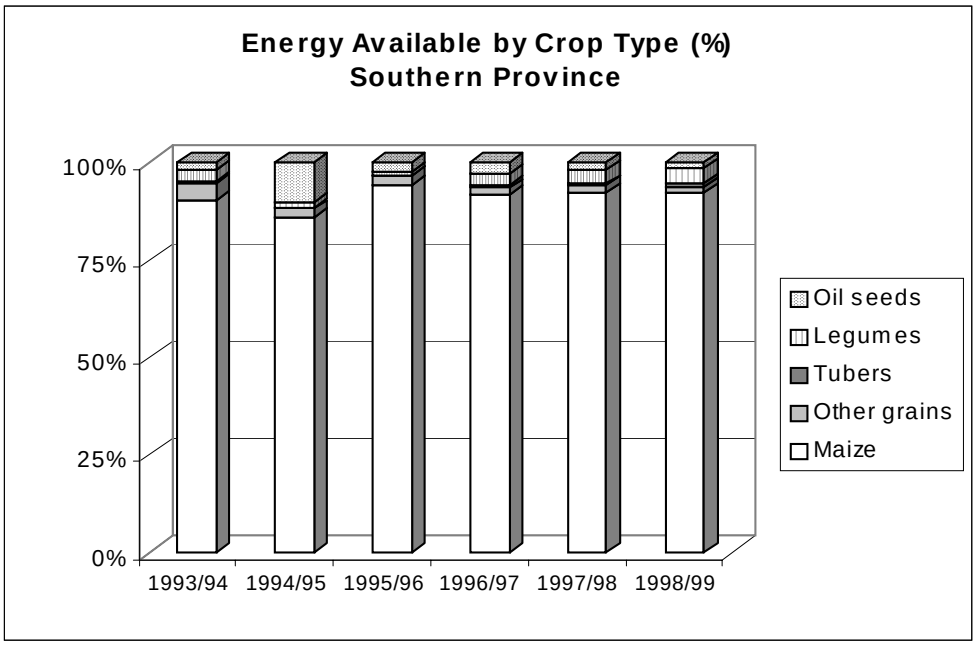






Proportionate energy production in rural areas from smallholder food crops by crop type (%)





Proportionate Energy Production in Rural Areas from Smallholder Food Crops by Crop Type (%)