AN ASSESSMENT OF THE EFFECTS OF CROP DIVERSIFICATION POLICY IN ZAMBIA

A Research Report Presented to the Department of Agricultural Economics and Extension of the University of Zambia

BY

EMMANUEL PHIRI

In Partial Fulfilment of the Requirement for the Degree of Bachelor Agricultural Sciences

ACKNOWLEDGEMENTS

The journey to attain my bachelor's degree has come to an end. It is my pleasure to express my gratitude to GOD for the unfailing love, support and for the life given me.

My sincere and deepest gratitude goes to my Supervisor and co-supervisor, Dr G. Tembo and Mr. Likulunga for providing a clear roadmap that has produced this paper.

Many thanks to Agricultural Economics class of 2012 for their constructive criticism and support. Thank you so much for helping in this learning process.

To my family and UNZA Seventh-Day Adventist church, I say thank you for holding me closer in my dark times. I am deeply indebted to Favour Mandanji Nyikosa; I cannot thank you enough for your unfailing emotional support and loyal friendship.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ACRONYMS

PAM	Policy Analysis Matrix
GDP	Gross Domestic Product
FNDP	Fifth National Development Plan
CSO	Central Statistic Office
MACO	Ministry of Agriculture and Cooperatives
ZARI	Zambia Agriculture Research Institute
SNDP	Sixth National Development Plan
NAP	National Agriculture Policy
OECD	Organisation for Economic and Community Development
DRC	Domestic Resource Coefficient
NPC	Nominal Protection Coefficient
EPC	Effective Protection Coefficient
FAO	Food Agriculture Organization
ZAMACE	Zambia Agricultural Marketing and Commodity Exchange
PPP	Public-Private Partnership

ABSRACT

An Assessment of the Effects of Crop Diversification Policy in Zambia: A Policy Analysis Matrix Approach.

Emmanuel Phiri
University of Zambia, 2012

Supervisor:
Dr. G. Tembo

Diversification of farming is very useful investment to mitigate risk, an engine for ensuring food security and assured sustainable incomes to farmers. This present study was conceived to assess the efficiency of maize and sorghum production, hence shedding light on the efficiency of crop diversification policy in Zambia. Two competitive crops (maize and sorghum) are selected to assess the efficiency of production using a modified policy analysis matrix (PAM) approach. The findings suggest that Zambian trade and domestic policies aimed at achieving both food security and crop diversification through high procurement price and heavy subsidization of inputs in maize production have induced major inefficiencies in crop diversification.

The study revealed through three key policy analysis indicators that sorghum production is efficient (DRC= 0.03) comparable to maize production (DRC= 0.87). Maize private price is 10.8 percent above social price (NPC= 1.08), and sorghum private price is 6.1 percent below social price. Also, maize producers enjoy heavy subsidy of 10.3 percent (EPC= 1.03) for their value added whereas sorghum producers face a net tax of around 6.1 percent (EPC= 0.61) for their value added. This indicates positive incentives for maize producers which is a cost on national budget given that domestic resource utilization is inefficient (DRC= 0.87) as compared to sorghum production (DRC= 0.03)

In that regard, it is recommended that diversified farming should be implemented through Private-Public Partnerships to reduce on costs that impede sorghum production growth.

Key words: crop diversification, agricultural policy, efficiency, risk, Zambia.

CHAPTER ONE
INTRODUCTION

1.1 Background

This study is an application of a policy analysis matrix (PAM) to assess the efficiency, costs and benefits of diversified production, which is implemented under a web of contradictory policies, including high procurement support price, and input subsidies, such as fertilizer and hybrid maize seed.

The Zambian agriculture sector is an important part of the economy contributing about 18-20 per cent of gross domestic product (GDP) and employing about two thirds of the labour force (FNDP 2006). The sector is dominated by smallholder peasant agriculture which accounts for 85 per cent of total food production. Out of the total agricultural land, about 57.8 per cent is cultivated under maize while the 42.2 per cent is under other crops (sorghum, millet etc.). This shift to diversified farming is attributed to many interrelated factors which include food security, recurrent droughts and floods (Belaineh 2003; CSO 2009).

Rural households in the country are exposed to a variety of risks that include harvest failure as a result of recurrent droughts and floods, frost and other climatic events (Dercon 2002). These influence the production and resource allocation decisions of smallholder farmers. Furthermore poor marketing and service structure make a significant issue to cash – constrained smallholder farmers.

In an effort to adapt to high degree of uncertainty which arises from dependency of the agricultural production on uncontrollable weather conditions which caused fluctuations on crop yields and income instability, the Zambian government encouraged farmers into diversified farming. Crop diversification (diversified farming) is one method of reducing income variability and ensuring food security (Briglauer 2000). According to comparative advantage theory, diversification can reduce risk but at the expense of income.

It is argued that diversified farming by growing more enterprises may lead to farm income stability (Tefera et al. 2003). Despite the significant role crop diversification is playing in agriculture, there are a few studies on efficiency, costs and benefits of diversified farming.

1.2 Problem Statement

In Zambia, according to MACO (2008), diversification is progressive and benefiting farmers shifting from maize to competing crops (sorghum, millet, tubers etc.). This is in light of agro climatic, agronomic, household food and nutrition security problems faced recurrently by the country. However, diversification may result in efficiency losses casting doubt on the desirability of crop diversification policy. Moreover, there is a gap of empirical evidence with respect to efficiency of diversification policy in Zambia. Of the few studies conducted by Zambia Agriculture research institute (ZARI), they focused more of developing crop varieties suitable for the various ago climatic regions to the exclusion of the efficiency of a policy that affects 70 per cent of small scale farmers and economic viability of the agricultural sector.

In study by Yao (1996), he found out that crop diversification policy was undesirable and after conducting sensitivity analysis, however, the results suggested that potential price changes, increasing water scarcity, and environmental effects justify the intervention policy. In another study by Mesfin and Fufa (2011), they focused on the pattern, trend and determinants of crop diversification and not its efficiency.

Zambia has a long history of policy vacillations in respect of agriculture and often policy making has rarely been evidence- based policy (Farrington & Saasa, 2002). For instance the input support programme is more oriented in maize production than diversifying, and fails to take into account the comparative advantages for different agro-ecological reasons (FAO, 2000).

1.3 Theoretical Framework

For rational decision making in the agricultural policy, agricultural policy analysis should have a clear and logical way of judging one alternative or policy option against the other. This limit to genuine differences of opinion in an ideal setting general logical approach called the policy analysis matrix (PAM) is proposed to serve that purpose. PAM's unique feature is its flexibility and its strength lies in its ability to analyse the effect of multiple policy instruments. It is a consistency framework which enables measurements of the efficiency of government policy intervention on producers, consumers and the economy at different stages of a vertical commodity chain.

Policies are the instruments of action that governments employ to effect the desired change. Three principle categories of policies are used to bring about change in agriculture; the first is the agricultural price policy. Two main types of price policy instruments can be used to alter prices of agricultural outputs or inputs, quotas, tariffs or subsidies on imports and quotas, taxes or subsidies on exports directly or increase amounts traded internationally and thus raise or lower domestic prices; these policies apply only to volumes traded internationally ,not to domestic production. Domestic taxes and subsidies, in contrast, create transfers between the government treasury and domestic producers and consumers. Some cause a divergence between domestic prices and world prices; others do not.

The second category of policies is nationwide in coverage. Macro-economic policy includes central government's decisions to tax and spend (fiscal policy), to control the supply of money (monetary policy) and to impose macro price policies affecting the foreign- exchange rate (exchange rate policy) and the domestic factors (wage, interest and land rentals rate).with the exception of land market policy, these decisions typically are not taken because of their impact on the agricultural sector. But macro policy effects, however unintended they might be, can more than offset the desired incentives of agricultural price policy.

In addition to price and macro policies, governments influence their agricultural sectors through public investment policy. Government budgetary resources can be invested in agriculture to increase productivity and reduce costs. The most common investments in agricultural research are to develop new technologies, in infrastructure (roads, irrigation, ports, marketing facilities), in specific agricultural projects to increase productive capacity and demonstrate new technologies and in education and training of agriculturalists to upgrade the human capital in the sector.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter reviews relevant literature on crop diversification and the conceptual framework. It goes on to define the PAM coefficients and then interpret their relevance to policy analysis.

2.2 Empirical Studies on Crop Diversification Policy

Across the world, several studies have been conducted with regards to crop diversification policy. In a study conducted by Yao (1997) to assess the costs and benefits of the Thai agricultural diversification policy in 1994-96, three competitive crops (rice, soybeans and moonbeams) were selected to study their comparative advantage in terms of a policy analysis matrix (PAM).the results showed that rice is more profitable than soybeans and moonbeams, implying that government intervention through diversification incurred efficiency losses. Given different policy and economic environments, this may not be the case in Zambia.

In a study done by Nelson and Fynn (2008) in Ghana, an application of PAM to study the social and private profitability of six maize production systems and six rice production systems amid increasing cereal prices showed that all 12 systems contributed to national economic growth and private income generation among farmers, at least under higher cereal prices. However, if cereal prices fall to the lower levels, most of the rice systems lose their profitability. This suggests that intervention measures (policies) may not necessarily incur losses. They focused on production systems with increasing prices much to the exclusion of the overall efficiency of the policy.

In Guatemala, Immink and Alarcon (2008) focused on complementariness between cash crops and food crops in crop diversification. It is commonly believed that food availability of small holder farmers will be affected by the displacement of food crops by cash crops. They found out that diversified farmers tended to have larger farms and cropland extension than maize farmers. Furthermore, diversified farmers had higher per capita income levels than maize farmers. They also found the risk associated with growing cash crops despite higher returns as; income loss from crop failure, market price variability overtime, weak and

inefficient marketing institutions and higher input requirements. In a similar study in Zimbabwe, Jayne (1994) using an econometric model found that cash crop production was economically unviable in an environment of higher food-marketing costs to rural areas despite the higher economic returns.

A careful study of literature on diversification indicates that most of the empirical studies undertaken focused on its determinants, pattern and trend of crop diversification much to the exclusion of its efficiency. For instance a baseline study by ZARI (2007) focused on effectively addressing periodic food deficiency in drought prone areas, an agro-climatic aspect. Of the few studies that have been done along the broader aspect in other countries ,their findings may not necessarily apply to Zambia as on such studies have been undertaken and given the differing policy ,social ,economic and political environment. This prompts the need for an academic inquiry to address the knowledge gap.

2.3 Conceptual Framework

For this study, policies are defined as government actions intended to change behaviour of producers and consumer's .Analysis is the evaluation of government decisions to changing economic behaviour. Agricultural refers to the production and consumption of commodities produced by cultivating crops or raising livestock. From these definitions, agricultural policy analysis can be defined as a logical system for analysing public policies affecting producers, marketers and consumers of crops and livestock products (Pearson, Gotsch and Bahri).

For qualitative analysis of policy, the policy analysis matrix (PAM), pioneered by Monke and Pearson (1989), is often used. The PAM embodies many insights from international trade theory and cost benefit analysis. The PAM is the representation of two basic identities. The first identity defines profitability as the difference between income costs(rows),whereas the second measures the effects of the differences in incomes ,costs and profits arising from distorting policies and market failures(columns)in this way ,the matrix allows us to compute the effects of a particular policy or the adoption of a new technology on income ,costs and profits.

Table 2.1: Policy Analysis Matrix

	Revenues	**Costs Tradable**	**Domestic**	**Profit**
Private Prices	A	B	C	D
Social Prices	E	F	G	H
Divergences	I	J	K	L

In table 2.1 above, private profitability from farming production is represented by (D=A-B-C) while social profitability by (H=E-F-G) and divergences between private and social valuations of revenue, costs and profits are in the last row of the PAM. They represent a net balance from the application of a combination of policies that create economic distortions (trade protection, price controls taxes and subsidies), market failures and correcting policies that aim to restore efficiency conditions. The columns of the matrix show income and profits, as well as a breakdown of costs into two components, tradable inputs and domestic production factors.

The main purpose of constructing a PAM is to capture the differences between private and social profitability. Private profitability refers to observed revenues and costs reflecting actual market prices received or paid by farmers, traders and processors in the agricultural system studied. These private or actual market prices thus incorporate the underlying economic costs and valuations plus the effects of all policies and market failures. Social profitability measures comparative advantage or efficiency in the agricultural commodity system. Efficient outcomes are achieved when an economy's resources are used in activities that create the highest levels of output and income. Social profitability, is to be strictly understood in conventional efficiency terms, e.g. adopting international prices as a benchmark in the valuation of tradable goods and therefore without encompassing other possible social objectives, such as the redistribution of income, food security or conventional protection.

Some conventions are adopted for pricing outputs and inputs in the PAM, in order to calculate social profitability. For those outputs and inputs which are internationally traded, world prices (c.i.f for imports and for exports) set up appropriate social values, whereas the

valuation of domestic factors corresponds to their opportunity cost (Martinez, Picazo-tadeo and Estruch, 2008).

For this study, the PAM will help in evaluation of the effects of government policies on profitability of sorghum and maize, thus enabling us to see the effects of policies on production in these two major crops. Since profitability affects production in agriculture, the PAM will be used to see the divergences between profitability in the absence of policy and profitability with the policy in place .This divergence will be a good measure of the general efficiency of the policy that is being examined.

To determine whether a farming system enjoys a comparative advantage in relation to the international market, certain ratios can be calculated from the PAM which helps us determine competitiveness, comparative advantage and efficiency in policies. These ratios are explained below;

1.1.1) **Domestic Resource Cost Ratio (DRC)**

$$DRC = G/(E-F)$$

This is the quotient between the cost of the domestic factors, valued at social prices and the value added also computed at social prices. An agricultural system enjoys a comparative advantage if its DRC ratio is less than one, indicating that the economy is saving foreign exchange by means of domestic production. DRC indicates whether use of domestic factors is socially profitable (DRC<1) or not (DRC>1). It is the most useful indicator; however, it may be biased against activities that rely heavily on domestic, non traded factors such as land and labour.

1.1.2 **Nominal Protection Coefficient Ratio (NPC)**

$$NPC = A/B$$

This ratio shows the extent to which domestic prices are higher or lower than the world prices. NPC >1, indicates incentives in place and NPC<1, indicates disincentives. The domestic price used in this computation could be either the procurement price or the farm gate price, while the world price is the international price adjusted for transportation, marketing, and processing costs.

1.1.3 **Effective Protection Coefficient (EPC)**

EPC= (A-B)/ (E-F)

It is a ratio of value added in private prices (A-B)to value added in social prices (E-F).an EPC value greater than one ,EPC >1, suggests that government policies provide positive incentives to producers while a value less than one ,EPC >1,indicate that producers are not protected through policy intervention.

CHAPTER THREE
RESEARCH METHODS AND PROCEDURES

3.1 Introduction

This chapter outlines the methods and procedures used to achieve the stated objectives. It gives information on the study sites, data collection and data analysis tools that were used in the study.

3.2 Study Sites

Selection of crops is paramount. Maize and Sorghum are preferred as they are some of the major competing crops in diversified farming. The study was conducted in Zambia.

3.3 Data Collection

The basic information needed is yields, inputs requirements and the market prices of inputs and outputs. The data of transportation cost, processing cost, storage cost, port charges, production/input subsidies and import/export tariffs are also required to derive social prices. Secondary data for 2010/11 farming season was used in the study. Data sources included the World Bank country data sets, FAO, MACO, CSO, ministry of commerce and trade ZAMACE etc. The three ratios NPC, DRC and EPC, where calculated as outline in the conceptual framework.

3.4 Data Analysis

A policy analysis matrix (PAM) was used to analyse the secondary data for 2010/11 farming season. This involved construction of: 1) inventory budgets, 2) input disaggregation tables, 3) systems budgets and 4) PAM and coefficients for both maize and sorghum. These are shown below:

Table 1: Maize inventory budget

	Units	Private Prices (ZMK)	Social Prices
Average Yield (kg/ha)	2230	1300	1201.74
Total Revenue		2899000	2679880.2
Variable Costs:			
Seed (kg)	20	5400	5400
Fertilizer;			
Top Dressing (kg)	200	5300	3210.75
Basal Dressing (kg)	167	5120	3112.75
Chemicals (kg)	2	173.2	142.5
Transport		7600	7600
Labour (days)	230	269.06	269.06
Interest on working Capital		261.25	261.65
Fixed Cost:			
Land (ha)	1	1500	2450
Farm Equipment		1.28	2.13

Table 3.2: Maize input disaggregation

	Private Prices	Social Prices
Fertilizer Total Cost	1915040	1161979.25
Of which:		
Tradables	1630040	639479.25
Domestic resources	522500	522500
Transfers	-237500	0
Seed total cost:	108000	108000
Of which:		
Tradables	194.46	142.5
Domestic resources	26125	26125
Transfers (import subsidy)	-11875	0
Chemical total cost	346.4	285
Of which:		
Tradables	194.46	142.5
Domestic resource	142.5	142.5
Transfers (import subsidy)	-51.96	0
Transport total cost	16948000	16948000
Of which:		
Tradables	15782825	15782825
Domestic resources	1165175	1165175
Transfers (import subsidy)	0	0
Domestic resources:		
Labour	61883.8	61883.8
Land	1500	2450
Capital	585441.9	587337.4

Table 3.3: Maize Systems Budget

	Private Prices	Social Prices
Total revenue	2899000	2679880.2
Tradables costs:		
Fertilizer	1630040	639479.25
	-237500	0
Seed	93750	81875
	-11875	0
Chemicals	194.46	142.5
	-51.96	0
Transport	15782825	15782825
Domestic resource costs:		
In fertilizer	522500	522500
In seed	26125	26125
In chemicals	142.5	142.5
Direct labour	61883.8	61883.8
Direct land	1500	2450
Direct capital	585441.9	587337.4

Table 3.4: Maize PAM and coefficient

	Total Revenue	Tradable Input cost	Domestic Resource cost	Profit
Private Prices	2899000	1474557.5	1197593.2	226849.3
Social Prices	2679880.2	165043321.75	1200436.4	-15024877.95
Tranfers	219119.8	-15029764.25	-2843.2	15251727.25

NPC = 1.08, EPC =1.03, DRC =0.8

The same computations where conducted for sorghum.

3.4 Sensitivity Analysis

According to Yao (1997) a static model like a PAM may generate results which are biased against government policies. To overcome this limitation some sensitivity analysis where conducted to identify some major factors which may lay support to government intervention. Such factors as output and input prices were found to be critical in shifting comparative ranking between the two crops.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results and study findings. It begins with interpretation of PAM coefficients and goes on to discuss sensitivity analysis on comparative advantages. The table below shows a summary of PAM coefficients for 2010/2011 farming season for maize and sorghum production.

4.2 Interpretation of PAM Coefficients.

Table 4.1: Summary of PAM Coefficient for 2010/2011 Farming Season

	Maize	**Sorghum**
NPC	1.08	0.61
EPC	1.03	0.14
DRC	0.87	0.03

The NPC coefficients show that domestic price for maize has remained above the corresponding international reference price, whereas for sorghum the domestic price is below the corresponding international reference price. For maize, NPC is 1.08, suggesting that the domestic price is higher than the reference price by 10.8 per cert. This indicates that the maize prevailing market price in Zambia is 10.8 per cent higher than the socially desirable price. Similarly, sorghum NPC is 0.61, indicating that the domestic price is lower than reference price by 6.1 per cent. The sorghum farmers receive a lower private price than is socially desirable. NPC results clearly show government efforts to support maize producers by providing higher producer price which acts as an incentive for the observed increased maize production trend in Zambia.

The EPC is a more reliable indicator of the effective incentives than the NPC, as the former recognizes that the full impact of a set of policies includes both output price and enhancing effects (import tariffs) and reducing effects (input subsidies). The EPC nets out the impact of protection on inputs and outputs and reveals the degree of protection accorded to the value-added process in the production activity of the relevant commodity. The EPC values show

that maize farmers enjoy a heavy subsidy of 10.3 percent (EPC=1.03) for their value-added whereas sorghum farmers face a net tax of around 1.4percent (EPC= 0.14) for their value added.

The DRC values of maize and sorghum are both less than unit. However, the sorghum value (DRC=0.03) is lower than maize value (DRC=0.87), suggesting that sorghum has an obvious comparative advantage over maize. This indicates that the opportunity cost for using domestic resources measured at world prices terms is much lower for sorghum than maize, that is, sorghum production has efficient domestic resource use in terms of value added generated. This indicator reaffirms the conclusion reached with protection coefficients earlier. For highly protected maize farmers, DRC value is higher than for sorghum farmers.

4.3 Sensitivity Analysis on Comparative Advantages

Following Yao (1997), sensitivity analysis was conducted to test whether changes in underlying assumptions such as output and input prices substantially alter the comparative advantage initial results. In first scenario, moving the output price for sorghum up by 35 percent changes the comparative rankings. Rankings remain unchanged when output price is lowered. This indicates that maize would become more competitive over sorghum when output price rises by 35 percent.

A 35 percent decline in maize output price had a similar result. Comparative rakings changed in favour of maize production over sorghum. Changes in CIF prices for both commodities produce similar results. For example, 30 percent decrease in sorghum CIF price shows maize gaining comparative advantage over sorghum. Changes in input prices produce more or less similar results.

CHAPTER FIVE
CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The PAM indicators suggest that maize is inefficiently produced and sorghum efficiently produced in Zambia. Interestingly these results are consistent with government objective of improving agricultural development through diversified farming as it can lead to efficient resource allocation, but are inconsistent with high procurement price and heavy subsidization of inputs in maize production.

Furthermore, it was validated through sensitivity analysis that modest changes in output and input prices could significantly alter the comparative rankings. If the current maize price policy translates into lower domestic price than world price, such a change could increase exports to places like Democratic Republic of Congo. This could harm some farmers, but this would be than offset from gains from trade.

The general conclusion from the results is that the current trade and domestic crop diversification policy that usher in the current levels of effective protection is inefficient in its current form.

5.2 Recommendations

Based on the empirical analysis, policy makers must promote diversification through public private partnerships (PPP's). This is so because the current package seems to only promote publicised political decisions that promote popularity of leaders at the expense of sustainable diversified farming. With balanced partnership between government and business community, a better result may come out.

Access to market information with regards sorghum needs to be given attention. Developing a sustainable vertical integrated market chain could improve diversified farming. Further study regarding costs and benefits, challenges and opportunities need to be explicitly studied.

REFERENCES

Yao, S.H (1996). **Comparative advantage and Crop Diversification**: A policy analysis matrix for Thai agriculture. J. Agricultural Economics, 48: 211-222.

FAO, (2001). Policy analysis study: Egypt. **Comparative advantages and Competiveness of major crops.** Food and Agriculture Organization of the United Nations.

Monke, E. and S. Perason, (1987). **The policy analysis matrix for agricultural Development** Ithaca. NY: Cornell University Press.

Sharma, H.R (2005). **Agriculture diversification in South Asia**: Patterns, Determinants and Policy Implication.

Singh IJ, Rai KN, Karwasra JC (1997). **Regional Variations in Agricultural Performance In India**. Paper presented at the Annual Conference of Indian Soc. Agric. Econ.

Timmer, C.P (1997). **Farmers and Markets: The Political Economy of New Paradigms**. Am. J. Agric. Econ., 79: 621-627.

Vyas, V.S (1996). **Diversification in Agriculture: Concept, Rationale and Approaches**. Indian J. Agric. Econ., 51(4): 636-643.

Wehbe M, Eakin H, Seiler R, Vinocur M, Avila C, Marutto C (2006).**Local Perspectives on Adaption to Climate Change**: Lessons from México and Argentina. AIACC Working Paper No. 39. September2006.