Economic risk as an impediment to the commercialisation of maize production in Lesotho.

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Abstract

Although, approximately 80 percent of Lesotho's population is dependent on agriculture, its grain output has continued to decline in absolute and relative terms. Average yields per hectare of maize are estimated to have dropped by 42 percent in 2006/07. It seems maize production is randomly and systematically impeded to change from subsistent to commercialised production - aimed at producing market surpluses according to principles and motives vested in specific abilities and formalised in law.

Agriculture's contribution to GDP is approximately 16 percent. In order to address poverty, the trend should be reversed. In a complete study, all the possible contributions, including costs and benefits for agriculture, the significance of impediments in Lesotho will be investigated. This study, examines risk impact on agriculture production, income and returns. It is standard to assume economic related factors underlie an inability to produce satisfactory and sustainable agricultural production. This study tests the significance of such an assumption.

This paper proposes that the ground for such an assumption, one of underlying economic factors being instrumental in an inability to commercialise maize production, will be evident in the source of economic risk and pricing. Product price premiums, as measures in off-setting systematic economic and portfolio risk, are reviewed. Self-insurance and diversification are key instruments in managing the systematic and specific risk facing the agricultural sector in general, and maize production specifically. If collaboration prevails along with partial compensation and/or diversification for risk, then economic risk may not be the only factor preventing surplus maize production, or the only supporting factor or commercial motive in maximising returns through maize production.

The finding of the study is that economics in general and economic risk are not significant impediments to the commercialisation of maize production.

This study is different from other research in this field in that it moves away from the standard assumption that economic factors are central in impeding commercial agricultural production research has also to be focused on factors autonomous of the economy but which effect economic outcomes like cultural impediments in developing economies like Lesotho. The study indicates, by analysing the higher moments (economic risk) of the stochastic nature in economics as a specific attempt to prevent any ambiguousness, that economic decisions are to a great extend motivated by factors other than economic factors in many instances in great and in increasing conflict with economic principles. This founds a motivation for a shift in focus and is the study's contribution to research in this field. It also contributes to the on-going debate in South Africa as to the problems and underlying factors in the commercialisation of subsistent agricultural production in South Africa.

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Chapter One: Introduction

Lesotho is a small landlocked country, bordered by South Africa with low levels of natural resources, except water. Most of the population reside in rural areas and are dependent for survival on agriculture and remittances from family members employed principally by South African mining companies. (World Bank, 2006).

Maize remains the most prominent staple food in Lesotho, constituting 80 percent of the rural staple diet, and most of the production comes from the lowlands. The objective of this study is to determine the role played by specific risk (non-covariant risk) in the production of maize in Lesotho. By definition, this kind of risk may be sensitive to purposeful management intervention. This may give the government relatively effective (low cost) options and leverage in hedging not only specific risk, but market related risk in agriculture, and maize production.

Although, approximately 80 percent of the population are dependent on agriculture, Lesotho's grain output as the staple food, for example, has continued to decline (FAO, 2007). Average yields per hectare of maize are estimated to have dropped by 42 percent in 2006/07 (FAO, 2007). As a result, the total cereal production has dropped dramatically.

This drop in production is attributed to severe droughts across the country as a whole. Rainfall in the months of January-March in 2007 have been well below average, coupled with high temperatures (FAO, 2007). However, compounding factors such as a diminished labour supply due to the HIV/AIDS pandemic, and increasing grain prices have impacted the situation. In addition, the utilisation of farming land for production purposes has also dropped drastically as a percentage of total land available. (FAO, 2007). This has resulted in agriculture's overall contribution dropping to as low as 16 percent of GDP in 2006.

Subsequently, the incidence of poverty remains high (Watson and Hall, 2002). The African Development Bank estimates that 55 percent of the population live below the poverty line. Of that, 40 percent are extremely poor. The bank estimates Lesotho's Gini-coefficient to be 0.66 out of theoretical 1. The major contributing factor is the rising unemployment and underemployment, which has resulted from structural changes. Most men were retrenched from the mines in South Africa when mining activity dropped in that country (FAO, 2007).

Given this, there is an assertion that poverty reduction strategies should focus on agriculture and accessibility to health and education (Welch, 2007). The poorest population in Lesotho is in the highland areas where natural resources and opportunities for employment are very limited (FAO, 2007). Farming is their only means of survival despite arable land being very limited. Single women, divorcees, widowers, and those abandoned by their husbands, head-up most of these

households. Such households are vulnerable because they lack the necessary agricultural assets, such as livestock. The key to addressing poverty in this environment and maximising real and social returns lies in increasing and optimising agricultural output, especially in the rural areas.

1.1 World Agricultural output

According to the World Bank (2007:23), two-thirds of the world's agricultural value is created in developing countries. On average, agriculture contributes 29 percent of GDP in agriculture-based countries and employs approximately 65 percent of the labour force. However, in transformed and urbanised countries, agriculture contribution is as low as 5 percent of GDP. This has resulted in rural populations getting poorer, as they are mostly dependent on agriculture for subsistence.

These rural communities engage in subsistence farming, mainly due to a low asset base and unfavourable conditions (World Bank, 2007). They consume most of what they produce and are net food buyers in the food market.

Nonetheless, some countries have managed to successfully transform their agricultural sector. As an example, India managed to stir up the 'green revolution' by use of technology and mechanisation to hedge their vulnerability to various exogenous shocks. China instilled institutional innovations, while Ghana managed to reduce poverty in the rural areas through growth in agricultural activity (World Bank, 2007:25).

Conversely, in most countries, agriculture is not regarded as important for development. In these countries, per capita agricultural growth is still at anaemic levels, resulting in a sharp decline in agriculture's contribution to GDP (World Bank, 2007). Rapid population growth, soil degradation and adverse weather conditions have exacerbated the situation. Further, the political economy has been biased towards urbanisation. Consequently, food insecurity is increasing in the rural areas as well as poor urban areas.

Nevertheless, new opportunities are emerging. New markets are developing for new products such as biofuels. But, the increased demand for agricultural products has to be matched with increased supply, in order to maintain price levels. Technologies are being developed that ensure economies of scale and reduced prices; ultimately making food more affordable for the poor. These developments put agriculture in a position to become the main driver for development in agricultural-based countries.

The World Bank (2007) observes that growth originating from agriculture is at least twice as effective in reducing poverty as the contribution of growth from external agriculture. It is estimated that in China, aggregate growth in agriculture is 3.5 times more effective in reducing poverty than growth from non-farming activities (World

Bank, 2007). Such successes require improvements in the asset base and through more competitive smallholder farming. .

Lesotho presents a classical example of smallholder, rural farmers. They lack proper infrastructure to farm beyond subsistence level. Consequently, Lesotho's agriculture sector's contribution has dropped from 30 percent seen in the 1980s to the current 16 percent of GDP (FAO, 2007).

1.2 Macro-economic performance and agri-economy in Lesotho

Between 1995 and 1997, Lesotho recorded modest economic growth. However, the political instability in 1998 resulted in negative economic growth. By 2005 the economy had picked up and was growing at approximately 6 percent (World Bank, 2006).

The focus changed to secondary and tertiary sector growth. The developments in the Lesotho Highlands Water project and the promulgation of an African Growth and Opportunity Act (AGOA) facilitated growth in the secondary sector. Preferential access to US markets under AGOA, positioned the manufacturing (textile) sector as the country's largest employer. Nonetheless, phasing out of quotas under the Multi-Fibre Agreement negatively impacted the sector; resulting in job losses (World Bank, 2006).

The textile industry has played a major role in creating employment, producing output and exports (FAO, 2007:9). Lesotho also exports diamonds, mohair and wool. The country has also generated income from workers' remittances, estimated at 30 percent of GDP, and from the South African Customs Union (SACU).

The agricultural sector's poor performance is attributed to adverse weather conditions marked by severe drought. The three main food crops grown in Lesotho are maize, wheat and sorghum, together contributing 70-80 percent of total production. (Maize remains the most prominent staple food in Lesotho constituting 80 percent of the rural diet though most of the production comes from the lowlands).

The majority of maize farmers are small-scale subsistence operators. In most cases, the capital-deprived farmers are isolated and restricted from following the latest farming techniques; unable to improve inputs and production. The production in Lesotho is costly, and consequently the product is uncompetitive as compared to South African imports, and as a result, maize production is very low. The country has to rely on imports and foreign aid to meet consumption needs (FAO, 2007).

Even if the production of maize were to increase, it would take a long time for Lesotho to become self-sufficient. With the rising maize prices and increased demand, Lesotho faces a major threat if local production continues to decline. Large-scale production is necessary to reduce prices, lest Lesotho faces a continual reliance and dependency on foreign aid and unrelenting poverty and food insecurity (World Bank, 2007).

1.3 State of poverty in Lesotho

Lesotho remains one of the poorest countries in the world, despite recent economic growth. According to the African Development Bank, Lesotho has a Gini-coefficient (in terms of the distribution of income) of 0.66 with 55 percent of the population living below the poverty line (FAO, 2007). It should however, be noted that Lesotho has unreliable data on poverty.

The poverty in Lesotho is exacerbated by the decline in mining activity in South Africa. Where most Basotho men were employed; they now face unemployment as well as increasing prevalence of HIV/AIDS. The resulting deaths have left households headed mostly by children and women (FAO, 2007). This has resulted in lack of manpower in all sectors of the economy.
Ultimately, the country suffers from severe food insecurities. In Lesotho, food insecurity is measured against the availability of maize as a staple food. With the production of maize declining rapidly, the situation is worsening. Therefore, the government's objective is to increase maize production and improve food security.

According to the country's Poverty Reduction Strategy (PRS), the Lesotho government, amongst other measures, proposes to encourage block farming and employment of modern techniques in addressing poverty. Although there is no clear plan on how to achieve such an objective (Nakani, 2006).

The Poverty Reduction Strategy – 2006/2007 (GOL, 2005) states that:

> *"Government of Lesotho is committed to reducing hunger. The focus will be on improving productivity through proven methods of intensified agricultural production in areas that are agro-ecologically suitable, encouraging appropriate water harvesting and irrigation techniques, promoting block farming."*

External assistance has declined significantly from 1980 and 1990 levels. The donor agencies shifted their focus to South Africa after the abolition of apartheid. Further, Lesotho did not qualify for debt relief under the Highly Indebted Poor Countries initiative of the World Bank. Nonetheless, the World Bank notes that Lesotho would need double the current aid levels if it were to meet poverty reduction targets as per the Millennium Development Goals (World Bank, 2007)

For the rural population, such aid would have to be directed towards improving agricultural production. The previous policies made an attempt to increase farming activity using aid to increase productive assets (FAO, 2007).

Lesotho has a Human Development Index of approximately 0.49 and is ranked 149th out of 177 countries in the UNDP's Human Development Index (UNDP, 2006). About 70 percent of the population, live below the poverty line. The positive growth registered in the 1990s failed to significantly reduce poverty levels. (The changes in the mining sector in South Africa, that resulted in a lot of miners being retrenched

has made the situation worse. Most poor families were depended on the remittances from the family member employed in South Africa.) The Government of Lesotho (GOL) has to address these daunting challenges.

The Poverty Reduction Strategy – 2006/2007 (GOL, 2005) further states that:

> *"GOL will implement the following strategies:*
>
> *a) Adopt appropriate farming practices. The policy focus will be on the diversification and substitution; encouragement of field crops in areas that are agro-ecologically suitable; Exploring opportunities for block farming, especially in the lowlands areas; promotion of commercialisation of agriculture; and introduction of improved agricultural technologies;"*

1.4 Changes in policies since 1980s

In the early 1980s, the government of Chief Leabua Jonathan initiated a Food Self-sufficiency Programme. Under the scheme, the government engaged in sharecropping with landowners, providing the inputs and the necessary infrastructure such as tractors. The scheme allowed for private sector participation in order to avoid 'crowding-out'. Private machinery owners were sub-contracted and compensated according to agreed rates. The government recovered its cost after harvest (Landahl et al, 2003).

Under the scheme surpluses were traded through co-operatives and ultimately through the millers. Although no reliable data exists, there is general consensus that the system worked and actually addressed the food-insecurity issue.

In 1986, Chief Leabua Jonathan was toppled by the military, who continued the programme. However, when democracy was restored in 1993 and the Basotho Congress Party (BCP) came to power, the scheme died a natural death. Apart from the fact that the scheme was 'synonymous' with the previous regimes, which threatened the BCP, the government changed some elements of the scheme. Originally the scheme operated as a self-contained unit, reporting to the office of the Prime Minister. Subsequently, the unit was split and the agricultural bank was formed. The bank, subsequently, lacked capacity and expertise to support the scheme (Landahl et al, 2003).

Other changes that were introduced affected field owners, who were required to make cash payments for government services. Most small farmers could not afford this levy , and their participation ended.

Following these changes, agricultural production declined significantly. Recently as part of the Poverty Reduction Strategy, the government introduced 'block farming[1]'. This scheme is defined by landowners partnering with infrastructure owners. The government simply provides guarantees for loans endorsed by the commercial banks. Further, the government has secured the services of agricultural experts from South Africa to assist in adopting the latest land management and farming techniques (UNDP, 2006).

In 2006, pilot block farming projects were implemented; one of the farmers producing 2.7 tonnes of maize per hectare, compared to the previous average of 1 tonne per hectare. In the 2007-2008 season, the project was extended to cover 1000 hectares from its previous total of 250 hectares.

These projects are based in the lowlands. Although, ultimately they will have a positive impact on the maize prices, they still do not address the challenges faced by the rural poor, who form 80 percent of the population and remain smallholder subsistence farmers (FAO, 2007).

1.5 Problem Statement

For years agriculture has been, as discussed, the main contributor to Lesotho's GDP, at approximately 30 percent (World Bank, 2006). Although, it now contributes only 16 percent to GDP due to growth in manufacturing activities, it is still the main employer and source of income for most of the population, especially the poor. However, agricultural activity, and maize production specifically still remains at subsistence levels. The commercial activity of total agricultural production contributes only 10 percent of the total agricultural output (FAO, 2007).

In order to alleviate poverty, the agricultural situation has to change. One way would be to transform the agricultural sector from a subsistence activity, to commercial farming using methods mentioned earlier, such as block farming. Such methods have been proven in the lowlands, but they may fail in the highlands (rural areas). In some of these areas, a tractor is an unthinkable tool of trade, because of the landscape and in particular, steep terrain

Several reasons have been presented for poor crop yields, including adverse climate conditions, low soil fertility and lack of proper irrigation (Allison and Chungu, 2003). Modernisation of agricultural production, a necessary step in commercialising agriculture, and is considered a workable answer.

It is evident that previous attempts made by policy-makers in promotion of commercial farming were of limited success (Nakani, 2006). This presents a challenge for investigion, analysis, and proper identification of the reasons..

[1] A group of fields that belong to a few households but are cultivated as a single block. The main aim being to realise economies of scale.

The role played by idiosyncratic risk and market risk factors, which cause imperfect covariance in agriculture, in general, and specifically in the production of maize and its income, is investigated and analysed in this study.

1.6 Research objectives

The purpose of this research is to assess the reasons for subsistence farming persisting in Lesotho. The land-rent theory states; viable commercial production is a result of changes in land rent, as a subject of costs incurred as capital requirements, transportation and technology (Jepson, 2006; Alston et al, 1997). Political economy considerations such as subsidies or cheap credit could increase the marginal production of land. Therefore, the aim is to establish whether these factors are at play or not, and if so, to qualify their impact on risk, be it positive or negative. The major investigation includes the following considerations for Lesotho:

- Risks facing farmers may contribute to the continuation of subsistence farming.

- Policies governing agriculture and land tenure and their impact: for subsistence and commercial farmers.. Further, investigate any other attempts of commercial agricultural projects that may have been initiated. Identify major obstacles and conditions needed for successful transition.

- Recommend enhancements to existing policies and/or formulation of new policies by considering inferences made in this study (Purdon et al, 2001; Renaud, 1972; Varvasovszky and Brugha, 2000).

1.7 Importance and benefits of the study

Food insecurity is a major challenge facing developing countries and the problem is more prevalent in sub-Saharan Africa. Benson (2004) argues that addressing poverty should be central to economic development. Lesotho is a 'typical' sub-Saharan country with chronic and high levels of absolute poverty.

Ideally the findings should benefit both policy-makers and farmers. The key elements of the study should outline the lessons learned from previous aborted and/or failed attempts, which in turn inform future policy developments, challenges facing farmers and ultimately the development of a framework (value-chain) within which the objectives outlined in the Poverty Reduction Strategies may be achieved.

This study moves away from the standard assumption that economic factors are solely responsible for impeding commercial production. This shift is the study's contribution to the field of research.)

Specific criticism may be levelled at the findings, based on the methodology not being sufficiently robust in determining the exact nature of the role and contribution of economic risk itself. This critique will only be valid if economic risk exists in a form, which is neither dominated nor overshadowed by risk types other than economic risk. It therefore stands alone as identifiable and distinct as a clearly calculable influence. This study is exploratory and is aimed at determining whether economic risk is a significant impediment in commercialisation of agricultural production. The study will contribute to the on-going debate in South Africa, as to the problems which underpin the commercialising of subsistent agricultural production in South Africa.

1.8 Chapter Summary

Chapter two: Agriculture's importance to the Lesotho economy: a macroeconomic perspective - The purpose of this chapter is to give a brief historical macroeconomic overview of the Lesotho agricultural sector and its inherent problems. The main objective is to outline the subsistence nature of agriculture in Lesotho. Further, to identify risks prevalent in this sector and demonstrating how these risks have been mitigated by farmers diversification.

Chapter Three: Shocks, return and the insurance of agricultural risk: a fundamental analysis - The purpose of this chapter is to develop a financial framework to calculate the vulnerability and exposure to shocks of agriculture and agriculture return in Lesotho. The financial framework will be developed based on the Capital Asset Pricing Model (CAPM) to illuminate and understand the underlying problem specifics of subsistence farming in the country from a financial perspective.

Chapter Four: Methodology and estimation: The purpose of this chapter is to outline the methodology that was adopted for the research. Using CAPM and Abitrage Pricing Theory (APT) theories, the chapter outlines the process identifying idiosyncratic and market risks impacting on the Lesotho agricultural sector. An econometric model based on Ordinary Least Squares (OLS) is built and tested for conditions necessary for a sound OLS model.

Chapter Five: Discussion of the results: The purpose of this chapter is to discuss the results and explore possible policy considerations for the Lesotho government. Further identify areas for future research.

Chapter two: Agriculture's tarning importance to the Lesotho economy: a general macroeconomic perspective

2.1 Introduction

The purpose of this chapter is to give a brief historical, macroeconomic overview of Lesotho's agricultural sector's contribution to the economy and the inherent problems in agriculture. The main objective is to outline the subsistence nature of agriculture in Lesotho and the burden this has created for its economy. Further, to identify narratives of prevalent risks and the reasons for persistent subsistence farming.

Lesotho, small and land-locked, is one of the poorest countries in the world, with a GDP of approximately US$1.4 billion. Lesotho's economy is highly integrated with that of South Africa. Therefore, its economic policies, especially monetary, follow the trends set in South Africa, although not identical in nature. For example, there are differences in agriculture production and marketing (World Bank, 2007).

Lesotho has pursued economic growth through export-oriented manufacturing, mainly in the textile and footwear sectors since 1995. The focus in manufacturing has seen the agricultural sector's contribution to GDP drop to 16 percent from the 30 percent experienced in the 1980s. The contributing factors are found in other sector's growth, specifically textile manufacturing. Nonetheless, in real terms, agriculture growth has dropped, for instance in 2006/2007 cropping season, yields per hectare of maize and sorghum are estimated to have dropped by 42 percent and 25 percent respectively (FAO, 2007). The agricultural sector still employs approximately 50 percent of the population. In the rural areas, where 70 percent of the population reside, the land is more suitable for animal husbandry. Consequently, Lesotho benefits from exports in high quality wool and mohair, although, more recently, it has suffered from declining animal quality and disease has become a major threat, as indicated by an increased live-stock mortality rate.

2.2 Macroeconomic performance in Lesotho

Lesotho has limited natural resources and a very narrow production and export base. Agriculture, as already discussed, along with the informal sector account for 80 percent of employment in 2005. Nonetheless, agriculture's contribution to GDP has dropped to a mere 16 percent (World Bank, 2006).

There has been major growth in the manufacturing sector fuelled by growth in the textile industry. Through the African Growth Opportunity Act, Lesotho has benefitted by its status as one of the African countries having received preferential treatment in accessing the United States markets. Subsequent to the enactment of this Act, the manufacturing sector has improved its contribution to 44 percent of GDP (World Bank, 2006).

Lesotho also exports diamonds, wool and mohair. With imports amounting to 90 percent of GDP, it renders Lesotho's economy highly open?. Contributing largely to the GDP are the workers remittances, approximately 30 percent of GDP (World Bank, 2006).

Lesotho is a member of both the Common Monetary Area (CMA) and the Southern African Customs Union (SACU). As such, Lesotho enjoys the contribution of SACU receipts, resulting in a surplus in its fiscal balance since 2003/04. Coupled with this, is a lower current account deficit and improved international reserves, which have increased to more than double the recommended minimum level (World Bank, 2006).

Nevertheless the SACU receipts have proved unsustainable and there is a trend in decline. Real economic growth has also dropped from an average of 3.3 percent in 1994-2004 down to 1.3 percent in 2005/2006, as a result of external shocks in the manufacturing sector and low output from agriculture for reasons already mentioned.

A large percentage of Lesotho's inflation rate is inherited from its close ties and dependencies with the South African economy, something it has little control over. Loti, Lesotho currency is valued at the same level as the South African Rand, which eradicates Lesotho's capability to pursue independent monetary policies. Lesotho is sitting with an endemic overvalued currency, and any market fluctuations in the value of the Rand, which are frequent and unpredictable, impact Lesotho's monetary position; partly explaining the overhang in Lesotho's international reserves.

Prior to 2002, inflation had reached high levels driven by food shortages in the region. However, the trend turned as the food supply improved. Towards the end of 2005, inflation had reached a low of 3 percent (Table 2.1). This trend was reversed as food and oil prices soared globally. By the beginning of 2008, inflation had reached 9 percent. During this period, the currency also depreciated in line with the Rand and against other major currencies.

Table 2.1: Lesotho - Economic Performance Indicators

Indicator	2002	2003	2004	2005	2006
GDP (US$ bn)	0.7	1.1	1.4	1.5	1.4
Real GDP growth (percent)	3.5	3.3	2.3	1.2	4.5
Exports (US$ m)	357	475	707	650	750
Imports (US$ m)	763	994	1 302	1 260	1 309
Current account balance (US$ m)	-142	-135	-76	-44	14

Consumer price inflation (percent)	34	6.7	5.0	3.4	5.0
Foreign Exchange Reserves (US$ m)	406	386.5	406.4	460.3	501.5
Exchange rate (M: US$1)	10.5	8.6	10.5	7.6	6.5

Source: Lesotho Central Bank 2007.

Unemployment remains a major challenge in Lesotho. Most able-bodied men were employed in South African mines and the level had reached approximately 127 000 in 1989 and it has since dropped to around 52 000 in 2007 (World Bank, 2007), mainly through declining profitability in South African mining. With an growing population, these declines in employment levels exacerbate poverty in the country.

2.3 Population, HIV/AIDS and Poverty

According to the Lesotho Bureau of Statistics (BOS, 2007), the country's population was estimated at 1.8 million in 2006, with approximately 80 percent living in the rural areas. Although the exact impact is unknown, HIV/AIDS has contributed to the sharp decline in population growth and life expectancy. Mortality rate is high amongst the economically active population resulting in a significant adverse impact on the economy.

Rural migration to the urban areas has increased, resulting in 6 percent growth in the urban areas owing to the decline in agricultural activities in 2006 (FAO, 2007). An increase in manufacturing activities has resulted as a form of alternative employment, resulting in a sharp increase in internal migration activity. Nonetheless, the government remains committed to rural development, promoting it through the provision of rural infrastructure, such as roads (World Bank, 2007).

Data on exact poverty levels in Lesotho, is very limited. However, estimates from government agencies show widespread trends, with approximately 55 percent of all households living below the poverty line by 2006 (FAO, 2007).

Economists agree that for a developing country like Lesotho, increasing agricultural production is crucial in addressing poverty. However, agriculture's contribution to GDP has been decreasing firstly inherently due to inefficiencies in production and secondly, to an extent, by not keeping up with the growth in other sectors. Lesotho faces many challenges in agricultural production, contributing to higher risks associated with farming.

2.4 Historical view of agriculture in Lesotho

Since independence in 1966, the agricultural sector has gone through a process of deterioration (Lundhal et al, 2003). During the earlier years, agriculture contributed 40-45 percent to GDP. However, the situation has changed drastically over a period

of 30 years. In relative and absolute terms the agricultural production has dropped, meaning production is not only decreasing in relation to previous years (own/absolute drop) but also in the contribution to the GDP (relative drop).

The Basotho have a history of engagement in agriculture, with crops contributing approximately 70 percent and the rest by livestock. The farmers produced cereals like maize, sorghum and wheat under ostensibly dry-land conditions, as well as having success in cash crops such as cabbage (Lundhal et al, 2003). Also, they raised livestock including sheep, goats and cattle. In fact, livestock has always been, traditionally, an indication of wealth, as well as a reservoir of value within Basotho culture.

Agriculture in Lesotho has experienced natural and man-made problems, which have always placed restrictions and limits in production; only 13 percent of the land is arable, which places a huge constraint on production, which has also always been rain-dependent. There has also been gradual soil degradation through over-grazing and soil erosion. Traditional agriculture has low potential due to being sensitive to weather conditions (FAO, 2007).

Previous governments have attempted to introduce measures to counteract these adverse conditions, so that production could be improved, unfortunately with very limited success. One such attempt was the initiating of asparagus, which was considered suitable for the local weather and soil conditions in Lesotho (Santho, 1988).

2.4.1 Actual factors affecting agricultural specific production: The asparagus programme in Lesotho

In the early 1970s, when the government realised the extent of the unreliability and unsustainability of traditional agriculture, they initiated non-traditional methods and programmes. The mission was to identify high yielding labour intensive crops, suited to the climatic conditions in Lesotho. The crops were low maintenance, and free from complex techniques that would place demands on small growers (Lundhal et al, 2003).

As a result the government identified asparagus as an ideal crop for the export market (Santho, 1988). Under the Thaba-Busiu Development Project, the first plantation started in 1974. A cannery was also set up and the growers could sell at an agreed upon price. The growers received technical agricultural support and as a result, production had covered 30 hectares and produced 12 000 cans from the cannery by 1977.

The capacity of the cannery was expanded and other products, including vegetables, were introduced. The increased capacity also fuelled increased production, which reached 920 tonnes from 400 hectares by 1991 (Senaoana, 1988).

The yield had reached 3.5 tonnes per hectare. However, the best growers reached a yield as high as 10.5 tonnes per hectare (Lundhal et al, 2003).

Although the asparagus programme had great potential, it failed. The downward trend started after 1991 and continued until 2000. The overall production had reached a mere 30 tonnes in 2000. The yield had also dropped drastically, hardly a tonne per hectare. Consequently, the cannery was closed. The subsidy from European Union that supported the project was also stopped (Senaoana, 1988).

Several factors are attributed to the failure of the project, for example, the tightly integrated process that resulted in growers being tied to the cannery. Growers were not allowed to sell their produce anywhere else, despite opportunities in South Africa. South African companies were paying higher salaries than the local cannery was paying. Expanded markets would have benefited the growers and ignited supply. As such, the returns could not justify the risks taken by the farmers, and they opted to shift their resources to other higher yielding projects. Other factors contributed to its demise too, such as poor management of the cannery, poor technical assistance to the farmers, and capacity problems at the cannery, were responsible for the failure (Lundhal et al, 2003).

The programme however showed that the potential for non-traditional crops existed. Other crops such as potatoes, beans, pears and peaches were then tried. Variability in weather conditions and inherent risks in production due mainly to natural limitations seemed to have also contributed to the project's failure (Lundhal et al, 2003). Therefore, these problems; weather conditions, land tenure and irrigation had to be addressed. It called for focussed and well-funded projects, which stood the chance of migrating to fully commercial production. Such projects facilitated proper risk management resource pooling. In this way, well-structured funding mechanisms may be established.

2.4.2 Production and limitations on production: factors in general

Research findings for the Lesotho farming sector is limited. The situation is disturbing, considering the economic importance of this sector. The following review is based on preliminary discussions with various stakeholders, including policy-makers in the Ministry of Agriculture and reports from the Food and Agriculture Organisation (FAO, 2007).

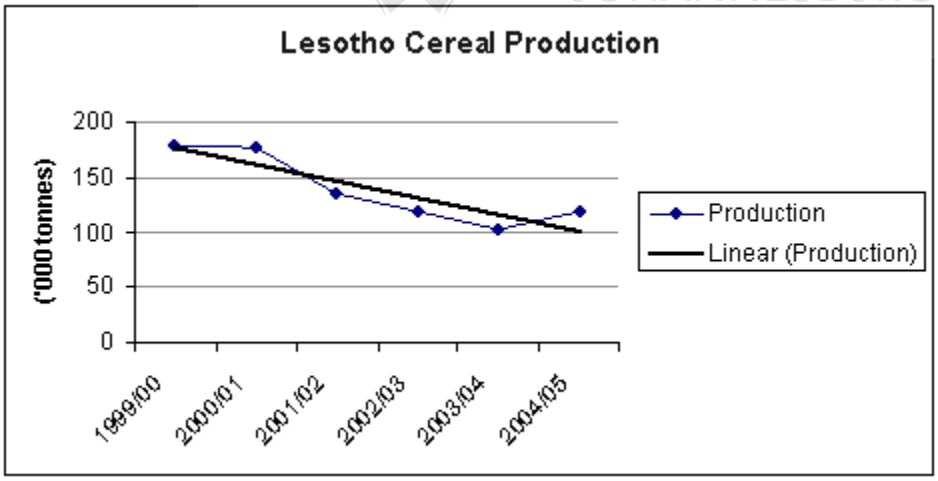
On average, grains contribute 70-80 percent of the total agriculture production in Lesotho. Maize remains the staple food in Lesotho though its production effectively and in efficiency has dropped over the years. Average yields per hectare of maize were estimated to have dropped by 42 percent in 2006/07. The sensitivity of production to natural shocks is to a great extent attributable to human error. Most planting occurs in the lowlands, with Leribe, Maseru, Mafeteng and Berea being the leading districts in production. These districts contribute up to 70 percent of total production. The few commercial farmers are based in these districts. Gregg (2004)

observes that in the highlands in any country, is usually poorly adapted to arable farming, which in essence confines and limits the communities to subsistence farming. The quality of this land deteriorates quicky, due mainly to soil erosion and over use by the community who are solely depended on agriculture for their existence. These factors compound the risks associated with subsistence farming, and as such, greater effort and concentration is needed to manage and mitigate them effectively. .

The majority of grain farmers, even those fortunate enough to farm in suitable areas for maize production are small-scale subsistence farmers with very low productivity and average yields. The low yields are as a result of many factors ranging from drought to poor farming techniques and overuse of land by saving on inputs to try and compensate for expected losses. Inputs are mostly imported from South Africa, which increases the overall cost of production. All these factors lead to low and poor cereal production both in quality and volume. . However, some farmers still manage to produce quality food, especially cash crops (FAO, 2005).

In general, the FAO (2005) estimated cereal production in 2005 at 119 000 tonnes, which increased by 15 percent from the previous year, but was only 84 percent of the five year average. A six-year assessment shows a steady decline, shown in Figure 2.1 below. In 2005, 293 000 tonnes were imported both commercially and through foreign aid. Still, this was insufficient, leaving citizens dangerously low in food supply.

Figure 2.1: Lesotho cereal production



Source: FAO (2007)

The central region of Lesotho has been the most adversely affected. This region has the biggest share of arable land in Lesotho.

Hence for Lesotho, given the total area of arable land (25 percent) with large variations in soil quality, the agricultural situation is very alarming, as the situation remains dire. In order to improve the situation a complete overhaul of human and natural factors and methods would need to be considered. To reach satisfactory

commercial production levels would require major reforms, at social infrastructure and sector management levels, including the resolution of land tenure issues, the overuse of land, traditional approaches and mechanisms of production and marketing, use of modern technology and importantly, the introduction of techniques to insure agricultural risk and pooling of risk through cooperatives, diversification of production, insurance against natural shocks, fixing of prices or premiums paid on agricultural products designed to hedge risk. These measures would facilitate the management of market risks, which would lead to improved returns from agriculture (also see World Bank, 2007 on this).

2.4.3 Interrelating factor specifics influencing agricultural in general and maize production specific

2.4.3.1 Soil, weather and human nature

Human action, traditional farming methods and physical factors, like soil conditions, have led to deteriorating standards over the years and problems such as poor soil management and over-grazing. Traditionally, farmers allow their livestock to graze freely, which, together with compensating for natural losses through over-stocking, ultimately destroys the fields. Farmers engage in livestock farming to diversify their focus from land farming as a way to manage the risk associated solely with continuous land farming. Further, farmers use of fertilisers is inconsistent, so too any reliance or use of advanced farming techniques such as the application of lime to acidic soil, over-cropping and land over-use as short term survival mechanisms. The weather has also played a major role.

Lesotho has experienced extreme droughts with very low recorded rainfalls which results in overuse to compensate endured and expected losses. Extreme heat and temperatures have also reached highest recorded levels. These extreme and unpredictable weather conditions have severely impacted agriculture, crop production and livestock levels, food provision and access to water. . Recently the lowlands was badly affected, the region where most agriculture production takes place (FAO, 2007).

Limited resources have further resulted in minimal land preparation; in some instances fields remain fallow for long periods. Where animal traction is used as the principal form of ploughing, dry soil is a constraint to good and timely planting (World Bank, 2007).

Lesotho has also failed to employ large scale irrigation systems for expansive fields. Although Lesotho is reputed to have ample water, and remains a net exporter to South Africa, irrigation systems, mainly traditional, are low cost and inefficient, used mainly for small holdings, if at all, and especially for cash crops (UNDP, 2006).

2.4.3.2 Social principles and motives, investment in livestock and the substitution of crop production

Production in livestock presents much larger challenges than crop production in Lesotho. Traditionally livestock, particularly cattle, plays a specific role in the economy, for which ideal substitutes are not available. In Lesotho, livestock is a reservoir of value. Men employed in the mines in South Africa bought cattle to 'accumulate' assets and hedge future vulnerabilities (World Bank, 2007).

Traditionally, livestock is not sold for profit, but rather as a form of insurance in cases of emergency or poverty. So, this precludes raising livestock for the sole aim of slaughter and commercial value. (Lundhal et al, 2003). In essence, livestock is not seen as a 'productive' asset, but rather a long run stable asset ; a low returns physical capital asset, which also exacerbates land overuse (over-capitalisation).

Therefore, any drive to establish mainstay livestock farming, was bound to run into problems, creating further problems for crop production, especially maize. Governments have failed to address this issue and change views in terms of an alternative approaches in generating revenue – and returns and income certainty through cash crops. In the 1980s, retaining livestock had sound capital and price returns, as compared to other forms of investment (Swallow et al, 1987). This magnifies the abuse and overuse of land, rather than creating a viable commercial livestock sector.

Another problem facing livestock farming is the limited grazing land available. Livestock farmers are dependent on grain fields, especially maize stalks, for livestock feeding, especially through the dry seasons. Therefore, poor grain production has a major impact on the overall success of livestock farming. Some farmers are forced to buy cattle feeds from South Africa, which ultimately increases the costs of cattle farming, sometimes for reasons very different from economic ones (World Bank, 2007).

However, livestock farming and crop production still represent conditional potential value in Lesotho. It would require an integrated approach from inputs to marketing, aimed at assisting farmers in decreasing risk and attitudes to production.. Lesotho has a national abattoir that has been operating at sub-optimal levels. Another challenge is the abattoir's location, based in Maseru (lowlands) where most livestock farmers are located in the rural areas. Maize, sorghum and wheat production can also be integrated into a system of centralised feedlots in order to overcome these problems and others like shortages in management and marketing skills (Landhal et al, 2003).

2.4.3.3 The Land tenure problem

Agriculture related problems can be traced back to the issues of land tenure. In Lesotho, the King owns the land by right and through the Chief, households are assigned land for agricultural purposes. Grazing land is available to the community and traditional rules and norms operate alongside a mainly money-driven market economy, influenced by different forces, a flourishing environment for misuse of

commons by market forces. After harvest, the fields are also left for communal grazing (Lundhal et al, 2003). Nonetheless, the ratio of landless households is fairly high.

Fencing of the land is restricted although the practice is becoming more relaxed. The allotee has limited rights to use the land for commercial purposes. The land may not be sold or be mortgaged. This practice has received much criticism over many years and needs to change. The opportunity cost of traditional land, both economic and social, might result in political suicide. In 1979, the traditional laws were relaxed through the Land Act of 1979 (Lundhal et al, 2003). Under this law, inheritance was introduced, meaning land could pass from generation to generation. The act also allowed for identification of certain areas as designated agricultural areas.

Suffice to say, the Land Act has not been enforced successfully because of the reasons already discussed. The Chiefs resisted, simply because the Act reduced their powers, especially on an issue as critical as land. The military government that ruled between 1986 and 1994 had an opportunity to change the laws, since they had no fear of not being elected to power, but the opportunity was missed.

Lack of title to the land rendered the land unproductive. Potential investors were wary of committing resources to the land without the necessary security that ensured long term tenure. (Lundhal et al, 2003). Most people, who still 'own' the land, have no means of production. It is crucial to marry land with other factors of production. Given the prevailing macroeconomic environment, addressing these issues has become crucial.

2.4.3.4 Agricultural markets in Lesotho and South Africa

Lesotho is an open economy and allows the free flow of goods and services across its borders with South Africa. This has proved to be critical in facilitating the flow of commercial imports to bridge the gap between domestic production and consumption requirements. Food aid also plays a major role in covering the shortfall (UND, 2006).

Importation of cereals will continue as Lesotho is unlikely to become self-sufficient in food. Lesotho's membership to Southern African Customs Union (SACU) is important to reduce trade barriers, specifically the flow of cereals and other food between Lesotho and South Africa (World Bank, 2007).

The domestic market is however not as well developed. The main channels are the commercial millers located in the lowlands. Lesotho Flour Mills and Lesotho Milling Company are the main milling operations.. Other small millers purchase local grains in winter months after harvest for sale in summer months when the demand increases and many households have depleted their stocks (FAO, 2007).

Farmers take their surplus to the main milling companies where their produce is graded and sold. The process is costly, particularly due to transportation. Therefore,

framers situated remotely cannot take advantage of these facilities. The millers have not established collection centres due to low production.. Demand from millers is limited due to the poor quality of cereals produced domestically. The millers use South African methods to grade the cereals, looking at factors such as moisture content, measures which are not familiar to farmers in Lesotho. The underlying causes and factors which cannot be managed through traditional farming methods because of inferior traditional decisions in planting, harvesting and marketing of surpluses, as well as the absence of localised modern storing facilities and mechanisms to motivate purposeful surplus production. The market reality of surplus production as an optimal and low cost opportunity and production solutions are in contradiction with traditional views - minimising loss and decreasing returns in the absence of the necessary capital - in terms of the high opportunity cost, risk and loss associated with surplus production when allocating and concentrating scarce available resources into scale production practices. Therefore this has led to a situation where farmers, even as the commodity prices soar, continually produce at subsistence level (Landhal et al, 2003).

2.4.4 Existing commercial farming in Lesotho

Commercial farming's contribution to overall agricultural production is fairly low, estimated at 30 percent in 2007 (FAO, 2007). Such farming activities are mainly in the lowlands of the country where the arable land is concentrated. Commercial farmers produce mainly cereals dominated by maize production as a staple food (FAO, 2007).

Due to low commercial farming, agricultural exports are subsequently low. (The government, in collaboration with South Africa on a Joint Bilateral Commission of Corporation (JBCC), has initiated 'block farming' to advance commercial farming). The project involves commercial banks for funding and the government provides loan guarantees.

Block farming[2] is recently geared, as discussed in the former chapter, to introduce crop diversification and high value crops under monitored and controlled environments. The initiative is introduced to decrease risk by improving commercial agricultural production in Lesotho.

2.5 Conclusion

The chapter outlined the economic performance of Lesotho and the declining role of agriculture and its contribution to the production output. Agriculture remains at subsistence levels seems to be because of cost and risk factors such as poor soil quality which results in low yields. A lack of commercial farmers and leadership skill and government initiatives in horizontal and vertical planning of integrated

[2] A block is a group of contiguous fields although owned by different households to realise economies of scale.

projects and infrastructure would address the risks and establish markets and access to markets if addressed.

A case of an asparagus project was outlined which had strong potential. Nonetheless it failed, due to low returns which did not mitigate the risks. The low returns were a result of several factors, mainly by narrative poor management especially on the market side.

Farmers have attempted to diversify into livestock farming though it is not regarded as a commercially vaiable activity and not practised for economic motives per se. As such, it presents other challenges such as over-grazing which in turn leads to soil deterioration since zoning techniques have not been employed.

Maize production, which is a staple food, has experienced similar challenges. Government policies have attempted to increase production of maize. Limited success has been achieved due to the poor management of the negative factors outlined above. This paper will not consider, analyse and investigate all the discussed factors. This paper, will only investigate the probability that risk may underlie the subsistence approach to agricultural production and maize production specifically. So, if risk underlies amongst other factors, the absence of commercial maize production, it follows then the risks may be managed through proper control and management of these factors by supporting a move from subsistence to commercial maize production.

In the next chapter we investigate and analyse the existing literature on theory of the underlying factors responsible for the generating of risk. We explore the possibility, nature and magnitude of risk as underlying investment in an asset, as well as the manner and mechanisms available by which the consequences of these risk effects can be managed, if such random economic risk, indeed exists.

Chapter Three: Shocks, return and the insurance of agricultural risk: a fundamental analysis

3.1 Introduction

The purpose of this chapter is to develop a financial framework to act as benchmark in estimating the vulnerability and exposure to economic related shocks and risk of agriculture and agriculture return in Lesotho. The financial framework will be developed on the Capital Asset Pricing Model (CAPM) and Asset Pricing Model (APM) to measure the respective effects of economic related systematic and specific risk (respectively market and specific risk in the rest of the study) on agricultural and specifically maize production and income in Lesotho with the objective of illuminating and understanding the underlying problem specifics of subsistence farming in the country from a financial risk perspective.

The hypothesis states that it is problematic for subsistence farmers to hedge, or insure individually, against specific risk by diversification (Bjornson and Innes, 1992a). This may be the reason as discussed for being perpetually trapped in subsistence farming. The vulnerability and sensitivity of agricultural production to risk created by the market forces, the systematic or market risk, will also be measured for more robust conclusions. The existence of economic related specific risk as an indication of agricultural and maize specific returns and premiums as compensation for economic related market risk.

The insurance mechanisms at work in the transition from subsistence to commercial farming are depicted in two real theories that will be used to interpret the mechanisms of financial appropriateness in terms of stand-alone and market risk (Gloy and LaDue, 2002). The CAPM hypothesis states that specific risk and market risk can be identified, quantified and also insured respectively by diversification and receiving premiums on return. This opens the possibility for pooling mechanisms and policies in terms of specific risk and premiums to be paid on systematic risk to compensate agricultural production risk, making such production a viable economic choice contributing to among other economic factors, the transformation of society's ability to engage in commercial farming.

Waters (2000) describes the transition from subsistence to commercial farming as "the transformation of societies in which each household has the ability to produce what it needs for basic daily survival and social reproduction into ones where market mechanisms must operate for households to meet basic daily needs". In Lesotho, only a handful of farmers could claim to be engaged in commercial farming.

In most countries farmers experience variable and low prices, yields and returns (high risk), which leads to farmers seeking alternative stabilising sources of income or return (Business Perspectives, 2000). Most farmers, even in the United States, have resorted to 'part-time' farming, seeking employment in other sectors due to an inability to hedge relative high risk and relative long periods of low return in the agricultural sector (Business Perspectives, 2000).

A similar pattern has emerged in Lesotho as other sectors of the economy show growth. The manufacturing sector, far lesser prone to the fickleness of natural influences has grown significantly, especially the textile industry (World Bank, 2006). This has resulted in more people seeking employment in the textile industry and fewer in the agriculture sector, leaving the country as a whole exposed to food shocks. The behaviour may indicate the problem of small and subsistence farmers have to hedge or insure individually against specific risk in agriculture, due to the absence of insurance mechanisms in agriculture and low product prices making subsistaince farming a less risky mechanism of production. Despite this, some farmers still manage to produce for the market, especially cash crops (FAO, 2005). This may be an indication that commercial farming can successfully operate in Lesotho when obstacles are removed such as greater certainty about product prices, greater access to liquidity through which returns are smoothed, decreasing the country's exposure to food shocks.

Several other factors besides risk, can be outlined as barriers to significant commercial production. Land tenure security is one example of a multiple of such factors. Leasing and property transfer laws in Lesotho need to improve as improvements will contribute as collateral in attracting long-term investment[3]. Other issues cited in managing risk include a lack of collective or pooling mechanisms like co-operatives, which work well in other countries. As an example, in Brazil, a colonisation model[4] was used. Jepson (2006) also notes that in this market-orientated model co-operatives facilitated the whole value chain, from acquiring land and selling it to individual farmers, to arranging cheap credit for production and access to markets (Daniels, 1997). This pooling model is profit oriented and does not result in land speculation and other anomalies which are normally associated with a government subsidy approach. Good infrastructure, such as roads, plays a major role in insuring risk and encouraging commercial activity. Distance to the markets affects the net returns from the commercial farming activity. Other factors such as capital requirements, labour costs, low and variable yields and market prices also act as risk barriers to commercial farming.

We therefore determine whether specific risk is problematic and the reasons for this. Explore the need for insuring mechanism as already discussed. We further analyse and explore the appropriateness of these mechanisms within real economic theories

[3] Interview with the Principal Secretary of the Ministry of Finance – Dr M. Majoro.
[4] A model where commercial companies acquires land around settlements for commercial farming purposes.

to insure risk, increase and stabilise return and promote subsequent commercial farming. We also measure the "appropriateness" of product return in terms of systematic risk.

3.2 Financial framework to analyse agriculture's exposure to stand-alone and market shocks and risk.

The agricultural sector is inherently risky (Just and Pope, 2001). Production in agriculture is risky as it is subject to unpredictable and random shocks such as the weather, pests and diseases and also systematic shocks like input and output price and returns shocks. Over the years, role players within the sector have developed techniques and instruments for commercial farmers to manage these risks. The risks may not be totally eliminated but can be greatly reduced.

Two types of economic risks exist in agriculture as defined by Gabriel and Baker (1980). Production or real risk, specific and systematic: associated with production and price of goods. It includes factors such as technology risk, institutional risk and human resource risk. Then, risk which underlies and is directed by domestic and international real risk, economic related financial risk, specific and systematic: this risk basically relates to economic shocks in this study that influence the solvency of an agriculture business or project (Gabriel and Baker, 1980) and ignores non-economic or non-price shocks like political and social shocks for instance. Financial risk is by nature the flip side of the coin, due to the fact that shocks are always interpreted from a financial economic perspective, directly effecting solvability and measured as such. Although real and nominal (or non-economic shocks) are part and parcel of the cumulative effect in price, volatile prices and income, therefore the risk is derived from real supply and demand effects or factors. The risk that is exchanged and priced in financial markets, risk for which such markets and priced exist, directly reflect as such on solvency. Risk that cannot be structured and priced - when maize price expectations are for example formed by maize farmers on the basis of non-price factors, or risk bias based on non-price factors, or uncertainty effects on solvency - are not considered in this study. The objective of this study, as discussed, is an attempt to isolate and measure the effect of specific economic risk that can be diversified away as an impediment on farmer's ability to commercialise maize production in Lesotho.

Risk for analytic purposes, as discussed, can be divided into specific, stand-alone or systematic risk (market risk), respectively. Risk associated with agriculture specific and general risk, which influences agricultural and the economy as a whole are the result of random real and/or nominal shocks. Conventional wisdom shows that returns must be of such a nature as to at least compensate for, or hedge the risk taken. If not, if the marginal cost of hedging is higher than the marginal increase in return it can lead to poverty, default and insolvency.

Management of these risks is crucial as they affect the welfare of the farmers as well as production of food for the country.. Risk in agriculture may be specific to the sector, but a risky agricultural sector creates a larger specific risk for the country as a whole. Farmers may also default on credit commitment if exposed to severe risk. Systematic or stand-alone risk that affects many farmers may trigger other failures within agribusiness and the aggregate economy of a country. Therefore, policymakers should be equally concerned about the management of such risk (Mishra and Lence, 2005).

3.2.1 Random shocks, stand-alone risk, diversification and the effects on product return.

The purpose of this section lays the basis for the framework to act as benchmark to determine agriculture's exposure to specific and market shocks. This framework is necessary to determine the exposure of agriculture in Lesotho to shocks and specific risk and to a lesser degree and to complete the framework also market risk. The risk of an investment or product (production) as measured by the standard deviation, variation or error of return is the direct result of a failure or impossibility to determine all possible factors underlying return. Stochastic error, like throwing a dice exists, but probability can be attached to such error or risk of performance failure as expected through exogenously determined factors ;wind effects for example.. Perold (2004) states that in finance, the fundamental question to be answered is: Do the expected returns ("returns") completely compensate also for risk taken?

Intuition has it that the higher the risk of an investment, the more volatile the return on that investment, or more exposed the product or investment is to shocks, the higher the return or lower the price of an investment has to be, to compensate for the risk and to make an investment or product viable. Conventional wisdom advises not to put all your eggs in one basket but to spread the eggs among several baskets (Chamberlain, 1983). This wisdom to stabilise returns is only partly true. Financial economic theory proposes rather to when put eggs in one basket, ensuring there are other products (rubber balls for instance) in the basket as well. This once off "portfolio" of assets stabilises the risk if the basket were dropped or we could spread the eggs among imperfectly correlated time spaced and/or state spaced-baskets (not selling the baskets in the same market at the same time) to smooth the return (space the selling of maize and/or plant maize but in different climatic regions).

Risk and return of products is therefore not only determined by its specific risk, risk that can be diversified or pooled but also in the manner that it is held; only eggs that cannot be diversified but are hedged by a mechanism as discussed in the latter. The more diversified an investment or product portfolio, the lower the risk, the more

optimal the lower the cost which is affecting the return of the investment. Due to the fact that all our investment in the example is nature dependent and prone to random shocks, even through diversification, it will be impossible to hedge against all shocks, the systematic risk of rain that affecting all agricultural products to a point and therefore return (Markowitz, 1952). Systematic risk needs to be compensated by a premium on return, the risk-return, a lower price by implication creating a premium compensating and reflecting the relative openness or sensitivity to systematic risk. These two theoretical possibilities have been central to the development of the Capital Asset Pricing Model (CAPM).

The basic premise of CAPM is some of the risks affect or destabilise the return but not necessarily all of them; only those that cannot be hedged away or insured by a premium. In theory these products will not be planted if the lower price does not compensates real economic costs like fertilizer. This implies that part of the return has to then compensate for risk implying an actualising lower price, if risk cannot be diversified. The assumption in CAPM is that one component of a shock, stand-alone risk, can be diversified away so that it does not destabilise the return on a product. The remaining component, a market shock, cannot be diversified and has to be hedged as part of the return, the premium, a lower relative price to stabilise the return (Gharghori et al, 2007; Iqbal et al, 2010).

The return is at the level of part risk premium not net return, which provides risk cover as part of cost. Only the component of product or portfolio risk that cannot be diversified away, the market risk, therefore determines the payment for risk or risk premium and affects the return on a portfolio. This premium is a fraction of the return needed as the cost to ensure a stable or riskless return and in effect a lower real return. Two possibilities therefore exist to stabilise the return of a product in view of shocks: either stabilise the return by cushioning or compensating risk with a cost premium or stabilise risk or shocks effects by diversification (Gharghori et al, 2007).

The question remains, how to determine which shock or component of risk is systematic, market related in economics and which shock or component of risk is stand-alone. To determine the different components of risk is the first step to efficiently ensuring a risk free return. For the portfolio to be efficient it has to be of such a nature that it will ensure the highest return at a given risk, or a given return at the lowest risk in the portfolio, so as to ensure a risk free return. The products in the basket or portfolio influence one another in terms of risk and return. The risk and return of a product referred to as standard risk and average return calculated over time (Gharghori et al, 2007).

We therefore have different product combinations, each with a different risk profile and expected return, which are optimised in minimising risk and ensuring risk-

free return. For simplicity, and creating a benchmark for risk-return for portfolio selection, it is assumed that free access to an already risk free product exists (risk free in the sense of fixed real return and default free product – risk free or stable return). The assumption illuminates principles followed in efficiently ensuring a stable risk free return. Income as return is in the study the foundation of the financial framework to analyse subsistence agriculture financial problems.

3.2.2 Maximising risk-return in an uncertain but perfect correlated world

A risk free or stable return product, not affected by any shock will, if available, always decrease the risk of any portfolio when it is included, even in an uncertain, one way world where all products react identically to all shocks. The intuition behind the statement is simple If it is the only product in a portfolio there is no risk in the portfolio. Risk in a portfolio with the risk free asset is the result of risky products or shock sensitive products in a portfolio. Risk averters, who have a choice, will keep the riskless product in their portfolio only if risky products are efficiently insured, and compensated for, risk in terms of an exchange for risk appetite of investors will determine the fraction of risky assets in such a portfolio. A product may have a high return but only at the cost of high risk. It is therefore essential to determine which component of a product or portfolio product return can be attributed to risk insurance in making a fair comparison between differences in return (Gharghori et al, 2007).

Two seemingly identical portfolios at margin, with one introducing a marginal riskless product will ensure it is the more efficient one (maximum return at a given risk). The riskless product adds return and not risk to a portfolio. All efficient portfolios therefore need the riskless product to be included. If it isn't, then by implication a more efficient portfolio exists. A riskless product is necessary but not sufficient to ensure portfolio efficiency or to efficiently stabilise portfolio return (Fletcher, 2007; Iqbal et al, 2010).

For analytic purposes and determining the mechanism needed to insure market risk and stabilised portfolio return, we assume the existence of a two product world and two product portfolio, one risky and the other risk free. To find the highest expected return in relation to risk or risk-return combination, we need to know each product's risk. The riskless product has no risk and will only add risk free return to the portfolio. The risky product adds risk and return to the portfolio. The return consists of riskless return and a premium to ensure stable or risk free return. The risk premium is the difference when return on the risk free asset is subtracted from the risky product return. The risk premium of the portfolio in relation to, or divided by the risk of the portfolio, is indicative of the risk-return or the relative risk of the portfolio (Sharpe ratio). The risk-return, relative risk or Sharpe ratio can be determined for different quantities of the same risky product combined with the risk free product. The portfolios will, as more of the same products with the same risk

are added, proportionally increase in risk (more risky assets added to the portfolio) and proportionally in premium (constant increase in premium compensates for the constant increase in risk) to proportionally compensate the proportional increase in risk (Fletcher, 2007).

The increase in risk will be compensated by a proportional increase in premiums that result in a constant Sharpe ratio for each portfolio, implying that all portfolios created in this manner are efficient and in effect riskless, or have stable returns. The continuum of efficient portfolios or riskless/stable return portfolios are formed by adding more of the risky products and exactly compensating for the risk is known as the efficient portfolio frontier ("frontier") or Capital Asset Line ("CAL") (Fletcher, 2007; Iqbal et al, 2010). The risk premiums cushion exactly the influence of shocks on return and in so doing stabilise return at the riskless rate. So we are indifferent as to which portfolio to choose, the one appears to be as good as the other, and indifferent, whether holding the riskless or risky product in the portfolio or not.

The portfolio frontiers of different returns but risk identical products (in a perfect covariant world) in combination with the riskless product (two product portfolios) can be computed in the same way and compared. The frontiers will all be the same at zero risk because the riskless product will be the only product in the portfolio. All other risk identical products are strictly part of the portfolio but have negative values that isolate them from risk. One cannot lose return from a product that one does not have. The frontiers differ in slope due to differences in compensation for the same risk. The different risk-return implies more than proportional differences in risk compensation between the products, with the highest absolute return and lower return products when risk increases. If an investor decides to diversify into a one risk-riskless product portfolio it will be efficient or at the lowest opportunity cost to choose the risky product with the highest risk-return (Sharpe ratio) and by implication the highest frontier which will insure stable returns. The highest frontier compensates more for the same risk, relative to the lower frontiers and is the efficient frontier (frontier with maximum return at given risk) for the riskless and multiple risky product portfolios (Iqbal et al, 2010).

The difference in risk-return between the highest and lowest frontiers increases exponentially with the increase in risk. The higher the risk-return at a given risk the lower the effect of market shocks and risk and the "more" stable is the return (Gharghori et al, 2007).

If one only has a choice between one risky product and a riskless product in a perfect covariant world then the optimal choice is the highest absolute return product on the condition that the portfolio includes the risk free product. Any economy with market risk only, can ensure stable returns and income efficiently only if it has the risk free product with the highest absolute return in its portfolio. The highest CAL

therefore creates the upper boundary or frontier for efficiency if a portfolio is only exposed to market shocks and risk. The risk free product and the risky product with the highest risk return are necessary and sufficient to efficiently stabilise portfolio return, risk free portfolio return in a world with only market shocks. The risk free product and the risky product with the highest risk return is necessary, but not sufficient to efficiently stabilise portfolio returns in a world with market shocks and stand alone shocks (Gharghori et al, 2007; Iqbal et al, 2010).

3.2.3 Maximising risk-return in an uncertain imperfectly correlated world

In a perfect negative correlated world with only two risky products, the return on the products will react in an idiosyncratic or stand-alone but perfect negative manner (perfect negative in direction and extent of reaction to shocks), to the same and identical shocks. In a perfect negative correlated world, the negative reaction of return to a shock will neutralise the positive perfect reaction of return to the same and identical shock ensuring a risk free world without any effects on return and riskless returns. The perfect two-way reaction after the shock will neutralise risk without affecting portfolio return; if the portfolio is a perfect representation of the world. The return is in the above section as the sum of the individual return of the products in the portfolio. Diversification is necessary and sufficient to efficiently stabilise portfolio return, riskless return in a world with perfect negative correlated random shocks. The risk is opposed to the above section, neutralised without opportunity cost or negative risk premium (Fletcher, 2007).

In an imperfectly correlated (in direction and extent of reaction to shocks) risky multi-product world, risk may be reduced by diversification without decreasing the return of the portfolio or at any cost to return. The return on the diversified multi-risk product portfolio is equal to the sum of individual product return in the portfolio. The risk of the portfolio is decreased by diversification or including non-perfectly correlated products in a portfolio and the return of the portfolio increases proportionally to the number of the imperfectly correlated products in the portfolio (Iqbal et al, 2010).

Diversification alters the risk of a portfolio but not the return of the portfolio. The lowering of risk takes place without any decrease in return or cost for return or negative premium. The diversification of a portfolio decreases the risk in the portfolio but not at the cost of return when the risk is specific risk. The imperfect correlation in return of some products will be partially compensated or offset by variation in the return of other products in the same portfolio and result in a decrease in portfolio risk of return. The risk of a portfolio therefore depends non-proportionally on the heterogeneousness or diversity of the products in the portfolio. The return of the portfolio depends proportionally on the number of products and their individual returns. The non-linear change in risk and linear change in return

will result in a non-linear change in the Sharpe ratio or risk return. Each combination of products or portfolio will have different risk-returns (Gharghori, et al, 2007).

The problem now is that one does not have a unique return for a given risk. All portfolios with the highest return at a given risk have to be chosen to determine the efficient frontier for portfolios with only risk products. The portfolio with the highest return at a given risk is the portfolio (highest Sharpe ratio) that will isolate the portfolio return efficiently from the effects of stand-alone shocks, which is the efficient portfolio. Specific risk cannot be neutralised but the effects of risk on portfolio return can be diversified away. Diversification is necessary and sufficient to efficiently stabilise return, to receive riskless return in a world plagued by specific shocks. But unfortunately in the real world market and specific risk exists at the same time and in the actual world assets are plagued by market and specific risk and the same time and in different ways (Fletcher, 2007; Iqbal et al, 2010).

3.2.4 Maximising risk-return in an uncertain state of the world plagued by market and stand-alone shocks

A combined strategy is necessary to stabilise return in a world plagued by market and stand-alone shocks. The riskless product and the specific risk product with the highest Sharpe ratio has to be included in the market portfolio to efficiently insure return against market risk and in a efficient (diversified) portfolio has to be included both and in combination with other products in order to isolate return against stand-alone risk. So intuitively the optimum portfolio for market and specific risk will be at the point where both is included and further in the same combination. The riskless product will increase the return of a portfolio without affecting risk and therefore increase the risk-return or Sharpe ratio. The risk product with the highest Sharpe ratio will increase the Sharpe ratio of the market portfolio (Fletcher, 2007). The efficient portfolio will decrease the risk of the market portfolio without decreasing the return. The market portfolio will exist where an efficient portfolio, of a whole range of specific risk products are efficiently diversified portfolios (no stand alone risk), meets (is tangent), where the combination of riskless and high risk-return products or assets for both market and specific risk portfolios is the same. The optimal portfolio includes the riskless and highest risk-return product and all other assets which as if only reflecting their market risk (Fletcher, 2007; Iqbal et al, 2010).

3.2.5 The deduction of the market exposure of a product and insuring stable return

The risk premium needed to insure a product against market risk or ensure stable return is a function of the relative risk of the product to that of the benchmark or market portfolio, the portfolio with the highest risk-return. The higher the relative risk of the product, the larger the standardised change in return, the larger the risk

premium needed to compensate for the higher sensitivity to market shocks and market risk (Fletcher, 2007). The risk premium for the product to stabilise return, to make return market riskless and to insure against market risk depends therefore on the component of risk that is common for both – the market risk. This is the component of product risk that correlates with market risk, the only existing risk in the market portfolio because all specific risk is diversified away. The standard error of the product return or risk represents the total risk or exposure to market as well as stand-alone shocks. The standard error of market portfolio return or risk is only the market related risk that could not be diversified away by even the optimum portfolio (Gharghori et al, , 2007; Iqbal et al, 2010).

The relative risk is known as the beta and is the fraction of the total risk of the product exposed and sensitive to market shocks. The higher the beta of the product, the larger the exposure to risk that cannot even be diversified away by the optimum portfolio,t he higher the risk premium needed to stabilise return or to ensure a risk free return. The risk free return plus the beta fraction of market risk premium equals the price of the product that ensures a risk free return (Fletcher, 2007; Iqbal et al, 2010).

The price of any real or nominal product or asset can, under strict assumptions, be determined only by knowing or calculating the beta of a product, risk free return and the risk premium of the market portfolio (Perold, 2004). No real, fundamental or economic information is needed to price a product. This knowledge is obsolete in the sense that fundamental or economic information is reflected and can be deducted from the risk behaviour of the product. In perfect complete markets, no product price can be higher or lower than what its relative risk dictates. If such conditions do not exist, that is if risk is under or over compensated for, then arbitration will equalise compensation and no arbitration will be possible. This deduction is the motivation for extending the framework to analyse the fundamental problematic of agriculture in Lesotho.

3.3 Concluding on the frame work

3.3.1 CAPM and the hedging of market risk

The (CAPM) of which the building blocks were discussed in the sections above, was developed after a series of other theories such as portfolio theory, which showed how investors can optimally trade off risk and returns by building a portfolio of investment (Markowitz, 1959). Other theories or paradigms attempted to link expected returns to the financing of the underlying asset (Bierman and Smidt, 1966). Later the method developed by Gordon and Shapiro (1956) became popular;

$$r = D/P + g^2$$

Where ***r***, the cost of equity capital is the dividend yield plus the growth rate, given that ***D*** is the payout dividend and ***P*** is the stock price. The assumption is that the dividend will grow perpetually at a rate ***g***. The major challenge lies in forecasting the growth rate. The problem with earlier models was some of the variables were not measurable and only intuitive.

The CAPM was originally developed to determine measurable factors to quantify risk and expected returns on capital equipment. The basic assumption is that risks can be eliminated as discussed above, if an investor can hold investments whose risks are independent and cancel each other (Perold, 2004). Put differently, the idiosyncratic or specific effect can be eliminated by diversification which in turn does not affect the expected returns (Collins, 1988).

Markowitz (1952) showed that the benefits of diversification depend on correlation. Markowitz concluded that assets do not have to be uncorrelated to minimise the risk, they simply have to be imperfectly correlated.

In its basic form, CAPM states that E_s, the expected return of an investment, the return needed to compensate for systematic risk:

$$E_s - r_f = \square + ß(E_m - r_f) + e \quad (1)$$

Where

$\square$ – is the return in excess of the compensation for the risk taken or risk-adjusted measure of what is termed the active return on an investment

r_f - is the risk free rate

$ß$ – beta, is the sensitivity of the investment's return to the return on the market portfolio

E_m - the expected return on the market

The model implies that in order to calculate the expected return of an investment, the expected return of the whole market and the sensitivity of the said investment should be known. The model implies that one can and should differentiate between the components of risk and what can be hedged, what cannot be hedged and which will need specific measures, so that the relative risk of a asset or investment can be determined and give an indication of the systematic exposure and sensitivity of the investment. This implies that in order to hedge market and specific risk, to develop mechanisms or to recommend policies in terms of the effects of shocks on the return and risk of any investment, it will first be necessary to decompose the components of risk. If market risk is determined through the CAPM, the specific risk, the non-correlating residue of risk exists due to the inability to fully diversify specific risk. Such a probability may exist in poor communities unable to diversify or fully diversify due to the limit, illiquid, cash stripped and dependent nature of the assets (e.g. ploughs) in their portfolios.

The key assumptions behind CAPM are; an average investor is risk-averse and evaluates investment in terms of expected return and risk (standard deviation of returns); the capital markets are perfect; investment opportunities are accessible to all investors and such investors make some estimates of expected returns and risk on investment including the correlation among investment returns (Perold, 2004).

3.3.2 The Arbitrage Pricing Theory (APT) and the hedging of specific risk

A departure from CAPM was the development of Arbitrage Pricing Theory (APT) (Ross, 1976). The basic premise of APT is well diversified portfolios may vary in value due to systematic factors (Collins, 1988). The model addresses and identifies imperfect covariance aspects in production in a pool or portfolio, and the degree of openness of a portfolio to systematic or market risk. As in the CAPM, the APT recognises that systematic risk affects assets in a particular way, however individual assets will respond in different ways. As an example, inflation affects all asset returns though differing degrees (Arthur et al, 1988).

Investors consider the expected systematic changes in their stating of expected returns. It is presumed that investors will continually seek opportunities to improve their risk-return positions. With idiosyncratic risk greatly minimised through diversification, only unanticipated changes in systematic risk affect returns on investment (Collins, 1988). Therefore, APT considers the relevant market risk factors only, pertinent to the investment in question. This implies the possibility that some market risk can be levered and managed to a certain extent. The market portfolio as such does not play a major role in the APT, rather a small group of imperfectly correlated but common factors that cause imperfect covariation among asset returns (Arthur et al, 1988). Such risk would require specific risk management strategies beyond diversification.

Under APT most assumptions made according to CAPM are relaxed; assets should not have a factor structure and not all should be traded (Arthur et al, 1988). Nonetheless, APT assumes that assets differ in their response to these common factors. By virtue of being systematic, these risk factors are derived using equivalent sets of assets (Arthur et al, 1988). However, it is difficult to determine these risk factors; therefore most studies employ factor analysis to measure them.

Under APT, the risk factors have an associated risk premium and the risk premium of an asset is equal to the weighted average of the risk premium. The weighting is the sensitivity of an asset returns to the common factors. Similar to CAPM, the APT assumes that asset returns follow an exogenous linear process. The asset pricing and return therefore can be stated (Chen, 1983) as:

$$E(R_i) = R_f + \square_1 b_{i1} + \square_1 b_{i2} + \ldots\ldots + \square_j b_{ij} \quad (2)$$

where $\square_j$ is a premium related to factor j, and b_{ij} is the coefficient that describes the sensitivity of the returns of asset i to risk factor j. The sensitivity coefficients are estimated from the market model:

$$R_i = E(R_i) + b_{i1}\square_1 + b_{i2}\square_2 + \ldots\ldots + b_{ij}\square_j + u_i \quad (3)$$

where $\square_j$ is the standardised factor of the systematic risk and u_i is the error term. As such b_i is comparable to ß (beta) of the CAPM with the exception of several systematic risk factors ($\square_j$) have already been identified. Some tests have shown that APT is better than CAPM in explaining asset returns (Arthur et al, 1988).

In this study, APT methodology is used in a contrasting manner to the purpose the model was originally developed and founded by Ross (1976). The APT in this study is used to specify possible specific risk factors in line with the full insurance principle (to see if such factors can explain prevailing and unexplained risk if systematic risk is calculated by the CAPM. This specification supported by the theory on consumption insurance in developing countries (Diamond, 1993 and Kotlikoff, 1994). In this model:

$$R_i = a_0 + g_1 b_{i1} + f_2 b_{i2} + \ldots\ldots + f_j b_{ij} + u_i \quad (4)$$

Intuition in this model is different from the way in which the model is conventionally used. In this paper R_i is the expected change in maize income, $g_1 b_{i1}$ is the change in total agricultural income and f_j is the factors that impose specific risk and b_{ij} describes the sensitivity of the income to the specific risk factor j. The intuition is that if $g_1 = 1$ and $f_j = 0$ maize income is fully insured. If not then maize income is sensitive for the specific risk factors, f_j. The rationale is that all market related changes in return will be captured in the change (risk) in total market return. The fraction of covariation of R_i with $g_1 b_{i1}$ represents the total market risk in maize income.

When starting with the testing, instead of looking at f_j $\mathbf{b}_{ij}$ as being an individual market risk factor in the conventional APT model, f_j $\mathbf{b}_{ij}$ represents total risk, specific and market risk in the agricultural sector. The implied remaining of the total risk (1 - g_1) would indicate the specific risk that is not diversified but can be diversified. The remainder or non-covariate fraction demonstrates the existing openness of maize farmers to specific risk not hedged due to a lack of diversification, insurance and/or self-insurance. The parts that do not co-vary with the explanatory (specific risk) variables, that is the specific risk that the product and product return is exposed to, is diversifiable but not diversified, which the poor are unable to do for reasons previously discussed.

3.3.3 Agricultural production and market and specific risk.

The framework can now be extended for general analysis in analogy to the theoretical foundations and principles of the CAPM (Fletcher, 2007; Iqbal et al, 2010) and APT (Ross, 1976). The rationale and the framework outlining how, can be applied to the real side of an economy. In light of CAPM and by using financial

information for agriculture in Lesotho, it will be possible to analyse the real or economic vulnerability of agriculture and the maize sector specifically, to market shocks and to come to usable conclusions on the nature of the market barriers that prevent commercial maize farming. In light of APT and using financial information about agriculture in Lesotho, it will also be possible to analyse the real or economic vulnerability of agriculture and the maize sector specifically, not only to specific shocks but also identify specific factors which are not fully diversified, creating specific risk barriers that prevent commercial maize farming.

In line with the conclusions for the market portfolio, the creation of an all-inclusive country portfolio to act as a reference or benchmark where sector specific risk can be analysed, is needed. Rather than constructing a country portfolio and return, gross income data is used, first to determine the relative exposure of agricultural income in Lesotho to market related shocks and to determine and analyse the sector specific risk. The variance in the time series data for income, makes it possible to determine the exposure (standard error) of Lesotho to market shocks or market risk firstly assuming in CAPM that stand-alone risk is diversified away. This can conditionally be done under the assumption that the country portfolio is similar to the market portfolio in the CAPM, and representative of Lesotho, and exogenously determined and bridled by random market shocks (Fletcher, 2007; Iqbal et al, 2010). The same logic follows in the stepwise decomposition in determining the market risk impeding maize production. A market related portfolio is not relevant for the APT in determining the degree of diversification of stand-alone risk.

The related change in income and risk of the aggregate country portfolio is the same for the individual investor and therefore for the maize producer (investor) in analogy, the sum of the products in the specific industry portfolio (agriculture) and the related sector (maize) variance of the income and market risk of the (maize) producer (investor) and the premium paid on the market risk in relation to the aggregate industrial market risk in Lesotho. Similar, but in terms of specific risk the related change in income and risk on the aggregate country portfolio is the same for the producer of maize in analogy, the sum of the products or sectors in the specific industry portfolio and the related variance of the income and the premium paid on maize production to the specific risk that Lesotho is exposed to. The effect of market and specific shocks on agricultural income and maize production specifically, can be determined, if such risk exist by using a CAPM in combination with an APT and the logic which underlies the full insurance principle (Diamond, 1993 and Kotlikoff, 1994). The latter is also used in the specification of specific explanatory variables which may underlie the specific risk responsible for sector variances in income or risk which may underlie maize production and returns.

Similarly as with to the methodology above, as a related example, if an investor wants to determine the risk of an investment in mining, the investor can compare the risk of the company to that of the mining sector as a whole, or to an all inclusive

mining index and determine the beta, which is the exposure and sensitivity to market shocks. To determine sectors' relative market risk, beta, we need industry income (return), in this instance, agricultural income and sector income; that is the income from maize production in case of the study. In the same way, by using an adjusted APT methodology we can not only identify and measure sectors' non-diversified specific risk, but also the underlying specific non-diversified factors. CAPM and APT therefore gives us a framework to determine the exposure to systematic and specific shocks and risk, and a mechanism to analyse and place Lesotho's agricultural problem of commercialising maize production in a market as well as specific risk related context.

In sum: the testing procedure in the next chapter will follow. First as discussed above, to make the results and inference more robust the premiums paid in total agriculture income, (AGRIC) is regressed on the premiums paid on gross national income (domestic market portfolio). In order to capture existing market related risk in agriculture, we attempt to firstly identify in terms of CAPM, if such risk exists in agriculture as a whole and is compensated for. If not □ the return in excess, in the case of the study, both a negative and possitive □, of the compensation or non-compensation for the market risk exist. This is then followed by regressing the premium in maize return on the premium of total agricultural return, to identify the market risk in the production of maize specific and to see if market risk exist and is compensated for.

Secondly, by making use of the full insurance principle and adjusting the conventional APM specification, to identify possible specific risk presence in maize production, that is specific risk not diversified in full, that cannot not be detected by CAPM due to its nature of assuming complete diversification. If such non-diversified risk exists in maize production, such that $g_1 \neq 1$ in (4) then to start and identify and specify possible individual factors rather than aggregates, like g_1, that can be a reason for specific risk. If such risk and risk factors can be identified it is then left as a topic for further study to investigate, isolate as such, non-diversified specific risk in specific economic variables that effect maize return.

3.5 Conclusion

In our build-up of the CAPM and APT theory, we have demonstrated that agriculture is challenged by systematic risk and specific risk that may not be diversified away orbecause of the illiquid nature of the poor's assets due to their dependence on these assets in self-sustaining. The existence and effect of systematic or market risk on agricultural income can be calculated with a CAPM model as demonstrated. The existence of specific risk on the other side, due to the assumption of fully diversifiable risk in this model and the implied absence of specific risk , can be determined by the APT model, an economic model normally used for the

determination of systematic risk in combination with the logic underlying the full insurance principle (Diamond, 1993 and Kotlikoff, 1994). The aim in the next chapter is to determine the sensitivity of maize income to possible specific risk factors and to get an indication of non-diversified risk and non-diversifiable or market risk.

Chapter Four: Estimating the role played by specific risk factors in the subsistence nature of maize production in Lesotho

The objective of the study is to identify the risks or probability of default facing the agricultural sector in Lesotho, specifically maize production as possible reasons as to why subsistence farming still motivates agricultural production rather than market or commercial production. The central point is an attempt to isolate the specific risks, the individual farmer's propensity to default due to the vulnerability to specific risk factors, and market risk or factors general to the agricultural sector that may cause a default. Subsequently, to identify the potential for the use of pooling, formal insurance and other available hedging mechanisms in order to manage of specific risk.

The objective of this chapter is to determine the role played by idiosyncratic or specific risk in the subsistence nature of production. That is to calculate the role of a class of risk that is due to its random nature manageable and controllable. The role played by idiosyncratic or specific risk in maize production in Lesotho in order to identify for further study - if specific risk is reason for subsistence production - possible hedging mechanisms like pooling systems and collective institutions, are needed to support the commercialising of maize production.

The hypothesis of the study is that it is problematic, due to poverty and meagre resources, for subsistence farmers to hedge by diversifying assets or insuring individually against specific risk and to form mechanisms like co-operatives to hedge in agriculture. This may be a reason for them being trapped in poverty and continued subsistence as the reason for agriculture production.

The cornerstone for investigation in the chapter is the initial adoption of CAPM logic (if efficient markets exist for all financial assets investigated then the pricing process can be described by CAPM) of efficient processing of information and pricing, to analyse the risk-returns from the agricultural assets and the possible risks associated with the sector as if such market efficiency existed. The basic premise of CAPM is the proportional risk-return on an asset may be estimated given the risk-return on the entire market portfolio as well as the relative sensitivity to the market portfolio of the said investment.

Building on CAPM the study explores the notion that stand alone risk and market risk can be identified, isolated and quantified, the first proportionately compensated in terms of premium, return proportionally above the risk free return, and the latter pooled. This investigation explores the possibility and opportunity of identifying related mechanisms and policies that can contribute to transforming society's ability to structure maize production into sustainable commercial farming.

4.1 Model estimation and data

4.1.1 Estimating agriculture's vulnerability to market risk

The first step in the analysis which follows is the determination of a seeming lack of commercialised agriculture in Lesotho, production that is market and return focused, and maize production specifically stemming from market risk, that is risk that is identified for Lesotho's economy as a whole. Is market risk and vulnerability to market risk reasons for agriculture in Lesotho not being compensated proportionally, fuelling subsistence in agriculture as a whole and maize production specifically? To determine the vulnerability of the return or income in agriculture in Lesotho when unexpected market related or price changes are passed through the natural interrelated channels between markets, when such return is market and price dependent needs to be calculated. Because of the financial approach, the vulnerability in agricultural return is related to the volatility in general return, we need to identify not only the related volatility and risk but also to determine whether the risk is compensated for. The market return and risk by which the agricultural return and risk is related includes the non-agricultural sectors, to estimate or to calculate the vulnerability of agriculture relative to market risk and return, the CAPM in (1) is used to calculate the vulnerability.

$$r_t = \propto + \beta r_{mt} + \epsilon_t \; r_t = r_f + \beta(r_m - r_f) + \varepsilon_t \; R_p = \square + ß(Er_m - r_f) + e$$

Where

$r_t - r_f = R_p$- where R_p represents the implied or required premium to compensate market risk and r_t. is the specific return, in the study it refers first to total agricultural return and where indicated return from maize production.

r_f - is the risk free rate, $ß$ – beta, is the relative sensitivity of the investment's return to market risk, which prescribes the magnitude of the premium paid for the price of the asset (on the price of the agricultural product or products) given the premium on the market portfolio.

$\square$ – is the return in excess of, or shortcoming in the compensation for the risk taken or risk-adjusted measure of what is termed the active return on an investment. Negative compensation is a reality in real markets like agricultural markets under specific conditions, esspecially where the market and the motives of profitability in production are significant but their contribution to such a decision is either meagre or absent and where the production decision is dominated by autonomous factors such as politics, culture, tradition and religion.

r_m- the expected return on the market portfolio or GDP in this research

e – error term

The dependent variable (compensation for unexpected changes in the return of agricultural product sectors due to market risk) in CAPM, the proportional premium needed to hedge agriculture return against market risk, is estimated by retracting average agricultural income from the estimated agricultural income in each period under calculation. In such a way determining the deviation from the expected and planned from what in effect actualizes. If such differences are biased and systematic, risk is real in production outcomes. Market returns, (r_m) (r_m) in (1), (the GDP of Lesotho is taken as a proxy for return on a market portfolio) minus the risk free return, r_f r_f in (1), gives the risk free rate of return for the market (risk free) portfolio. β in (1), the explanatory parameterized variable, gives the proportional market risk of agriculture, and R_p r_t the relative risk-return, that is the premium calculated for agriculture as a whole, the calculated extra return, above risk free return in agriculture that is needed to compensate the exposure of agriculture to market risk. If β is not significant, if proportional risk is incalculable, the implication is that market prices in agriculture are driven by factors other than conventional market factors as illustrated by the insignificance of the covariance between r_t r_t and $(r_m - r_f).(r_m - r_f)$.

The same procedure is then repeated to determine the relative exposure of individual agriculture product sectors to the total market risk of Lesotho through a decomposition of agriculture. This is reflected in unexpected changes in GDP relative to agriculture and market exposure of the different product sectors under investigation, livestock, crop production and maize production. The reason underpins the individual sector's openness to market risk and the proportional compensation or vulnerability of these sectors for such risk. And if vulnerable, is this vulnerability optimally compensated for.

The results model agriculture as a whole, gauging the risks facing agriculture and the specific subsectors in determining each sector's vulnerability to market risk, as well as the compensation received for such risk; as such the systematic risk facing the agricultural sector is determined comparatively with GDI as whole. Then in terms of the different agricultural sectors to calculate their individual market risk and relative compensation for such risk. The agriculture sector return is in this case decomposing into crops (CROPS) and livestock (LIVESTOCK) with gross domestic income (GDI) based on CAPM. The major motivation in looking at the sector in total and then to decompose it into crops and livestock is that farming is subsistent in nature, characterised by an absence of market related pricing. Other than economic parameters, tradition for instance, determines its own price for agricultural products and maize specifically, factors which make market risk insignificant as a factor in production. In subsistence farming livestock is still used for horsepower, and sheep, goats and to a lesser degree cattle as sustainable means for subsistence, rather than commercial market related reasons, hence its critical role in production. This orientation, if market prices and related market risk is insignificant, reflect the reasons for subsistent dependence, as motivations for production other than market

related or price risk. A sector ruled under such conditions, is motivated by non-price and non-economic forces; autonomous factors outside of the economic system that are reasons for price inelasticity in production; forces motivated by culture, tradition, religion and survivalist motives. The same argument is true for maize production. Significant exposure to market risk will indicate the sector is being driven by market forces or, economic and financial motives, with a lesser dependence on subsistence motivations for agricultural production.

4.1.1 Data analysis

The research initially used data on Lesotho agricultural sector as a whole, crops and livestock based on annual data from 1977 to 2006. The data was extracted from GDP data, and divided into economic sectors. Since Lesotho does not have mechanisms, such as indices, Gross Domestic Income and real interest rate were used as proxy for market return. Climatology data was also sourced from the Lesotho Meteorological services in modeling systematic risk in agriculture.

Production numbers are not reliable indicators therefore the study employs return proxied by income.

Variable	Description
AGRIC return/income	Agriculture return/income
CROPS return/income	Crops – Maize is the major crop in Lesotho as a staple food return/income
LIVESTOCK return/income	Apart from crops, livestock forms a significant part of farming in Lesotho return/income
TEMP	As part of systematic risk in agriculture, temperature forms part of the model.
RAINFALL	Similar to temperature, rainfall imposes a systematic risk in the agricultural sector.
RIR	Interest rate is used as a proxy for the market return.

Table 4.1 - List of variable used to build the model

Various tests are performed on the data to establish suitability for economic modeling. Augmented Dickey-Fuller unit root test (ADF) is performed on all variables (Dickey and Fuller, 1979).
The hypothesis is:

H0: $\delta = 0\ (unit\ root)\ \delta = 0\ (unit\ root)$

H1: $\delta \neq 0\ \ \delta \neq 0$

It should be noted that the results are also confirmed using alternative tests including Kwiatkowski-Phillips-Schmidt-Shin as in Table 4.2.

	ADF			KPSS – 5% level		
	t-stat	Critical value 1% level	Durbin-Watson	Lm-stat	Critical value	Durbin-Watson
AGRIC	-5.94	-3.689	2.03	0.1659	0.739	2.28
CROPS	-5.64	-3.689	2.00	0.106	0.739	2.19
LIVESTOCK	-7.47	-3.689	2.24	0.500	0.739	2.79
RGDI	-3.57	-3.689	1.89	0.339	0.739	1.31

Table 4.2: ADF and KPSS

Under Augmented Dickey-Fuller, we may reject the null hypothesis that unit root exists in our data (t-stat < critical value). These results are confirmed by the KPSS test; hence the level data is suitable for regression analysis.

One of the conditions for a sound OLS model is that the residual series should be normally distributed. Using the Jarque-Bera normality test a normality distributed sample should have S = 0 and K = 0. Therefore a deviation from these two conditions would increase Jarque-Bera t-statistic.

	Skewness	Kurtosis	Jarque-Bera t-stat	Probability
Agric	-0.05	4.27	1.96	0.37
Crop	0.90	3.11	3.97	0.13
Livestock	0.50	3.36	1.38	0.49

Table 4.3. – Jarque-Bera Normality test results

The results in Table 4.3 show that the residuals from the regression models are not normally distributed and the zero hypothesis therefore may be rejected and return is non-stationary and has a unit root. This may be stated as error terms, which implies that risks are not random, which points to a level of autocorrelation in risk. This indicates that either lags in receiving income exists, due to hoarding and storing of surpluses for instance and are not reflected as such in the market in absence of future markets and/or autonomous factors rather than rational economic decisions being dominant in decisions of production. The CAPM methodology can thus not be applied. Due to this finding it has to be accepted that risk other than market risk determines the production decision in agriculture and the agricultural sub-sectors in the study, hence the adoption of APT to determine specific factors impacting on maize production

Additionally, APT may be viewed as the 'supply-side' model, since the beta coefficients reflect the sensitivity of the underlying asset to macro-economic risk factors. In this paper parameters indicating an exposure to specific rather than to

market risk are provided. This is done by introducing total agriculture production (AGRIC) or national average yield as a control variable capturing systematic risk in agriculture. The model is ideal for agricultural assets that respond to shocks in production rather than to the demand (Arthur et al, 1988).

4.2 APT results

The CAPM results, as discussed, will be applied. It is expected that sector specific or idiosyncratic risk would explain the largest proportion of risk in agriculture. Building a model that investigates multiple factors that may cause systematic risk in agriculture would be ideal. Similar to CAPM, APT is based on the premise that asset returns are generated by normal distributed variables in a linear process. Hence the model, as suggested by Roll (1977) supported by Ingeroll (1984), can be stated as follows:

$$R_i = a_0 + f_1 b_{i1} + f_2 b_{i2} + \ldots\ldots + f_j b_{ij} + u_i$$

Intuition in this model is different from the way in which the model is conventionally used. In this paper R_i is the expected change in maize income a*nd* f_j is the factor which parameterised the systematic effect of risk and b_{ij} describes the sensitivity of the change in income and income risk to the change in the risk of factor *j*.

Instead of looking at b_{ij} the study looks at the implied (1- b_{ij}) as it would indicate the risk that does not receive a premium, the part that does not co-vary with the explanatory variables, that is the specific and idiosyncratic risk the product is exposed to that can be diversified, which the poor are unable to do for reasons previously discussed. To ensure the result and inference are more robust, whole agriculture income (AGRIC) is, as discussed above, also used to capture all existing systematic risk in the model -that is to cancel out all systematic risk present that does not receive any premium.

Due to the non-normal distribution of the risk data series already discussed the nature of specific risk factors effects on the risk of maize income seems to be neither of an economic nature as for example reflected in the changes in maize prices nor the result of natural factors like rainfall in the maize production system.

4.3 Conclusion

The finding in this chapter is that neither market risk nor economic and natural specific factors that were specified were responsible for the inability to commercialise maize production in Lesotho up to 2006.

It has to be iterated that the study is a first to use such an approach and the research does not in any way claim to be a complete study, even in terms of the factors used in the analysis. The approach though shows; before assuming that economic and

natural factors underlie subsistence farming, as in Lesotho, such assumptions still have to be confirmed by a full investigation incorporating them.

Chapter Five: Synthesis

This study attempted to identify the risks facing agricultural production in Lesotho using both CAPM and APT. The CAPM hypothesis refers to the identification and quantification of specific risk and market risk, insured by diversification and by receiving premiums on return. This opens the possibility and opportunity to introduce pooling mechanisms and policies in terms of specific risk and premiums, paid out on systematic risk, as compensation for the risk of agricultural production; making it a viable economic choice; one that can contribute among other economic factors to transform society's ability to engage in commercial farming.

Consistent with Arthur et al (1988), market risk levels are low as a factor in total agriculture risk. The price inelastic nature of agriculture assets may be explained by various factors; crop products are thought to be illiquid, not easily tradable or produced for sole consumption, as suggested by subsistence farming in Lesotho. They are isolated and will therefore not respond to price changes (Bjornson and Innes, 1992b). Further, one of the major conditions for CAPM, is that investors expect to maximise returns, and farmers tend to engage in agriculture for reasons other than financial (life-style), hence their acceptance of low returns from their agricultural assets (Bjornson and Innes, 1992).

As in most developing and developed countries, farmers experience variable and low prices, yields and returns (high risk), which lead to farmers seeking alternative stabilising sources of income or return (Business Perspectives, 2000). Many farmers, have resorted to 'part-time' farming, seeking employment in other sectors such as the manufacturing, due also to the inability to hedge relative high risk and relative long periods of low return in the agricultural sector (Business Perspectives, 2000).

In Lesotho the manufacturing sector, far less prone to the fickleness of nature has grown significantly, especially the textile industry (World Bank, 2006). This has resulted in more people seeking employment in the textile industry and fewer in the agriculture sector, leaving the country as a whole exposed to food shocks. The behaviour may indicate the problem of small and subsistence farmers having to hedge or insure individually in this way against specific risk in agriculture, due to the absence of insurance mechanisms and low product prices, which make subsistence farming less risky mechanism of production. Despite this, some farmers still manage to produce for the market, especially cash crops (FAO, 2005). This may be an indication that commercial farming can be successfully operated in Lesotho when obstacles such as uncertainty of product prices, access to liquidity are removed. In so doing returns are smoothed and the country's exposure to food shocks is decreased.

Several other factors in addition to risk can be outlined as barriers to significant commercial production. Land tenure security is one example. Leasing and property transfer laws in Lesotho need improvement as they can contribute as collateral to attract long-term investment[5]. Other cited issues in managing risk specifically include a lack of collective or pooling mechanisms such as co-operatives having succeeded in other countries. This pooling model is profit oriented, which avoids land speculation and other anomalies that are normally associated with a government subsidy approach. Sound infrastructure, such as roads, play a major role in insuring risk and encouraging commercial activity. Distance to the markets affects the net returns from the commercial farming activity. Other factors such as capital requirements, labour costs, low and variable yields and market prices also act as risk barriers to commercial farming.

Although the initial objective in the study was to determine the role played by market and specific economic and natural risk factors in the subsistent nature of maize production in Lesotho, it then seems that these risk factors as specified in the study as the most probable factors were not in reality the probable causes of subsistence farming in Lesotho.

The study in no way claims to be a complete study of the risk factors that may be the rationale for subsistence farming in Lesotho. The contribution lies in the originality of the approach followed in the study and in emphasising the need to first confirm before making any assumptions in investigations of this sort.

Further research

It has been highlighted that some of the factors that may have had a negative impact on agricultural production were excluded, such as soil quality, hydrology and socio-economic factors. A further study that explores these factors would be helpful in informing government policies.

[5] Interview with the Principal Secretary of the Ministry of Finance – Dr M. Majoro.

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