Contract Farming its Promises and its Risks: A Quantitative Analysis

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Submitted to the
Institute of Graduate Studies and Research
in partial fulfilment of the requirements for the degree of

Doctor of Philosophy
in
Economics

Eastern Mediterranean University
June 2016
Gazimağusa, North Cyprus

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ABSTRACT

The objective of this study is to pinpoint the key opportunities and risks facing each of the stakeholders in export-focused contract farming value chain in Zambia.

Although a deterministic cost–benefit analysis indicated that this outgrower schemes would have a highly acceptable net present value (NPV), a Monte Carlo analysis using an integrated financial–economic–stakeholder model detects numerous risk variables that could make this system unsustainable. Some fundamental risks include the unpredictability of the real exchange rate, the global price of the commodity and the farm yield rates.

This analysis points out that irrigation systems are very important for both stabilizing yields and increasing them. The analysis also shows the limitations of loan financing for such outgrower arrangements when at the sector level it is difficult or even impossible to mitigate the risks from real exchange rate and international commodity price movements.

This micro-level analysis demonstrates how crucial real exchange rate management strategies are in accomplishing permanent viability in export-oriented agriculture value chains.

Keywords: Contract Farming, Monte Carlo Simulation, Outgrower Scheme, Smallholder Farmers, Stakeholders, Sustainability, Risks, Poverty Alleviation.

ÖZ

Bu araştırmanın amacı, Zambiya'da ihracat odaklı sözleşmeli çiftçilik değer zincirinde hissedarların karşılaşacağı fırsatları ve riskleri ortaya çıkarmak ve tanımlamaktır.

Deterministik maliyet-fayda analizi, bu düzenlemelerin net bugünkü değerinin gayet makul olabileceğini ortaya koymasına rağmen, ekonomik, mali ve hissedar modeliyle entegre olmuş bir Monte Carlo analizi bu sistemi sürdürülemez hale getirme ihtimali olan birçok riskli değişken olduğunu ortaya çıkarıyor. Buna göre, gerçek döviz kurundaki öngörülemeyen dalgalanmalar, küresel emtia fiyatındaki ve tarımsal getiri oranlarındaki değişiklikler bazı temel riskleri oluşturmaktadır.

Bu analiz, sulama sistemlerinin getirileri sabitlemede ve onları yükseltmekdeki büyük önemine dikkat çekmektedir. Sektör düzeyinde gerçek döviz kuru ve uluslararası emtia fiyatındaki hareketlenmelerden kaynaklanan riskleri azaltmak zor ve hatta imkansız olduğunda, bu analiz ayrıca böyle düzenlemeler için kredi finansmanında olası kısıtlamaların mevcut olduğunu gösteriyor.

Bu mikro-düzey analiz, gerçek döviz kuru yönetim stratejilerinin ihracata yönelik tarım değer zincirlerinde kalıcı finansal kapasiteye ulaşmakta ne kadar önemli olduğunu gösteriyor.

Anahtar Kelimeler: Sözleşmeli Çiftçilik, Monte Carlo Simülasyonu, Yetiştirici Düzenlemesi, Küçük Toprak Sahibi Çiftçiler, Hissedarlar, Sürdürülebilirlik, Riskler, Yoksullukla Mücadele.

ACKNOWLEDGEMENT

I would like to thank the following people: Prof. Dr. G P Jenkins, Prof. Dr. Mehmet Balcilar, Prof. Dr. Sevin Uğural, Assist. Prof. Dr. Kemal Bağzibaği and Asst. Prof Dr Hatice Jenkins and all the members of the Economics department, Eastern Mediterranean University, for their valuable support. I acknowledge the invaluable assistance of the following people: Primrose Basikiti, Majid Hashemi, Arif Yurtsev, and Fereshteh Pourmohammadi.

I would like to acknowledge the support of my wife Nawel, and daughters, Johana and Jouri. I wish my father was alive to see this: he left so soon. MHSRIP.

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LIST OF ABBREVIATIONS

ADSCR	Annual debt service coverage ratio
AfDB	African Development Bank
BOZ	Bank of Zambia
CIDA	Canadian International Development Agency
CF	Conversion factor
CIF	Cost, insurance and freight
CSO	Crop sponsoring organisation
DSCR	Debt service coverage ratio
EOCK	Economic opportunity cost of capital
EOCL	Economic opportunity cost of labour
Ext	Externalities
FEP	Foreign exchange premium
FAO	Food and Agriculture Organization
FNPV	Financial net present value
GDP	Gross domestic product
GRZ	Government of Zambia
Ha	Hectare(s)
Hg	Hectogram(s), is equal to one hundred grams
IFAD	International Fund for Agriculture Development
IPM	Integrated pest management
MACO	Ministry of Agriculture and Cooperatives
MOF	Ministry of Finance and Economic Development
NPV	Net present value

PA	Per annum
PMU	Project management unit
PV	Present value
RFP	Rural finance programme
ROE	Return on equity
SPNTO	Shadow price of non-traded outlays
US	United States
WB	World Bank
ZmK	Zambian Kwacha
ZRA	Zambia Revenue Authority

Chapter 1

INTRODUCTION

1.1 Background

Recently, the agricultural commodity chains in developing countries have experienced substantial restructuring due to adjustments in both demand- and supply-side factors as well as global policy changes. On the demand side, components such as population growth, greater urbanization, increase in income levels, and changes in preferences have reshaped demand for agricultural commodities with a significant rise in the demand of fresh vegetables and healthy foods. On the supply side, factors such as market liberalization (both nationally and internationally), technological improvements in transportation and logistics, have also played a key role in increasing production and affected the supply chains significantly. These factors have significantly promoted incidences of contract farming (Prowse, 2012) among smallholders especially in Sub-Sahara Africa (SSA).

Smallholder agriculture is the major livelihood of rural and poor families in developing countries, especially in SSA and to be more efficient, they need to overcome several major constraints in accessing agricultural commodity chains (Da Silva and Rankin, 2013). These constraints may include, but not limited to, economically insufficient quantities of production, inconsistent quality, seasonality, restricted storage services, high transaction or marketing costs, poor market information quality for smallholders, poor contract and limited capability to meet the high quality requirements of numerous highly valued outlets (Hazell, 2011).

Contract farming has been recommended as a vehicle for poverty eradication in Africa (World Bank, 2007). Within the framework of contract farming, governments and international organizations have proposed non-traditional agricultural exports from Africa as a promising avenue for increasing the incomes of smallholder farmers and alleviating poverty in rural areas (Brüntrup and Peltzer, 2006). Studies in economic growth (Hidalgo et al. 2007; Hausmann et al., 2011) have also shown that the odds of success in exporting new agricultural products can be increased if they are related and tend to use similar factor inputs to the current existing products that a country produces and exports.

The types of new crops that have been initiated most successfully through smallholder production are those that are labor-intensive and have relatively low transportation and logistics costs. They often require relatively low investment in storage facilities, and at the farm level are inexpensive to process. Such crops include coffee, cut flowers, cotton, tobacco, groundnuts, fresh vegetables and paprika (Bertow and Schultheis, 2007). Thus, these crops play a substantial role in promoting and ensuring sustainable agriculture production, ensuring food security, generating income for farmers and reducing poverty levels in many African countries. However, risks and uncertainties stemming from a wide scale of factors are persist within agriculture sector and supply chains for these crops.

A variety of risks may affect agriculture outputs such as weather conditions, natural disasters, uncertain yields owing to unpredictable weather (Morton, 2007), uncertainties in prices, high local and international transportation costs (Mamo, 1998), exchange rate fluctuations that affect farm-gate prices (Orden, 2010), escalating processing costs, volatile international market prices and stringent phytosanitary standards (Stevens, 2004)[1]. Vulnerability to certain risks is higher in case of developing countries and unpredictable circumstances of these risks can push smallholder farmers into a deeper state of poverty (Cervantes-Godoy et al., 2013).

Anatomically, some sources of uncertainty that are likely to exist in smallholder contract farming arrangements include:

i. *Output Market Uncertainty*
    - Price agreement
    - Contract form
    - Contract length
    - Contract size

ii. *Quality uncertainty*
    - Specification of quality seeds
    - Mechanisms of quality control
    - Quantity inspection areas

iii. *Input market uncertainty*
    - Arrangement of input supply
    - Mechanical support
    - Transportation arrangement
    - Credit arrangement

[1] Zambian paprika is marketed on standards based on the European Spice Trade Association (ESTA) and is controlled for salmonella, pesticide residuals and aflatoxins.

Susceptibility to these risks is what makes risk assessment essential when it comes to project appraisal of contract farming arrangements. Essentially, the risk analysis entails identifying risk variables and their associated uncertainty, and an assessment of their effect on project outcomes (Jenkins, Kuo and Harberger, 2014). Different values can occur for certain quantities of outputs and prices, and the risk in this case is the unfavorable outcomes as a result of this uncertainty. Risk assessment is the process by which facilitates project risk is evaluated and managed (The Association for Project Management, 2000). There are two main kinds of risk analysis namely qualitative and quantitative analysis. The key difference between the two is that qualitative analysis makes use of an illustrative rule to measure the possibility of occurrence. On the other hand, quantitative analysis uses probability distributions to depict variability of risk variance through the use of arithmetic modeling tools to compute probabilities of outcomes.

For this study, the focus is on a quantitative assessment of risk and sensitivity analysis on an integrated financial and economics feasible project model and Monte Carlo simulations which are generally considered to be a superior method of sensitivity analysis. It derives countless calculations given various conditions. These conditions are incorporated into the system and it generates random variables of inputs. From there, a series of net present values (NPVs) are calculated—a process conducted repeatedly in order to calculate an expected value. This study aims to identify the risks that need to be eliminated or reduced in order to achieve the project's goals and expected outcomes. By moving from a deterministic view of risk to a probabilistic approach, a project that might have had unfavorable outcomes such as a negative NPV, may be saved. This is done by mitigating the risk of the whole project through contractual provisions amongst stakeholders circumventing situations where feasible and viable projects are declined (Jenkins, Kuo and Harberger, 2014).

Benefits of quantitative include:

- Better comprehension of the project resulting in the formulation of more accurate strategies particularly for cost estimates and timescales (Moughtin, Cuesta, Sarris, and Signoretta, 2003);
- Better understanding of project risks, their consequences and mitigation, and the appropriate allocation of responsibility for each (Lowder, Mendelsohn and Speer, 2013);
- Increased awareness leading to the use of more appropriate types of contracts for different projects (Euro Log, 2016);
- Ability to make and justify decisions which enables a more efficient and effective management of the risks (Euro Log, 2016);
- Learning the risks in a project allowing evaluation of unforeseen events that actually expose the risks which also tends to dissuade the approval of projects that not financially viable (Mbokane, 2005);
- Risk assessment assists in building better project models with more realistic and rational future projections (Hulett, 2011).

While the application of such contract farming schemes has been found in a number of crops in Zambia, this assessment focuses on paprika growing as part of the project proposed by the African Development Bank (AfDB) and the Government of Zambia (GRZ).

1.2 Objectives of the Study

The hypothesis of this study is that a deterministic cost benefit analysis or investment appraisal of such an intervention employing mean values for the input variables will give very misleading results of the attractiveness of the project when only the NPVs are estimated from points of view of various stakeholders. A quantitative analysis of the risks associated with this contract farming scheme will identify a set of risks that must be mitigated if the intervention is sustainable.

Langmead (2005) observed that the variability in rainfall, prices, yields and unstable contracts is important to the sustainability of the paprika value chain in Zambia, but he did not quantitatively show how these risks could affect the viability of smallholder farmers and other players in the value chain. While these risks facing stakeholders in non-traditional export crop production and marketing have been identified in the relevant literature, as far as we are aware no attempt has been made to assess quantitatively the relative magnitude of these potential risks. Without a quantification of the magnitude of the potential risks then it is very difficult to design mitigation strategies that will have a high probability of success.

Against this framework, the major focus of this study is on the concomitant risks of financial cash flows of a contract farming project and the financial relationships between the main stakeholders, namely, the operator, the smallholder and the government. However, the overall economic impact is also critical in determining if there is a net surplus between the economic gains and the economic resource costs of the project after the costs of an acceptable level of risk mitigation of has been accounted for. After a financial cash flow model has been built and the base case financial analysis completed, an economic analysis will indicate the degree of economic surplus that could potentially be realized and to which stakeholders will the surplus accrue. The operator is the nucleus of the outgrower value chain, having the critical roles of being both the financial and the market intermediary. As a market intermediary, the operator provides a link between the international export markets and the Zambian smallholder. The operator will also provide extension services to the smallholder farmers in addition to those provided by the local government[2].

The relative impacts of the various sources of risk of the project are assessed through to sensitivity analysis and a Monte Carlo simulation of an integrated financial–economic–stakeholder model of smallholder paprika production, processing and export. The model is used to find out how these key risks alter the attractiveness of the operation from the perspective of the different domestic stakeholders in the export value chain.

1.3 Structure of Analysis

The next section is Chapter 2 which is a literature review followed by the project description in Chapter 3. Chapter 4 explains the methodology used in this dissertation and is followed by the financial analysis of the outgrower scheme is laid out in Chapter 5. An economic assessment of the outgrower scheme is provided in Chapter 6 and Chapter 7 provides stakeholder impact of the project in question. Chapter 8 which is pivotal to this study contains the risk analysis which indicates the major sources of risk and it quantifies these risks of contract farming and shows the impacts of such risk on project outcomes for different stakeholders involved in such

[2] Much of the international donor funding is focused on building capacity of government institutions so that they are equipped to adequately provide extension services to targeted smallholder farmers' groups in different areas of the country.

an agreement. Chapter 9 concludes the study by identifying policies that would enhance the sustainability of Zambia’s paprika value chain.

Chapter 2

LITERATURE REVIEW

This chapter takes as its point of departure the clarification of contract farming in terms of the basic principles along with its strengths and weaknesses from the farmers and contractors' points of view. Contract farming may be termed as a farming production being undertaken with an understanding between farmers and buyer, with set stipulations for the production and selling of the intended product(s). Typically, the farmer(s) delivers the contracted amounts of a particular agricultural product which meets the buyer's standards of quality. The product must be supplied at the predetermined time by the contracting party and in return that party obliges to procure the product and, in certain instances, to maintain production by means of provision of farm inputs, preparation of land, credit facilities and specialized advice (FAO, 2008).

Morrissy (1974) defines contract farming as a way of passing on agricultural expertise from firms to farmers. Since the firm has a vested interest in the quantity and quality of the output of the contracted farmers, it may provide valuable technical assistance especially in cases where farmers have no prior experience in growing the crop in question. Another way of looking at contract farming is as an arrangement for the production and supply of agricultural products under forward agreements to provide a certain agricultural product, at a time, price, and in the quantity needed by a contractor (Singh, 2002). According to the author, it essentially comprises of the following; a pre-consented price, magnitude or land area to be covered, quality and time. Although several explanations of contract farming have been suggested, it is important to note that there is no umbrella term that can encompass this whole concept.

Rehber (2007) suggests that contract farming has conventionally been deemed a "feature of an advanced capitalist agricultural structure". According to the author, it stands for developing a widely proposed means of agro-industrial incorporation for developing countries and their economies. For this reason, contract farming has been publicized throughout the last few years as a vehicle aimed at improving the efficiency of agricultural systems in less economically developed countries as well as a crucial component of rural improvement and settlement schemes (Baumann, 2000). Local authorities privately held resident firms, transnational corporations, some global support and funding bureaus, like the US Agency for International Development, The World Bank, Asian Development Bank, and Commonwealth Development Corporation have been a part of contract farming schemes (Glover, 1994).

There has been rejuvenated attention on the benefits of contract farming in the stir of economic developments that have lowered government spending for credit programs, primary crop price backings, input subsidies and national research and expansion systems (Schetjman, 1996). Although sharecropping contracts between lessees and lessors have been a feature of agricultural economies for a long time, contracts between firms and farmers with freehold over their personal plots seem to have emerged over the last 100 or so years (Eaton and Shepherd, 2001). There is evidence of how the Japanese employed contract farming after 1885 in Taiwan for sugar production, as did US banana firms in Central America in the early twentieth century (Watts, 1994). In developed capitalist countries, contract farming was common in the vegetable-canning sector and seed industry in the 1930s and ‘40s. From those days, contract farming has developed and turned out to be a major form of agricultural transformation. Rehber (2007) estimates that contract farming accounts for around 15 percent of agricultural production in economically advanced countries. In the US, contract farming accounted for 39 percent of total agricultural production by value in 2001, up from an estimated 31 percent in 1997 (Young and Hobbs, 2002). Germany boasts similar figures—38 percent of dairy, poultry and sugar are produced by contract farming. (The average for other commodities, however, is just 6 percent).

Contract farming is also on the rise in the developing world, particularly in sub-Saharan Africa. Beginning in the 1980s, contract-farming arrangements in Africa have since shifted from the public to the private sector (Little and Watts, 1994). Almost 12 percent of rural residents in Mozambique are involved in contract farming, mostly cotton, while in Kenya over half of sugar and tea is produced under contract, as well as a significant proportion of horticultural exports (Swinnen and Maertens, 2007). Coffee is another example of a successful contract-farmed crop, including Uganda’s Kawacom (Bolwig et al., 2009). In terms of public sector outgrower schemes one of the most successful is the Kenya Tea Development Authority (KTDA). This project was so successful that it led to the incorporation of the biggest tea management agencies owned by 54 factories that are in turn are owned by approximately 560,000 small-scale tea farmers across the country. The authority also grants secondary-school scholarships in tea-growing areas (KTDA, 2016).

Outgrower schemes are one of the possible interventions which attempt to increase participation of smallholders in the production of agricultural products. Encouraging smallholders to shift to outgrower schemes of high-value crops may increase their income and may improve their economic welfare, but these arrangements have to be analyzed by sensitive and in-depth evaluations. In other words, high-value crops may not necessarily translate into high farm profits (Tinsely, 2010) because of potential agricultural risks that may result in high variability of returns for farmers (Glover, 1987; Deininger and Olinto 2000; Ponte 2001).

Kohls and Uhl (1985) categorized contracts into three broad groups:

i. Market specification contracts: generally signed during the planting season, such contracts specify product quality, quantity, price and method of payment. The farmer retains management control, and has a guaranteed buyer if product specifications are met.
ii. Resource-providing contracts: integrators supply resources, managerial support and supervision. Producers' income guarantee is minimal, and prices are usually track spot markets.
iii. Management and income-guarantee contracts: transfer price and market risks to integrators from farmers, with the former assuming a managerial role in exchange. Contracts may also include production and marketing stipulations found in contract types i and ii.

Contract farming can also be considered in terms of the type of farm involved (Eoton and Shepherd, 2001). The Food and Agriculture Organization (FAO) provides a five-type classification.

i. *The informal model.*

This model involves simple seasonal production contracts agreed with individuals or small companies. Because these contracts entail the supply of minimal or no production inputs (such as credit and/or advice on grading and quality control), their success is contingent upon the availability and quality of external extension services. The model is commonly used for products that require minimal processing or packaging, and occasionally for staple crops such as maize.

ii. *The intermediary model.*

This model entails the firm (buyer) contracting an intermediary organization to formally or informally subcontract producers. The intermediary charges for embedded services (such as credit, extension services and advice on marketing and processing) and purchases output. The success of this model depends on careful design, appropriate incentives and robust control systems. At its worst, buyers lack control over production processes, quality assurance and delivery times. Farmers risk price manipulation, reduced income and a lack of technology transfer.

iii. *The multipartite model.*

A government agency or non-government organization (NGO) forms a joint venture with a private firm or financial institution, while a cooperative or other organization brings together farmers and provides embedded services. This model may involve an equity-share scheme for producers.

iv. *The centralized model.*

This is the most common contract-farming model, similar to the outgrower scheme frequently employed in Africa (see v, below). Government involvement is minimal, while the buyer's role ranges from the provision of limited inputs to control of most of the production process, from preparing the land to harvesting. The buyer purchases output from farmers (small, medium or large) in a vertically organized relationship with the contractor. Buyers are directly involved in the production process. Quantities, quality, delivery schedule and payment are agreed at the beginning of each season. Products typically covered by such contracts include sugar cane, tobacco and tea.

v. *The nucleus estate or outgrower model.*

A variation on model iv, the central firm (buyer) has its own farm in addition to contracted farmers, sourcing from both its own (nucleus) estate/plantation and contracted farmers. The buyer invests in land, machines, staff and management, while guaranteeing inputs to contracted (satellite) farmers. This ensures the cost-efficient utilization of nucleus-farm processing capacities, as well as meeting customer commitments on sales volumes. The nucleus estate may also be used for demonstration or research purposes. Now the preserve of the private sector, this model was often used in the transfer of state-owned land to former farmworkers. Typical nucleus-estate model products are perennials.

Contract farming has long been heralded for its promised benefits to smallholder farmers, contracting firms and the economy as a whole. However, a number of studies have highlighted serious pitfalls. At the farmer level, the increasing prevalence of cash crops means households are less self-sufficient—unable to weather sharp fluctuations in prices and susceptible to shortages of food (Key and Rusten, 1999). Farmers generally enter into contracts voluntarily. However, investments of time and resources lead to a shift in cropping patterns, leaving farmers overly reliant on contract crops and vulnerable to exploitative changes in terms governing their relationship with the buyer (Key and Rusten, 1994).

At the household level, contract farming in Africa is associated with disrupted power structures and increased tension (Carney and Watts, 1990). Contract farming risks similar disruption at the community level, where buyers contract mainly with bigger commercial farms, such that poorer farmers fail to benefit (Eaton and Shepherd, 2001). Finally, at the national level, state officials susceptible to powerful agro-industrial firms may collude to ensure that policies and resources serve business, not farmer interests (Watts, 1994).

Another problem associated with contract farming is side selling: that is, contracted farmers selling to another buyer. Products for which there is a high demand, usually staple foods, are more susceptible to this side selling (FAO, 2016). This was the case in Rwanda for the Kinazi cassava project. Inputs diversion by farmers is also a drawback. This is whereby instead of using the inputs for their intended production use, some farmers may sell these inputs and this may affect yields which leading to undersupply of contractors' needs. Side harvesting whereby farmers sell to the contract firm produce which is not their own. It is a way to avoid repayment. If two farmers are contracted, but one claims crop failure and the other sells their crops, then they only repay one set of inputs. Insufficient and inadequate farm management and technologies leading to inconsistent supplies. Because non-traditional crops cost more to produce, their failure represents a greater financial risk to the farmer (Simmons, 2002).

At the same time, non-contract farmers who are not part of an outgrower scheme are restricted to thin peripheral markets, where prices may be too low to support higher levels of production. Furthermore, non-contract farmers producing non-traditional crops face additional risks of greater perishability and less certain yields than for traditional crops (Marsh and Runsten,1995).

Furthermore, while outgrower schemes reduce some types of risks for contract farmers, these risks may be transferred to non-contract farmers. From a political-economy perspective, outgrower schemes reflect negative developments in the agricultural sector: the withdrawal of state support; greater specialization of production processes and markets; and inefficient systems of credit (Singh, 2002). Under this framework of analysis, contract farming is a manifestation of the social relations of production, encouraging the product differentiation that underpins monopolies (Wilson, 1986).

From an institutional economics point of view, however, contract farming is a means of creates positive externalities for rural development. At the macro-economic level, it is argued that contract farming overcomes market imperfections in terms of both produce and credit, as well as improving availability of essential inputs (labor, land, information. As such, contracting reduces transaction costs, improves sectoral coordination, and facilitates otherwise prohibitive investment in processing capacity (Grosh, 1994; Key and Runsten, 1999; Singh, 2002).

After discussing the weaknesses and issues associated with contract farming, the following section discusses the economic logic of why such contracts are still being utilized. The benefits of outgrower schemes are innumerable and well documented.

Benefits of contract farming from the farmers' perspective:

- An overall inference from practice and theory is that participation in contract farming increases income (Little, 1994; Singh, 2002). Studies (Dahl and Lochner, 2012; McLoyd, 1990; Milligan and Stabile, 2011; UNICEF, 2013) show that household income affects children's outcome and achievement. It is sufficient to say improved income will enable farmers to enhance the standards of living for their families especially for the children;
- Improved liquidity through access to credit facilities. As a result of entering a CF agreement, farmers can get their hands on funds they would otherwise not have. Generally, the cost to produce nontraditional crops per hectare is higher than traditional crops and growers will need funding to finance farming activities (Key and Runsten, 1999);
- Allows access to a reliable, wider market. Farmers receive a surety that their product will be procured after reaping (Simmons, Winters and Patrick, 2005);
- Improved access to non-financial services, for example new technology and extension and training services; better capacity utilization; lower market uncertainties through market-oriented production planning; and reduced production risk through longer-term farm planning;
- The performance of the whole farm system is enhanced through overflow of technologies and skills;

Benefits of contract farming from the contractors' perspective:

- More consistent supplies of raw materials; firm has control over production processes and quality; reputational gains to firm by involving local producers; company avoids having to resolve issues related to squatters or trade-union disagreements (Glover, 1984);

- Reduced staff costs through outsourcing and subcontracting; reduced transaction costs through contracts securing stable supplies; reduced procurement costs through economies of scale;
- Reduced disease or weather-induced supply risks through geographical diversification; reduced market risk through better alignment of supplier and customer requirements;
- In the case of foreign contracting firms, reduced risk by diversifying location of assets (Glover, 1984).

The next section of this study will look at a particular case of contract farming in Africa.

Chapter 3

PROJECT DESCRIPTION

3.1 Introduction

This project calls for a joint effort by several bodies to increase a sustainable smallholder paprika outgrower operation to 2,500 hectares. It requires that three components be set up in the intervention areas: irrigation infrastructure, capacity building with extension services, and rural financial credit.

In the scheme analyzed for this study, the operator generates revenues from the export sales of processed paprika in the European market. The revenue from the commodity sales is determined by the world price fetched by the Zambian paprika at the European point of import. The operator's cash flow costs are the expenses associated with off-taking the unprocessed paprika crop from the farmers as well as processing and transporting it[3]. As a financial intermediary, the operator bears the administrative overhead burden of sourcing credit from commercial banks to finance the working capital requirements of the outgrower smallholder farmers. The credit is advanced in kind to the smallholder farmers at a cost to the farmer that includes the

[3] Cost items are classified as either tradable or non-tradable and the exchange rate applied accordingly.

borrowing costs of the operator adjusted for a margin that reflects the cost of processing the credit and the anticipated default risk of the farmers[4].

In the model, this credit-processing cost is set at such a level that the net financial position of the operator is not adversely affected, unless the rate of credit default deviates from the anticipated target[5]. The net earnings of the operator are subject to income tax, while the value added tax (VAT) paid by the operator on purchased inputs is refunded through the zero rating of export sales. Delays in the collection of revenues and making payments for operating expenses, as well as the dynamics of the cash flow over time have been captured by the magnitude of working capital in the model as determined by the variations in cash balances, accounts receivable and accounts payable over time.

Historically, agriculture sector in Zambia has recorded average annual growth of 2.5 percent, compared to population growth of 3.7 percent. This sector has performed poorly because of:

- Poor economic planning of the country; priority is given to the mining sector.
- Over-dependency of smallholders to rainfed farming
- Lack of access to financial sources for smallholder agricultural development
- Inadequate extension and regulatory services of the government

Recently, due to an increase in the contribution of agriculture sector to GDP up to 25 percent, the Government of Zambia has paid more attention to the agricultural sector.

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[4] The interest charge may also reflect the type of collateral put up by the farmer (if any), and social capital associated with the outgrower group that affects the operator's confidence in the farmers using the credit.

[5] In practice, the interest rate paid by the farmer is likely to be charged by lowering the farm-gate price paid to the farmers. The application of the risk transfer to the farmer is discussed below.

Undoubtedly, more productivity in this sector can contribute more to the economy of Zambia. Outgrower schemes are considered as potential tools for this purpose. Hence, the government has started to allocate more resources for schemes in order to achieve sustainable economic growth and to reduce incidence of poverty in smallholder farmer areas.

The weather conditions in Zambia are such that they enable the country to produce paprika under both rainfed and irrigation farming conditions, but the expected yields are very different. Therefore, in designing an outgrower scheme for paprika, a critical issue is the relative amounts of rainfed cultivation and irrigation that should be included in the scheme. Rainfed cultivation is characterized by much lower yield together with a much greater risk due to uncertainty of the rains, and these factors greatly reduces its potential use as an instrument for poverty reduction. According to Langmead (2005), small-scale paprika farms in Zambia have different yield classes. As the yield classes rise, farmers increasingly use inputs, managed more efficiently, and ultimately there are those that use irrigation. It is likely that irrigation will be a key mitigation factor to manage the risk of yield variability as well as a major determinant of the average yield.

3.2 The Smallholder farmers

The cash inflows of the smallholder farmers are the farm-gate sales of the paprika crop to the operator that occur at the end of each cultivation cycle. The outflows of this group of farmers are the capital costs associated with investment in irrigation equipment and market support infrastructure, such as depot and storage facilities. Other outflows are the cost of agricultural inputs such as fertilizer, packaging materials, payments for consumption of electricity, crop management activities, irrigation equipment and maintenance costs. The farmers also incur expenses for land preparation.

A key non-cash aspect of the smallholder farmers' costs, and an important determinant of the incentive for the farmer to cultivate the crop, is opportunity cost, in terms of land and time spent growing cash crops instead of staple food crop, expressed as net value of maize food crop that would be grown, in the absence of a cash crop such as paprika. Without the proposed scheme, the majority of the farmers in Zambia would plant maize for their own consumption using the traditional means on rainfed land, the so-called "low-input, low-output" cultivation method such as the Chitemene system[6].

3.3 The Outgrower Scheme

In order to support such arrangements, the government of Zambia and the multilateral financial institutions have agreed in principle to provide financial assistance. In order to find out whether the scheme is able to use these funds efficiently, we estimate the cash flows from the perspective of the entire outgrower scheme arrangement by incorporating the financing provided by multilateral donors and the host government. All the investments, production, processing and transportation costs of the smallholder farmers and the operator are deducted from the value of sales. From the outgrower scheme perspective, all intermediate sales of paprika and transactions between farmers and the operator are viewed as transfers and are not included.

[6] In 2004, it was guaranteed this activity would bring farmers a net income of about US$ 100 per hectare a year (African Development Bank, 2004). This is equivalent to the amount of money that the farmers would pay for the maize crop out of their earnings from the cash crop such as paprika.

In the estimation of the cash flows, the inflation rates in Zambia and abroad and the changes in exchange rates have been consistently taken into account, assuming that purchasing power parity provides a benchmark for the market exchange rate over the long term[7]. The cash flow projections are expressed in units of domestic currency. The investment and operating costs have been classified as either tradable or non-tradable. The latter includes such items as local labor costs, construction services and domestic transport. Tradable items are expressed in dollars and then converted into local currency values (Zambian kwacha, ZMK[8]) at the projected market exchange rate for each period. Projections over time are made first in nominal then real values, using the appropriate price indices.

3.4 Project Coverage

The current global demand for paprika is about one million tons per annum. Major global producers include California, Eastern Europe, New Mexico, Northern and Southern Africa and Spain. Although the nutritional value of paprika is limited, there is a strong worldwide demand for its oil and powder, especially to be used as colorants for processed meats and other applications. While the international prices tend to vary from region to region and depend on the type of paprika harvested, the CIF price of paprika in London is expected to be, on the average, 4,500 US$/ton in 2012 prices. Based on information obtained from the operators and smallholders in Zambia and through market analysis, there is a potential export market for paprika.

[7] We do not assume that purchasing power parity will hold for any given period. However, over a period of 25 years it has been shown that the cumulative changes in the market exchange rates for 85 countries are very close to the cumulative changes in the ratio of the price index of the domestic currency country to the price index of the foreign exchange country for this same set of countries (Gray and Irwin 2003).

[8] The Zambian International currency code was ZMK by the time of writing the paper. This has been changed to ZMW through the rebasing of the kwacha by dropping the three zeros (Bank of Zambia 2012). This paper uses the non-rebased version of the currency and will use ZMK instead of ZMW.

A critical project design issue is the relative amounts of rainfed cultivation and irrigation that should be included in the project. More to the point, this analysis must address the question if any rainfed cultivation should be attempted. Its much lower yield, combined with a much greater risk due to uncertainty of the rains, greatly reduces its potential use as an instrument for poverty reduction.

Paprika rainfed cultivation requires a long growing season of 8-9 months, and is hand-harvested. The crop is not resistant to the common viral, bacterial, and fungal diseases. Quality standards sought from the crop include high dry weight yield per unit area and high colour value per unit of dry product.

Under irrigation, the annual yield rate according to agronomical analysis is 2.5 tonnes per hectare, while under rainfed farming it is only 0.9 tonne per hectare. The annual yield rate for rainfed is lower because there is only one crop as compared to two crops if irrigated. In addition, the yield for rainfed crop will be reduced if there is insufficient rainfall. On the average, each smallholder farmer will own and cultivate one hectare of land. The project as it is currently designed included 1,500 hectares of rainfed cultivation and 1,000 hectares of irrigation production. Based on the current capacity, industry plans and the prevailing production pattern, the areas designated for the paprika cultivation are presented in Table 1 for the period of 2013-22.

3.5 Project Costs

One of the factors that has hampered smallholder farmers' productivity and resulted in meagre and unsustainable income is the lack of infrastructure such as roads, irrigation equipment and storage as well as processing facilitates. To enable the smallholder farmers to produce high quality paprika to meet export standards, investment must be made in infrastructure including irrigation and processing facilities.

Table 1: Targeted Area (Hectares)

Year	Rainfed		Irrigated	
	Incremental	Cumulative	Incremental	Cumulative
2013	150	150	100	100
2014	400	600	200	300
2015	700	1,300	250	550
2016	150	1,400	250	800
2017	100	1,500	200	1,000
2018-2022	0	1,500	0	1,000

Source: "Smallholder Agriculture Production and Marketing Support Project: Preparation Report," Food and Agriculture Organisation of the United Nations FAO/ADB Cooperative Programme, Report No: 04/019 ADB-ZAM 31 May 2004.

3.5.1 Irrigation Development

Although Zambia is endowed with good rainfall patterns, changes in weather have been disastrous both for the farmers as well as for the economy. To have a sustainable paprika operation, an investment in irrigation is necessary. Major investment costs arise from the development of a new irrigation infrastructure as well as rehabilitating and servicing the existing facilities. The investment will start in 2013 and last until 2017 based on the project coverage area presented in Table 1. Once the initial investment is undertaken, it is expected that the project will start to operate in 2013 and expand to 2,500 hectares (1,500 Rainfed, 1000 Irrigated) from 2018 to 2022.

The costs of irrigation development depend on the type of technology employed. New facilities can be of three types of irrigation systems: drip, sprinkler and a dragline irrigation mechanism. Rehabilitation of the existing irrigation infrastructure involves the provision of new field equipment, and servicing of the pumps and motors. The scope of irrigation development and the targeted coverage area by type of technology are shown in Table 2.

Table 2: Irrigation Cost by Type and Targeted Area of Irrigation, 2012 prices

	Unit Cost (US$/ha)	Irrigated Area (hectares)*				
Technology		**2013**	**2014**	**2015**	**2016**	**2017**
New Irrigation						
Drip	1,772	16	32	40	40	32
Sprinkler	2,549	56	112	140	140	112
Dragline	1,809	8	16	20	20	16
Rehabilitation and Expansion						
Drip	1,103	4	8	10	10	8
Sprinkler	1,816	14	28	35	35	28
Dragline	1,809	2	4	5	5	4
Total Area		100	200	250	250	200

Source: "Smallholder Agriculture Production and Marketing Support Project: Preparation Report," Food and Agriculture Organisation of the United Nations FAO/ADB Cooperative Programme, Report No: 04/019 ADB-ZAM 31 May, 2004.
*The irrigation costs are based on the area covered by irrigation. These areas correspond to the irrigated cultivation shown in Table 1. If the total amount of irrigated area is changed, the required areas for irrigation will be adjusted accordingly.

The irrigation facilities demand additional electricity supply. However, not all areas designated for irrigation would require a new electricity supply as some of the farmers already have access to electricity. In fact, only 9.5 hectares each for sprinkler and drip type of irrigation will need new electricity installations in 2013. The unit cost of new electricity installations is 5,810 US$/ha and 3,335 US$/ha in 2012 prices for sprinkler and drip irrigation, respectively.

3.5.2 Depot Construction

Under the outgrower arrangement, farm produce must be transported from the farmers to the operator. To facilitate that, depots, storage and processing facilities are being built. The crop is stored in these storages as it awaits shipment to the operator plant for further processing. The construction cost per hectare is ZmK 1,884,000 in 2012 prices, irrespective of the cultivation method used.

3.5.3 Capacity Building and Training Costs

Smallholder farmers typically lack the farming and entrepreneurial skills necessary to produce and market the crops commercially. Capacity building and training becomes necessary to enable them to produce high quality crops that meet international standards. Furthermore, farmers need to understand the institutional framework under which these schemes operate and the price determination mechanism that governs what price they receive.

The capacity building and training will be conducted for the farmers as well as for the extension personnel who will be directly involved in overseeing the production of paprika. The training will focus on quality enhancement as well as the sustainability of production. There will also be training of the trainers and provision of transportation equipment such as motorbikes and bicycles for trainers. Capacity building will also be extended to the Project Management Unit (PMU) required for the coordination of the project and infrastructure installation. The annual costs of capacity building and training activities are estimated from the parameters presented in Table 3. It should be noted that the unit costs of activities are quoted separately by either in local or in US currency. Furthermore, the costs of the different items will vary over the life of the project according to the respective currency

Table 3: Capacity Building and Training Costs, 2012 prices

Activity	Unit	Unit Cost	Required Units				
			2013	2014	2015	2016	2017
Rainfed							
Quality Enhancement and Control							
Extension*	Ha	136,590 ZmK	200	400	700	100	100
Training of Farmers	Lump sum	48,442 US$	1	1	1	1	1
Training of Farmers	Lump sum	57,039,984 ZmK	1	1	1	1	1
Sustainable Production Investments							
IPM Measures**	ha	235,500 ZmK	200	400	700	100	100
Irrigated							
Quality Enhancement and Control							
Extension	Ha	136,590 ZmK	100	200	250	250	200
Training of Farmers	Lump sum	72,662 US$	1	1	1	1	1
Training of Farmers	Lump sum	85,559,976 ZmK	1	1	1	1	1
Sustainable Production Investments							
IPM Measures	ha	353,250 ZmK	100	200	250	250	200
Support to Extension Workers							
Motorbikes	Number	3,000 US$	6	0	0	0	0
Bicycles	Number	200 US$	12	0	0	0	0
Training of Trainers Workshop	Lump sum	3,659,670 ZmK	18	18	18	18	18
Electricity Supply Installations							
Capacity Building & Training							
Farmer Training	Days	942,000 ZmK	19	0	19	0	0
Extension Staff Training	Days	942,000 ZmK	2	2	2	2	2
PMU and Technical Assistance							
Two Part-Time Technical Assist.	month	14,130,000 ZmK	1	1	1	1	1

Source: "Smallholder Agriculture Production and Marketing Support Project: Preparation Report," Food and Agriculture Organisation of the United Nations FAO/ADB Cooperative Programme, Report No: 04/019 ADB-ZAM 31 May, 2004.

*These costs are budgeted based on the targeted hectares presented in Table 1.

**These costs are budgeted based on the targeted hectares presented in Table 1.

3.5.4 Total Investment Costs

The total investment costs over the period 2013-2017 amount to approximately US$ 4.7 million in 2012 prices. Details are presented in Table 4.

Table 4: Project Investment Costs by Category, 2012 Prices (million ZmK)

	2013	2014	2015	2016	2017	
INFRASTRUCTURE DEVELOPMENT						**Total**
New irrigation development	1,044	2,257	3,052	3,301	2,856	12,510
Rehabilitation/expand irrigation development	188	407	550	595	515	2,255
Electricity supply installations	489	0	0	0	0	489
Support to farm infrastructure-depot	509	1,322	2,265	1,031	837	5,964
Total	**2,230**	**3,987**	**5,867**	**4,927**	**4,208**	**21,218**
CAPACITY BUILDING AND TRAINING COSTS						
Quality enhancement and control	120	301	493	276	228	1,418
Sustainable production investments	76	193	320	169	139	898
Technical assistance	37	193	43	22	24	144
Support to extension workers	189	77	83	90	98	537
Total	**423**	**589**	**940**	**557**	**489**	**2,998**
Grand total investment costs (million ZmK)	2,652	4,576	6,806	5,484	4,697	24,216
Grand total investment costs (US$ equivalent)	510,066	879,992	1,308,941	1,054,653	903,215	**4,656,866**

Source: This table is built from the discussion in sections 3 and 4. The exchange rate used is 5200 ZmK/US$.

3.6 Operating Costs

The operator collects paprika from the smallholders and then processes and packages it. The crop is then transported by air to the European market.

3.6.1 Operating Costs for the Operator

Cost of Unprocessed Paprika: The operator pays for unprocessed paprika at the farm gate price, equivalent to 17 percent of the processed paprika price on the London market under the base case estimates of the costs of processing and transportation. This is also equal to the current farm gate price of paprika. The current world price is approximately US$ 4,500 per tonne in 2012.[9]

[9] The farm gate price factor was estimated based on the current practice prevailing in outgrower schemes in Zambia.

Domestic Transportation Costs: These costs cover the collection of paprika from the farmers, and are estimated to be 30,000 ZmK/ton per km. It is known that most of the smallholder farmers are located about 30 km from the operator.

Processing Costs: These costs include expenses incurred for electricity, hexane, mineral oil, water, wages, etc. Factory labour cost is estimated to be ZmK 1,600,000 per ton, while the cost of raw materials is estimated to be US$ 1,500 per ton in 2012 prices.[10]

International Transportation Costs: Although the domestic transportation costs are quoted in kwacha, international transportation costs are paid in US dollars. This cost, which is airfreight, is estimated to be US$ 500 per ton in 2012 prices.[11]

3.6.2 Operating Costs for Smallholder Farmers

Farmers are expected to remain in the scheme for at least 10 years, from 2013. The operating costs include land preparation, agriculture inputs, crop management activities, and the maintenance of the irrigation facilities.[12] It should be noted that the rainfed system would yield only one harvest a year, while the irrigated system will have two cultivation cycles.

Production Inputs

The agriculture inputs consist of seeds, planting materials, fertilisers, fumigations, packaging materials, and electricity (for irrigated areas). Some of the input requirements vary according to method of irrigation and number of cultivations

[10] Source: Agriculture Consultative Forum Lusaka, Zambia.

[11] Sources: Agriculture Consultative Forum, Lusaka, Zambia; Cheetah Zambia Ltd; Zambia Export Growers Association.

[12] "Smallholder Agriculture Production and Marketing Support Project: Preparation Report," Food and Agriculture Organisation of the United Nations FAO/ADB Cooperative Programme, Report No: 04/019 ADB-ZAM 31 May, 2004.

cycles per year. The following data, expressed in 2012 prices, are based on one cultivation cycle.

- Seeds: Each hectare will require 1.0 ton of seed. The price of seed is US$ 0.08 per kg.
- Compound B: During the planting of the crop, 8 bags of compound B fertilizer will be required per hectare under irrigation and 4 bags per hectare under rainfed conditions. A bag of compound B fertiliser costs US$ 20.00.
- CAN/LAN: This is another fertiliser required, 1 bag of CAN/LAN for rainfed and 3 bags for the irrigated crop. The cost of this fertiliser is US$ 19.11 per bag.
- Urea: with the irrigation, 4 bags of 50 kg per bag of urea will be required while 2 bags per hectare will be required under rainfed conditions. The price of urea is US$ 18.00 per bag.
- Pest Management: Pest management is estimated to cost US$ 45.32 per hectare under either irrigation or rainfed system.
- Packaging and Transportation: Based on a per hectare basis, 200 bags will be required to carry the crop if irrigation is used and 90 bags under the rainfed conditions. Each bag costs ZmK 470.
- Electricity: Irrigation requires electricity. For each hectare, the cost of electricity is estimated at ZmK 141,000 per year.

Land Preparation

Land preparation is conducted with a tractor or oxen, or both.

- Ploughing/Harrowing: Ploughing of land is necessary under the irrigation scheme once a season. A tractor will be hired and each will cost ZmK 90,000 per hectare.

Note that irrigation systems have two cultivation cycles a year and tractor services will be also needed twice.

- Oxen Operation: Oxen will be hired for land preparation. It is estimated that oxen will be used once a year under the rainfed condition, while for the irrigation areas, oxen will be needed twice a year. Hiring oxen costs ZmK 94,000 per hectare.

Crop Management

Crop management involves planting, fertiliser application, pest preparation, weeding, watering as well as harvesting and other crop-specific activities. These activities are labour-intensive; they mainly represent smallholder farmers themselves. It can also be undertaken by hired casual labour. The wage rate in rural areas is taken at ZmK 4,000 in 2012 prices per working day. The annual labour requirements for each activity are described below.[13]

- Nursery/Transplanting/Planting: Nursery preparation takes about 35 working days per hectare for rainfed farming. In the case of irrigation, it is 70 working days.
- Fertilizer Application (oxen use for basal application): Under irrigation farming, 10 working days will be required per hectare while 7 days will be required under rainfed condition.
- Pest Preparation: Irrigation will require 30 days while rainfed-farming will require 15 days.
- Weeding: Under irrigation, 15 working days are required per hectare and 10 days per hectare under rainfed scheme are required.

[13] All figures presented in this section have reference to two cultivation cycles under the irrigation scheme and one cultivation cycle under the rainfed system.

- Watering: 15 working days per hectare will be required under irrigation scheme. This will not be necessary under the rainfed scheme.
- Harvesting: To harvest the crop, 20 working days per hectare will be required under the irrigation farming, while 10 working days will be required under the rainfed system.
- Curing: The crop must be supplied as dry matter and this will necessitate curing. It will require 15 days to cure 1 hectare's harvest under irrigation scheme and 8 days for the rainfed farming.

Irrigation Maintenance Costs

Apart from the crop operating costs, additional maintenance costs in terms of the replacement of irrigation equipment will be incurred by farmers in irrigated areas. They are 15 percent of the asset value for the drip irrigation system, 12 percent for the sprinkler and dragline systems. In the case of facilities undergoing rehabilitation, the corresponding figures are 15.0 percent, 12.0 percent and 20.0 percent per annum, respectively.

3.7 Project Financing

3.7.1 Capacity Building and Training

As mentioned earlier, the overall smallholder development scheme is to be financed by several donors. The AfDB is considering providing the funding for the capacity building and training component of the project, while the World Bank has expressed a willingness to implement the irrigation and infrastructure component of the project in the same location as the activities financed through the AfDB. At the same time, the IFAD will implement a rural finance programme.

The capacity building and training component will be financed by a grant from the AfDB as well as contributions from the GRZ and smallholder farmers participating in the scheme. The AfDB will provide US$ 747,289, which constitutes 90.0 percent of the total investment costs, directly to the Project Management Unit established in Lusaka and bestowed with the task of overseeing the implementation of the whole programme. The Government's contribution of US$ 83,032 that constitutes 10.0 percent of total costs will come in the form of the provision of extension services on the ground. The World Bank is expected to provide a loan of US$ 3,541,241 that will be set up as a revolving fund to be used for infrastructure development and irrigation development. In addition, the participating smallholder farmers will contribute their own labour for the crop management activities.[14]

3.7.2 Smallholder Credit Scheme

The initial grant provided by the AfDB does not cover the financing of the input credit component for the smallholder farmers. This task is being undertaken by the IFAD through a separate project dealing with the development of rural finance in Zambia. Hence, the AfDB initiative requires the rural financing component to be functional by the time the project is operational in 2006. The credit scheme for outgrower arrangements is based on an initial IFAD grant, made available to a domestic commercial banks through the Bank of Zambia (BOZ).

A trusted financial institution will administer the grant as a revolving fund, which will be accessible to the agriculture operators who willing to engage/expand the outgrower scheme(s). The selected bank will do a credit risk assessment and due diligence checks on a borrowing operator, who will be responsible for the repayment of the loan. The operators will then lend to smallholder farmers for working capital

[14] These values are given in 2012 prices.

with an interest charge that reflects their costs of borrowing plus their costs of administering the loans to the farmers, and the default risk they bear that is associated with the farmers' borrowing. The funds are classified as short-term and medium-term loans.

Short-term Loan: The operator will provide short-term loans in the form of an input credit to smallholders to purchase seeds, fertilizers, pest management materials and to finance working capital for land preparation. The operator will borrow from the bank a US-dollar denominated loan at an annual rate of 8 percent nominal or 5.37 percent real, with an inflation rate of 2.5 percent, lending on to farmers with a margin of 5.85 real. A total of 3 percent of debt outstanding is written off each year.[15] The short-term loan is advanced at the beginning of every cultivation cycle. In irrigated areas, which have two cultivation cycles a year, the loan is advanced twice. It is disbursed once in the rainfed areas of farming. Because the loan repayment occurs at the delivery of the crop, the interest charges are calculated on the semi-annual basis in both irrigated and rainfed areas.

Medium-term Loan: The financial institutions will also make available medium-term loans, mostly drawn from the revolving fund to operators who in turn pass the proceeds to smallholder farmers for financing the irrigation and supporting infrastructure such as depots. The commercial bank assumes the risk of lending to operators, while operators assume the risks of lending to smallholder farmers. The financing terms are similar to the short-term loan. Operators obtain the loan from

[15] In other words, the lending rate to farmers would be 14 percent nominal which is equivalent to 11.22 percent real with the inflation rate of 2.5 percent. The 5.85 percent is obtained by subtracting 5.37 percent real from 11.22 percent real. The 8 percent interest rate as well as the loan terms was obtained from the Zambia Smallholder Preparation Report (2004), and the 5.85 percent margin was estimated using the information obtained from banks during the appraisal mission of this project to Zambia.

bank at a rate of 8 percent nominal and re-lend it to farmers at 14 percent nominal. The medium-term loan is however disbursed whenever an investment is required, and in each instance, the loan is assumed to be repaid in 5 years. Operators cover principal and interest due, irrespective of farmer defaults.

Chapter 4

METHODOLOGY

4.1 Integrated Project Appraisal

The central tool of the analysis is the pro-forma cash flow and net economic benefit statements. There are several components of the integrated appraisal approach.

First, the appraisal seeks to determine if the project will be financially sustainable. The focus of the financial module of the Smallholder Agriculture Production and Marketing Support project is to assess the financial sustainability of the proposed agriculture development mechanism in rural areas of Zambia. The scope of analysis includes the following components necessary for establishment of a continuous agriculture activity: irrigation development, capacity building and training, and rural finance credit. The main objective is to measure project impact on farmer incomes. The second important goal is to identify the critical factors that affect the sustainability of the marketing chain that smallholders are involved in, and to assess the threshold value of the project parameters that affect the financial sustainability of the scheme. An important indicator is debt service coverage ratios.

The economic feasibility of the project is determined from the pro-forma resource-flow statement, established during the financial appraisal. The integrated appraisal framework involves building the economic analysis onto project financial cash flows. On the benefit side, the sales of paprika on the international market are counted inclusive of the foreign exchange premium generated for the economy. Changes in residual values and accounts receivable are also incorporated. The economic costs comprise the initial investment costs by farmer, operator and government, plus the operating costs and changes in the accounts payable for both the farmer and operator. The resulting economic resource flow estimates the amount of the net benefits accruing to the economy of Zambia.

The stakeholder module of the integrated appraisal aims to identify project stakeholders, providing decision-makers with an assessment of economic externalities created by the project and of resulting stakeholder gain/loss.

The objective of the sensitivity and risk analysis is to identify the risks the project faces. Some risk variables can be controlled by project managers to a certain extent. Other risk variables are totally exogenous forces that are out of control by project managers. This analysis takes into account uncertainty of these key variables.

4.2 Financial Analysis

The first step in integrated investment appraisal is financial analysis, conducted under "with-project" and "without-project" scenarios. The "without" scenario refers to when farmers do not participate in the outgrower scheme but engage in traditional maize growing that would generate an annual net income of US$ 144 per hectare in 2012 prices. In the "with project" scenario, the smallholder farmer transfers all his assets to the project and engages in the cultivation of paprika. Given that all the assets could have been used in the production of maize, only those new assets and new activities are considered incremental investment in the evaluation of the project.

The yield rates used in the "with the project" scenario have been set at a level that implies that smallholder farmers have acquired necessary farming skills to engage in this activity. Therefore, the capacity building and training of both smallholder farmers as well as extension officers are indispensable part of the outgrower scheme.

The main objective of the financial module of the Smallholder Agriculture Production and Marketing Support project is to assess the financial sustainability of the proposed agriculture development mechanism in rural areas of Zambia. The project includes the following components necessary for the establishment of a continuous agriculture activity: irrigation development, capacity building and training, and agriculture credit. The analysis will focus on the incremental impact of the project on the incomes of farmers involved in the scheme. It will also identify the critical factors that affect the sustainability of the marketing chain that smallholders are involved in, and estimate the threshold value of the project parameters that influence the financial sustainability of the scheme.

4.3 Economic Analysis of Outgrower Scheme

The economic appraisal of a project determines its net benefits to society. The task is to quantify this impact and evaluate the economic viability of the proposed project. It is an assessment of whether the resources employed in this project are used efficiently. The economic appraisal converts financial transactions (i.e., project receipts and expenditures) into benefits and costs, to produce an economic resource statement reflecting the project's social value. An important feature of the economic analysis is its link to the project cashflow statement, maintaining a consistency with the financial analysis that allows the analyst to undertake sophisticated inquiries into the project's financial and economic performance at the same time.

The model is based on the financial values of project parameters converted into corresponding economic values, in line with the underlying principles of applied welfare economics. The economic price of a tradable good is established by multiplying the financial price of the good by its Commodity Specific Conversion Factor (CSCF). The economic price of goods is usually estimated net of taxes and subsidies but includes a foreign exchange premium due to distortions associated with the markets for tradable goods. They replace the receipts or expenditures in the financial cashflow statement.

4.4 Stakeholder Impact Assessment

The stakeholder analysis of the smallholder outgrower scheme project identifies the gains/losses of the scheme's implementation for each segment of society. The stakeholder analysis of any project builds on the following relationship:

$$P_e = P_f + \sum_{i=1} Ext_i$$

Where: P_e is the economic value of an input or output;

P_f is the financial value of the same variable; and

ΣExt_i is the sum of all the externalities that make the economic value different from the financial value of the item.

That is, the economic value of an item is the sum of its financial price plus the value of externalities (e.g. taxes, tariffs, subsidies and consumer/producer surplus). Applying a common discount rate to the calculation of impacts over the life of the project, reveals the following NPV:[16]

$$NPV_e^{EOCK} = NPV_f^{EOCK} + PV^{EOCK}\left(\sum Ext_i\right)$$

Where: NPV_e^{EOCK} is the net present value of the net economic benefits;

[16] In this case, the economic opportunity cost of capital.

NPV_f^{EOCK} is the net present value of the net financial cashflow; and

$PV^{EOCK}\left(\sum Ext_i\right)$ is the sum of the present value of all the externalities generated by the project.

The project generates two types of net benefits: financial, for those with an interest in it; and externalities, which accrue to other stakeholders including governments. Thus, the sum of the financial streams accruing to farmers and operator represents the financial NPV of the project. The externalities in this particular case are generated by the government of Zambia.

Stakeholder analysis entails the following steps:

- Identify project stakeholder impacts one by one (economic statement of benefits and costs minus financial cash-flow statement)
- Calculate PV for flow of externalities by line item (discount rate equals economic cost of capital)
- Allocate externalities' PV to economic group(s).

4.5 Risk Analysis

The main objective of risk analysis is two-fold: to understand sources of variable risk likely to affect project financial and economic outcomes, and to help identify appropriate means of mitigating those risks.

Risk is also an important tool in project selection, helping to reduce the likelihood of accepting a "bad" or rejecting a "good" project. Collecting and assessing data on key project variables to determine their probability distribution reduces uncertainty in decision-making.

Risk analysis establishes variability in project financial and economic returns. In the analysis, the uncertainty associated with the critical variables of a project is expressed in terms of probability distributions. One of the most effective means of replicating real-world dynamics is a form of risk analysis known as Monte Carlo simulations. This allows collecting and analyzing statistically the results of the simulations to arrive at a distribution of the possible outcomes of the project and the probabilities of their occurrence.

Step one is to identify key risk variables using sensitivity analysis. The sensitivity analysis carried out as a part of financial and economic assessment has already helped to find the critical parameters affecting the performance of the proposed project.

Step two is to specify probability distribution and likely value range for key risk variables, based on historical observations. Regression analysis is often used to process the statistical data on the past movement of selected risk variables.

Step three entails a Monte-Carlo risk simulation with Crystal Ball™ software, carried out over 10,000 trials using the probability distributions assigned to key risk variables.

4.6 Conclusion

This project, which aimed to increase the incomes of smallholder farmers through paprika-export outgrower schemes, was evaluated using integrated investment appraisal methodology. The outgrower scheme is based on a contractual arrangement between the operator and smallholder farmers, with the expectation of mutual benefits for both parties. The purpose of the investment appraisal is to ensure that funds are indeed directed to an activity that improves the well-being of participants, and the integrated framework is an invaluable tool for carrying out a basic financial, economic, stakeholder and risk analysis.

Chapter 5

FINANCIAL ANALYSIS

5.1 Parameters and Assumptions

The base case financial model of the project for outgrower smallholder farmers and operators assumes:

Price of Paprika

- The world price of processed paprika at London market is US$ 4,500 per tonne in 2012 prices. This price is assumed to rise at the rate of inflation of the US of 2.5 percent, which is used in this analysis.
- For the base case analysis, the farm gate price of unprocessed paprika is set at 17 percent of the London market price for processed product. However, the farmer's share of world price is expected to change with the changes in the international price. The 17 percent share of the world price paid at farm gate for paprika was set to reflect the current situation and also to reflect the value of costs that have to be absorbed by the world price when processing, transportation and selling the finished product in Europe.

Production of Paprika

- The annual yield rates are 2,500 kg per hectare for irrigated and 900 kg per hectare for rainfed land.
- Each individual smallholder farmer, on average, owns 1 hectare of land.
- No soil deterioration occurs to bring down the yield rates during the life of the project.

- Crop is sold by farmers to the operators for export; no output is kept for either home consumption or side selling.

Investment Costs and Financing

- The total investment cost of the project is US$ 4.7 million intended for cultivation of paprika on 1,500 hectares of rainfed land and 1,000 hectares of irrigated land. Details can be found in Table 4.
- The irrigation component constitutes 73 percent of the total investment costs over the period of 2013-17, while the capacity building and training will take the remaining 23 percent.
- The financing of investment in capacity building and training is secured through an AfDB grant of US$ 747,289 and GRZ contribution of US$ 83,082. The remainder of the investment costs are paid by the WB and the IFAD.
- The grant from AfDB is given to GRZ as a development loan. This special grant has to be repaid in 40 years' time with a grace period of 10 years. GRZ will be required to pay a commitment charge of 0.50 percent, nominal of the outstanding balance during the grace period. Interest charges on the loan are 1.0 percent nominal during the first 20 years of repayment and 3.0 percent, nominal during the last 20 years. In addition, the grant is disbursed on condition that GRZ meets the 10 percent obligation towards the total investment costs.

Operating Costs

- Input requirements for farming paprika are presented in Section 2.4.2.

- Costs for non-tradable inputs change with the domestic inflation rate, while costs for tradable inputs move with the US inflation rate as well as the market exchange rate.[17]

Smallholder Farmers Credit

- It is assumed that a functioning credit system will allow operators to borrow and on-lend to smallholder farmers.
- The loans are disbursed in US dollars from both the bank to the operator at the beginning of the growing season, and repaid when the crop is delivered to the operators. In rainfed areas, there is a single loan a year, while in irrigated areas there are two loans per year.
- The operator does not make any gain from the financial intermediation. This is based on the hypothesis that the operator incurs costs for processing and collecting of the loan and assuming the risk of default by farmers that are just sufficient to cover its financial margins that are estimated to be 5.85 percent real. This assumption applies to the short-term and medium-term loans. The charge on the financial margin is assumed to be passed on to the smallholder farmer.
- The medium-term loan financing available for smallholders through an operator is taken as a 5-year disbursement period, after which the accumulated principal amount is repaid in 4 equal annual principal repayments. The interest on loan is paid annually. In the case of the short-term loan, it is paid every six months.

Working Capital

- Farmers' Accounts Receivable: one week to settle accounts with operator. Farmers do not maintain separate cash balance or accounts payable because working capital covered by short-term credit.

[17] Tradable and non-tradable inputs are distinguished in section 2.4.2 with their unit costs expressed in the respective US or local currency.

- Operator's Accounts Receivable: approximately 4.5 weeks after operator's export sales of paprika.
- Operator's Accounts Payable: one week
- Operator's Cash Balance: operator to maintain balance equivalent to two weeks' of cash, based on total operating costs.

Life of Assets and Residual Values

- All moveable equipment such as vehicles, tractors, laboratory equipment and tools, and irrigation facilities are expected to serve 10 years.
- Buildings such as depots, storage facilities and related infrastructure are also expected to last 10 years. Electricity supply installations tend to have a longer economic life than other assets; they are assumed to be 20 years.

Taxation

- Income Taxes: No personal income taxes are imposed on income of smallholder farmers. However, operators, as an export of non-traditional product, are subject to 15 percent corporate income tax.
- Import Duty and Indirect Taxes: No import duty or VAT on project agricultural inputs or capital assets.[18]
- Raw materials used in this project are subject to an import duty rate of 0.5 percent; intermediate and semi-processed goods have a rate of 15.0 percent; and finished goods, fuel and lubricants are subject to 25 percent rate.[19]
- As an exporter of non-traditional product, paprika, the operator is subject to a zero rate of VAT on its export sales of paprika. Hence, the operator gets a refund

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18 In general, a value added tax of 17.5% is imposed on most of imported and domestically supplied goods and services in Zambia.

19 Source: Zambia Revenue Authority.

of all the VAT it pays on its purchases of fuel and domestic transportation charges used in the processing of paprika.

Inflation and Exchange Rates

- The domestic inflation rate is assumed to remain constant at 8 percent per year, and the rate of US inflation is expected to be 2.5 percent per year.
- The exchange rate is ZmK 5,200 per US dollar in year 2012.

Required Rate of Return

- The target rate of return on equity for the farmer is 10 percent real. This discount rate is chosen to represent the farmer's opportunity cost under these circumstances.
- The minimum rate of return on equity for operator is 15 percent real. This rate is standard rate on commercial activities.

5.2 Operator's Perspective

The proposed up-scaling of outgrower schemes have several indispensable components that are vital for the programme to work. The essential players include farmers, operator, and financial institution financing the operator. As mentioned earlier, the establishment and management of the financing fund are undertaken by the IFAD, and then a financial institution is selected to provide funds to operators for their credit financing of small farmers. The operator, on the one hand, plays a role of financial intermediary and on the other hand is part of the marketing chain of paprika. Thus, the operator is indeed the nucleus of the project's operation.

As a financial intermediary, the operator borrows the necessary funds and lends them to the farmers with a margin. For all intent and purposes, the margins are assumed sufficient to recover the cost of processing the farmers' credit and the risk of default by farmers. As a result, it would not affect the financial viability of the operators. Following this logic, the financial analysis treats the operator as essential player in the processing and marketing chain of paprika. For sustainable commercial operation of the chain, the operator should recover all the costs associated with the marketing and management activities of the outgrower scheme, and earn an appropriate return on investment.

The following is an algebraic representation of the net cash flows, $NCBFin_t^o$, of each operator in each period *t*.

$NCBFin_t^o$, of the operator in each period *t* are made up of a number of variables as follows:

$$INF_t^o = Q_t^e CIF_t + \Delta AR_t^o \tag{1}$$

$$OUTF_t^o = Inv_t^o + Q_t^{fg} P_t + Proc_t + DT_t + InT_t + \Delta AP_t^o + \Delta AR_t^f + \Delta CB_t + VATR_t + Inc_t^o \tag{2}$$

$$NCBFin_t^o = INF_t^o - OUTF_t^o \tag{3}$$

where INF_t^o = inflows of operator from export sales; Q_t^e = quantity of processed paprika exported; CIF_t = CIF landed price of paprika; ΔAR_t = change in accounts receivable of export sales ($AR_{t-1} - AR_t$); $OUTF_t^o$ = outflows of operator; Q_t^{fg} = quantity of unprocessed paprika bought at the farm gate; P_t = farm-gate price of paprika; Inv_t^o = capital cost[20]; $Proc_t$ = paprika processing costs (labour + fuel + materials input costs); DT_t = domestic transportation; InT_t = international transportation; ΔAP_t =

[20] The capital costs of the operator for processing are expressed as an annual lease cost for buildings and equipment.

change in accounts payable of operator (excluding paprika purchases) ($AP^o_t-AP^o_{t-1}$); ΔAR^f_t = change in accounts receivables of farmers (payable of operators for paprika) ($AR^f_t-AR^f_{t-1}$); ΔCB_t = change in cash balances (CB_t-CB_{t-1}); $VATR_t$ = value added tax paid on input purchases (+) and refunded (−); Inc_t^o = corporation income tax paid by the operator; $NCBFin_t^o$ = net cash flow of operator before financing adjustment.[21]

The net flows of the operator are then adjusted for the working capital loans and credit disbursements and total repayment flows between the operator and the farmers to calculate the operator's net position:

$$FinAdj_t^o = LnBk_t - LnOp_t + Rpmt_t^f - LnA_t - Crd_t - Rpmt_t^o \tag{4}$$

$$NCFinAdj_t^o = NCBFin_t + FinAdj_t \tag{5}$$

where $FinAdj_t^o$ = financing adjustment; $LnBk_t$ = loan from the commercial bank to the operator; $LnOp_t$ = loan and credit amount provided by the operator to the farmers; $Rpmt_t^f$ = repayment (assuming full repayment) of loans and interest by smallholder farmers to the operator; LnA_t = loan arrears of farmers to operators; Crd_t = credit-processing cost; $Rpmt_t^o$ = repayment of loan to bank by operator; $NCFinAdj_t^o$ = net cash flow to the operator after the financing adjustment.

[21] This analysis assumes that any incremental investment in capital equipment for the processing of the additional paprika from this scheme will be undertaken by the operator and financed through additional equity. Such incremental capital costs are included in the processing costs of the operator (FAO 2004).

Table 5: Financial Cashflow Statement: Operator's Perspective, 2012 prices (million ZmK)

INFLOWS	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Sales	0	4,973	17,603	37,194	62,156	74,786	76,577	76,577	76,577	76,577	76,577	0
Change in A/R	0	(430)	(886)	(1,158)	(1,241)	(1,076)	(255)	(255)	(255)	(255)	(255)	4,138
Total Inflows	**0**	**4,542**	**16,717**	**36,036**	**60,915**	**73,710**	**76,322**	**76,322**	**76,322**	**76,322**	**76,322**	**4,138**
OUTFLOWS												
Additional investment	780	0	0	0	0	0	0	0	0	0	0	0
Purchases at farm gate price	0	1,076	3,808	8,046	13,446	16,178	16,565	16,565	16,565	16,565	16,565	0
Processing costs	0	0	0	0	0	0	0	0	0	0	0	0
Labour	0	406	1,451	3,094	5,220	6,345	6,561	6,627	6,693	6,760	6,828	0
Fuel	0	1,560	5,522	11,669	19,500	23,462	24,024	24,024	24,024	24,024	24,024	0
Transportation	0	0	0	0	0	0	0	0	0	0	0	0
Domestic transportation	0	225	797	1,683	2,813	3,384	3,465	3,465	3,465	3,465	3,465	0
International transportation	0	553	1,956	4,133	6,906	8,310	8,509	8,509	8,509	8,509	8,509	0
Credit processing costs	0	40	134	257	345	379	329	241	174	132	112	11
Change in working capital	0	0	0	0	0	0	0	0	0	0	0	0
Change in C/B	0	147	303	397	426	370	89	89	89	89	89	(1,427)
Change in A/P	0	53	109	143	153	133	32	32	32	32	32	(514)
Change in A/P to farmers	0	21	43	56	60	52	12	12	12	12	12	(199)
VAT input refund (exports)	0	(246)	(872)	(1,842)	(3,078)	(3,703)	(3,792)	(3,792)	(3,792)	(3,792)	(3,792)	0
Income tax, operator	0	438	1,583	3,396	5,737	6,921	7,123	7,182	7,221	7,237	7,233	0
Total Outflows	**780**	**4,272**	**14,833**	**31,031**	**51,528**	**61,831**	**62,918**	**62,955**	**62,994**	**63,035**	**63,078**	**(2,129)**
Net Cashflow	**(780)**	**270**	**1,883**	**5,005**	**9,387**	**11,879**	**13,404**	**13,367**	**13,328**	**13,287**	**13,244**	**6,266**
NET CASHFLOW BEFORE FINANCING	**(780)**	**270**	**1,883**	**5,005**	**9,387**	**11,879**	**13,404**	**13,367**	**13,328**	**13,287**	**13,244**	**6,266**
Loan from Bank	0	0	0	0	0	0	0	0	0	0	0	0
Loan proceeds (medium + short-term loan)	0	2,790	5,742	9,276	9,727	10,127	7,284	7,284	7,284	7,284	7,284	0
Lending to Farmers	0	0	0	0	0	0	0	0	0	0	0	0
Loan proceeds (medium + short-term loan)	0	(2,790)	(5,742)	(9,276)	(9,727)	(10,127)	(7,284)	(7,284)	(7,284)	(7,284)	(7,284)	0
Loan repayments by Farmers	0	0	0	0	0	0	0	0	0	0	0	0
Repayments (principal + interest)	0	799	2,882	5,990	9,499	11,494	11,593	10,645	9,579	8,633	7,961	3,154
Loan arrears by farmers	0	(40)	(134)	(257)	(345)	(379)	(329)	(241)	(174)	(132)	(112)	(11)
Total repayments	0	758	2,748	5,733	9,154	11,115	11,264	10,403	9,405	8,501	7,849	3,143
CASHFLOW FOR DEBT REPAYMENT	**(780)**	**1,029**	**4,631**	**10,738**	**18,541**	**22,994**	**24,668**	**23,770**	**22,733**	**21,787**	**21,093**	**9,409**
Repayment to Bank												
Total Repayments (principal + interest)	0	(839)	(2,848)	(5,709)	(9,004)	(10,913)	(10,945)	(10,169)	(9,236)	(8,373)	(7,741)	(3,067)
NET CASHFLOW AFTER FINANCING	**(780)**	**189**	**1,783**	**5,029**	**9,537**	**12,080**	**13,723**	**13,601**	**13,497**	**13,415**	**13,352**	**6,343**

Table 5 presents the summary results of the financial cashflow statement from the operator's perspective. The revenues of the operator are the sales of paprika on the international market. The costs are the purchases of unprocessed paprika from farmers; cleaning, milling and packaging costs and transportation expenses. Regarding its role as the financial intermediary, the operator should receive interest income from the farmers used to offset the borrowing cost plus the costs of processing farmers' credit and risk of default. In the end, if the operator makes a profit from the marketing operations, it will pay income tax as other corporations do.

Table 6: Operator's NPV and ADSCRs

NPV	**ADSCR**	**2013**	**2014**	**2015**	**2016**	**2017**	**2020**	**2021**	**2022**
ZMK 101.5 bn		1.23x	1.62x	1.88x	2.06x	2.10x	2.45x	2.59x	2.72x

The operator's financial cash-flow statement is shown in Table 5. The net present value (NPV) accruing to all the participating operators involved in the outgrower scheme is positive, at ZmK 101.5 billion—a real return on operator equity of over 15 percent and sufficient to recover all operator costs. Operator participation in the scheme is therefore sustainable, offering above the target rate of return. A set of debt service ratios is also estimated in Table 6.[22] The annual debt service coverage ratio (ADSCR) indicates the ability of the operator to meet its scheduled loan repayments to the financing institution. The minimum ADSCR is 1.23x in year 2012, and the rest are in the range of 1.50x to 3.00x with an average of 2.12x. With the exception of 2013, it would appear that the operator would have adequate cash flow to service debt. However, the operator's ability to repay the credit is directly linked to the

[22] Annual debt service coverage ratio (ADSCR) is the ratio of annual project net cash flow after disbursement to annual debt instalments (interest and principal). The disbursements in this project logically reflect funding associated with the amount of annual or semi-annual incremental investments.

farmers' ability to supply the crop as contractually agreed. If a significant number of farmers' default for any reason on the delivery of the anticipated volumes of paprika or do not make their credit repayments, the operator is also likely to have trouble in meeting its loan repayment obligations to the bank. The next step is to assess the financial impact of the proposed project on the smallholders.

5.3 Farmers' Group Perspective

The viability of the initiative is directly linked to the sustainability of commercial production of paprika. The financial model focuses on the financial viability of the farmers' engagement in the proposed project. Table 8 presents the cashflow statement from the farmers' group perspective. The financial inflows include the proceeds from selling paprika (row 2) to the operator repayments at the end of each cultivation cycle (row 26) and the residual value of the irrigation facilities installed as a part of the project (row 4). The outflows include the investment costs, costs of agriculture inputs, land preparation, crop management, maintenance of the irrigation facilities and farmers' own labour. A key element is the opportunity cost of farmer's time (row 15), evaluated here as the net value of the maize that he would be able to grow if not growing paprika. It is essential that farmers have access to agricultural inputs, on credit if needed, each season, for the commercial production of paprika. The net financial cashflow from the farmers' group point of view incorporates the medium-term loan and short-term input credits from operator and credit repayments.

Thus, we model the position of the farmers as follows:

$$INF_t^{\ f} = Q_t^{fg} p_t + \Delta AR_t^{\ f} + Rsd_t^{\ f} \qquad (6)$$

$$OUTF_t^f = Inv_t^f + LandPrep_t + CropM_t + Mnt_t + IncMz_t^f \quad (7)$$

$$NCBFin_t^f = INF_t^f - OUTF_t^f \quad (8)$$

where INF_t^o = cash receipts of the farmers; Q_t^{fg} = quantity of paprika sold through farm-gate sales (γ*area cultivated); γ = yield rate per hectare for the paprika crop; P_t = farm-gate price of paprika; ΔAR_t^f = change in accounts receivable of the farmers; Rsd_t^f = residual value of the assets of the smallholder farmer group; $OUTF_t^f$ = total outflows from investing and operating activities of the farmers, including the farmers' opportunity costs; Inv_t^f = investment cost of irrigation equipment and market support infrastructure; $LandPrep_t$ = land preparation cost (labour cost); $CropM_t$ = crop management cost (labour cost); Mnt_t = maintenance cost of irrigation equipment; $IncMz_t^f$ = income from maize forgone by farmers[23]; $NCBFin_t^f$ = net cash flow of farmers before financing adjustment.

The net position of the farmers is derived by making adjustments for the medium-term loan and short-term input credit disbursements as well as their respective total interest and principal repayments, as follows:

$$FinAdj_t = LnOp_t + LnA_t - Rmpt_t^f \quad (9)$$

$$NCFinAdj_t^f = NCBFin_t + FinAdj_t \quad (10)$$[24]

[23] The net return from growing maize includes both the opportunity cost of the farmers' labour and also their land. The farmers' land used to grow paprika should not be counted again as an additional cost.

[24] Strictly speaking, the cash flow after financing adjustment represents the actual cash of the farmers. This is because the farmers do not receive the actual cash as represented by the sales at the farm-gate price, but rather an amount that is adjusted for the total credit expended on all farm inputs.

where $LnOp_t$ = loan inflows from operator; $Rpmt_t^f$ = repayment of loans and interest to operator if no arrears; LnA_t = loan arrears on repayments to the operator; $NCFinAdj_t^f$ = net benefit flow of farmers after financing adjustment.

At a real discount rate of 10 percent, the NPV amounts to ZmK 104 billion over and above what the farmers could earn by growing maize. This result suggests that the participating smallholder farmers will be able to recover all their investment, operating and credit costs as well as earn a return on equity of more than 10 percent in real terms. This result is quite plausible by regional standards as the paprika project links the rural communities to the modern market economy. The ADSCRs are an indication of the ability of smallholder farmers to generate sufficient net cash to cover the opportunity cost of growing a cash crop rather than subsistence maize cultivation and to cover the input credit repayments to the operator. As seen in Table 7 the resulting ratios are greater than 1.0x. This means that on average the farmers are expected to be able to cover their opportunity and input costs, and in addition, to service their credit repayments. The minimum value of the annual available net cash flows occurs in 2014. In that year, the ADSCR is 1.08x times the credit repayment to the operator and the highest is 1.88x in 2022.

Table 7: Farmers' Group NPV and ADSCRs

NPV	**ADSCR**	**2013**	**2014**	**2015**	**2016**	**2017**	**2020**	**2021**	**2022**
ZMK 104 bn		1.65x	1.08x	1.10x	1.24x	1.24x	1.51x	1.67x	1.81x

Table 8: Financial Cashflow Statement: Farmers' Group Perspective, 2012 prices (million ZmK)

INFLOWS	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Sales	0	1,034	3,661	7,736	12,929	15,556	15,928	15,928	15,928	15,928	15,928
Change in A/R	0	(20)	(41)	(54)	(57)	(50)	(12)	(12)	(12)	(12)	(12)
Liquidation Values	0	0	0	0	0	0	0	0	0	0	0
New irrigation development	0	0	0	0	0	0	0	0	0	0	0
Sprinkler	0	0	0	0	0	0	0	0	0	0	0
Drag line	0	0	0	0	0	0	0	0	0	0	0
Rehabilitation /expand irrigation development	0	0	0	0	0	0	0	0	0	0	0
Sprinkler	0	0	0	0	0	0	0	0	0	0	0
Drag line	0	0	0	0	0	0	0	0	0	0	0
Depot construction	0	0	0	0	0	0	0	0	0	0	0
Total Inflows	0	1,014	3,620	7,683	12,871	15,506	15,916	15,916	15,916	15,916	15,916
OUTFLOWS											
Investment costs											
New irrigation development	0	142	284	354	354	284	0	0	0	0	0
Sprinkler	0	714	1,427	1,784	1,784	1,427	0	0	0	0	0
Drag line	0	72	145	181	181	145	0	0	0	0	0
Rehabilitation /expand irrigation development	0	22	44	55	55	44	0	0	0	0	0
Sprinkler	0	127	254	318	318	254	0	0	0	0	0
Drag line	0	18	36	45	45	36	0	0	0	0	0
Depot construction	0	453	1,087	1,721	725	543	0	0	0	0	0
Operations Costs	0	0	0	0	0	0	0	0	0	0	0
Inputs	0	0	0	0	0	0	0	0	0	0	0
Seeds	0	143	470	958	1,226	1,432	1,432	1,432	1,432	1,432	1,432
Compound B	0	143	470	958	1,226	1,432	1,432	1,432	1,432	1,432	1,432
CAN/LAN	0	40	119	219	318	397	397	397	397	397	397
Urea	0	64	211	431	552	644	644	644	644	644	644
Pest management	0	81	266	542	694	811	811	811	811	811	811
Packaging	0	16	51	103	134	157	157	157	157	157	157
Electricity (for irrigation)	0	14	42	78	113	141	141	141	141	141	141
Land preparation	0	0	0	0	0	0	0	0	0	0	0
Ploughing/harrowing	0	18	54	99	144	180	180	180	180	180	180
Oxen operation	0	38	132	287	338	376	376	376	376	376	376
Crop management	0	0	0	0	0	0	0	0	0	0	0
Nursery/transplanting/planting	0	35	119	252	308	350	350	350	350	350	350
Fertilizer application (oxen use for basal)	0	8	27	57	71	82	82	82	82	82	82
Pest preparation	0	21	69	141	180	210	210	210	210	210	210
Weeding	0	12	40	83	104	120	120	120	120	120	120
Watering	0	6	18	33	48	60	60	60	60	60	60
Harvesting	0	14	46	94	120	140	140	140	140	140	140
Curing	0	11	36	73	93	108	108	108	108	108	108
Maintenance costs	0	0	0	0	0	0	0	0	0	0	0
New irrigation development	0	0	0	0	0	0	0	0	0	0	0
Drip	0	22	66	122	177	221	221	221	221	221	221
Sprinkler	0	89	267	490	712	891	891	891	891	891	891
Drag line	0	9	27	50	72	90	90	90	90	90	90
Rehabilitation/expand irrigation development	0	0	0	0	0	0	0	0	0	0	0
Drip	0	3	10	19	28	34	34	34	34	34	34
Sprinkler	0	16	48	87	127	159	159	159	159	159	159
Drag line	0	4	11	21	30	38	38	38	38	38	38
Forgone income from maize	0	125	425	900	1,100	1,250	1,250	1,250	1,250	1,250	1,250
Total Outflows	0	125	425	900	1,100	1,250	1,250	1,250	1,250	1,250	1,250
Net Cashflow	0	889	3,195	6,783	11,771	14,256	14,666	14,666	14,666	14,666	14,666
	0	0	0	0	0	0	0	0	0	0	0
NET CASHFLOW BEFORE FINANCING	0	889	3,195	6,783	11,771	14,256	14,666	14,666	14,666	14,666	14,666
Loan from Operator	0	0	0	0	0	0	0	0	0	0	0
Loan proceeds (medium + short-term loan)	0	2,682	5,521	8,919	9,353	9,737	7,004	7,004	7,004	7,004	7,004
CASHFLOW FOR DEBT REPAYMENT	0	3,572	8,716	15,702	21,124	23,993	21,670	21,670	21,670	21,670	21,670
Repayment to Operator	0	0	0	0	0	0	0	0	0	0	0
Repayments (principal + interest)	0	(768)	(2,771)	(5,760)	(9,133)	(11,052)	(11,147)	(10,236)	(9,211)	(8,301)	(7,655)
Loan arrears by farmers	0	39	129	247	332	365	316	232	168	127	108
Total repayments	0	(729)	(2,642)	(5,512)	(8,802)	(10,688)	(10,831)	(10,003)	(9,043)	(8,174)	(7,547)
	0	0	0	0	0	0	0	0	0	0	0
NET CASHFLOW AFTER FINANCING	0	2,843	6,074	10,190	12,322	13,306	10,839	11,667	12,627	13,496	14,123

5.4 Typical Farmer's Perspective

The viability of the initiative is directly linked to the ability of the individual farmer to sustain commercial production of paprika over time. The financial model also considers the financial viability of the individual farmer's engagement in the proposed project. Each individual farmer, called typical farmer, is assumed to possess, on average, one hectare of land and is admitted into the scheme in 2013. Table 9 presents the cashflow statement from the typical farmer's perspective. The financial inflows are the sales of paprika while the outflows are the investment costs, costs of agriculture inputs, land preparation, crop management, and maintenance of the irrigation facilities as well as farmers' own labour that incurred on one hectare of land. A key element is the opportunity cost of the typical farmer's time, evaluated here as the net value of the maize that he would be able to grow if not growing paprika on that one hectare of land. Also, the net financial cashflow from the typical farmers' point of view incorporates the medium-term loan and short-term input credits from operator and credit repayments. Taking into account the opportunity cost of maize growing, the financial net cashflows of the typical farmer yields a positive net present value of ZmK 12.2 million at 10 percent real discount rate (Table 9).

A set of debt-service ratios for the typical farmer are presented in Table 9 (row 26). The resulting ratios are greater than one meaning that the typical farmer is expected to be able to cover all the operating costs and service the credit repayments every year to 2022. The ratios are expected values and are not know for certainty. Comparing, the typical farmer's ADSC ratios with those of the farmers group, it is clear that the individual farmer's financial position from participation in the scheme is far much better than that of the collective farmers and this result strongly suggests that individual farmers are likely to generate sufficient cashflows to settle their loan and credit repayment obligations to the operator.

5.5 Outgrower Scheme Perspective

The cashflow statement for the scheme as a whole is presented in Table 8. This statement includes the cashflows of the smallholder farmers and operators and also incorporates the investment costs of the project financed by the donors and the GRZ. The main objective of the analysis here is to find out whether the proposed scheme is able to use the funds provided by the AfDB and World Bank efficiently.

The statement values the sales of commodity at the world price fetched by Zambian paprika on the international market. All the investment, production, processing, and transportation costs of the farmer and operator are deducted from the sales receipts. The intermediate sales of paprika between farmers and the operator are a transfer and are not included in the statement.

Cash flows of the overall scheme

The cash flow formulations for the overall contract farming scheme are as follows:

$$INF_t^{\,S} = Q_t^e CIF_t + \Delta AR_t^{\,O} + Rsd_t^{\,f} \tag{11}$$

$$OUTF_t^{\,S} = Inv_t^{\,f} + LandPrep_t + CropM_t + Mnt_t^{\,f} + Proc_t^{\,O} + InT_t + Crd_t + \Delta AP_t^{\,O} + VATR_t + Inc_t^{\,O} + IncMz_t^{\,O} \tag{12}$$

$$NBFin_t^{\,S} = INF_t^{\,S} - OUTF_t^{\,S} \tag{13}$$

where INF_t^s = inflows; $OUTF_t^s$ = total outflows from investing and operating activities of the scheme; $NBFin_t^s$ = net benefit flow before financing of the scheme.

Table 9: Financial Cashflow Statement: Typical Farmers' Perspective, 2012 prices (million ZmK)

INFLOWS			2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Sales			0.0	4.1	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
Change in A/R			0.0	-0.1	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
Liquidation Values			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
New irrigation development			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Sprinkler		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Drag line		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rehabilitation /expand irrigation development			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Sprinkler		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Drag line		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Depot construction			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total Inflov		0.0	4.1	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
OUTFLOWS			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment costs			0.0	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
New irrigation development			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Sprinkler		0.0	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Drag line		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rehabilitation /expand irrigation development	Drip		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Sprinkler		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Drag line		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Depot construction			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operations Costs			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Inputs			0.0	1.3	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Seeds			0.0	0.3	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Compound B			0.0	0.3	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
CAN/LAN			0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Urea			0.0	0.1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Pest management			0.0	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Packaging			0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Electricity (for irrigation)			0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Land preparation			0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Ploughing/harrowing			0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Oxen operation			0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Crop management			0.0	0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Nursery/transplanting/planting			0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Fertilizer application (oxen use for basal)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pest preparation			0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Weeding			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Watering			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harvesting			0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Curing			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maintenance costs, real			0.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
New irrigation development			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Drip			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sprinkler			0.0	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Drag line			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rehabilitation/expand irrigation development			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Drip			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sprinkler			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Drag line			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Forgone income from maize			0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Outflows			**0.0**	**8.4**	**4.3**	**4.3**	**4.3**	**4.3**	**4.3**	**4.3**	**4.3**	**4.3**	**4.3**
Net Cashflow			**0.0**	**-4.4**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**
			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NET CASHFLOW BEFORE FINANCING			0.0	-4.4	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Loan from operator			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loan proceeds (medium + short-term loan)			0.0	9.0	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
CASHFLOW FOR DEBT REPAYMENT			0.0	4.6	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Repayments to operator			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Repayments (principal + interest)			0.0	-1.5	-5.2	-4.9	-4.7	-4.5	-3.7	-3.0	-3.0	-3.0	-3.0
Loan arrears by farmers			0.0	0.2	0.4	0.3	0.3	0.2	0.1	0.1	0.1	0.1	0.1
			0.0	-1.3	-4.8	-4.6	-4.5	-4.3	-3.6	-2.9	-2.9	-2.9	-2.9
NET CASHFLOW AFTER FINANCING			0.0	3.4	0.1	0.3	0.4	0.6	1.3	2.0	2.0	2.0	2.0
FNPV, Paprika (million ZmK)		12.2											
ADSCR				**3.96**	**1.14**	**1.18**	**1.22**	**1.26**	**1.52**	**1.86**	**1.86**	**1.86**	**1.86**

Cash flows of the overall scheme

The net flows are estimated as follows:

$$FinAdj_t^s = \quad Grt_t + LnOp_t - Rpmt_t^o \tag{14}$$

$$NFFinAdj_t^s = \quad NBFin_t^s + FinAdj_t^s \tag{15}$$

where Grt_t = grant financing from international donors and local grants; $LnOp_t$ = loan receipts from commercial banks; $Rpmt_t^o$ = repayment of loan to commercial banks by operator; $NFFinAdj_t^s$ = net benefit flows after financing adjustment.

The outgrower scheme financial cashflow (Table 10) takes into account the external loans from the World Bank through the selected commercial bank, grant from AfDB and the Government as well as repayments of the operator's loan and interest payments (row 29). The net cashflow indicates the size and timing of net financial costs and benefits associated with the proposed outgrower scheme. When discounted by a rate of 12 percent real, the net present value (row 32) is ZmK 125 billion. This result implies that the expected net financial income from agriculture activities under the proposed scheme is greater than the initial investment costs of the project. However, it should be noted that the risk associated with this expected return might be substantial.

Table 10: Financial Cashflow Statement: Outgrower Scheme Perspective, 2012 prices (million ZmK)

INFLOWS	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Sales, operator	0	4781	16926	35764	59766	71910	73631	73631	73631	73631	73631
Change A/R, operator	0	-414	-852	-1114	-1194	-1035	-245	-245	-245	-245	-245
Liquidation values	0	0	0	0	0	0	0	0	0	0	0
Total Inflows	**0**	**4367**	**16074**	**34650**	**58572**	**70875**	**73386**	**73386**	**73386**	**73386**	**73386**
OUTFLOWS											
Investment costs	71	2455	3856	5053	3828	2960	0	0	0	0	0
Additional investment	780	0	0	0	0	0	0	0	0	0	0
Infrastructure development	0	1982	3277	4458	3462	2733	0	0	0	0	0
Capacity Building & Training	71	473	579	594	367	227	0	0	0	0	0
Operating costs, farmers											
Inputs	0	501	1629	3287	4262	5016	5016	5016	5016	5016	5016
Land preparation	0	56	186	386	482	556	556	556	556	556	556
Ploughing/harrowing	0	18	54	99	144	180	180	180	180	180	180
Oxen operation	0	38	132	287	338	376	376	376	376	376	376
Crop management	0	107	355	733	924	1070	1070	1070	1070	1070	1070
Maintenance costs	0	143	430	788	1146	1433	1433	1433	1433	1433	1433
New irrigation development											
Drip	0	22	66	122	177	221	221	221	221	221	221
Sprinkler	0	89	267	490	712	891	891	891	891	891	891
Drag line	0	9	27	50	72	90	90	90	90	90	90
Rehabilitation/expand irrigation development	0	0	0	0	0	0	0	0	0	0	0
Drip	0	3	10	19	28	34	34	34	34	34	34
Sprinkler	0	16	48	87	127	159	159	159	159	159	159
Drag line	0	4	11	21	30	38	38	38	38	38	38
Operating costs, operator											
Processing costs	0	1890	6705	14195	23769	28661	29409	29472	29536	29600	29666
Transportation	0	748	2646	5592	9345	11244	11513	11513	11513	11513	11513
Change in working capital	0	192	396	519	557	484	117	117	117	117	117
Change in C/B, operator	0	141	291	381	410	356	86	86	86	86	86
Change in A/P, operator	0	51	105	137	147	128	31	31	31	31	31
Change in A/P to Farmer by Operator											
Credit processing costs	0	69	175	304	364	378	283	205	150	120	108
VAT input refund (exports)	0	-379	-1226	-2462	-3211	-3792	-3792	-3792	-3792	-3792	-2462
Income tax, operator	0	421	1523	3265	5517	6655	6849	6905	6944	6959	6954
Forgone income from maize	0	125	425	900	1100	1250	1250	1250	1250	1250	1250
Total Outflows	**851**	**6328**	**17098**	**32560**	**48084**	**55914**	**53704**	**53745**	**53792**	**53842**	**55221**
Net Cashflow	**-851**	**-1960**	**-1024**	**2091**	**10488**	**14961**	**19683**	**19641**	**19594**	**19545**	**18166**
NET CASHFLOW BEFORE FINANCING	-851	-1960	-1024	2091	10488	14961	19683	19641	19594	19545	18166
Funding											
Grant from AfDB & GRZ	911	524	772	423	344	0	0	0	0	0	0
Loan from Bank to operator	2491	4996	8045	9314	9828	7284	7284	7284	7284	7284	2987
Total Funding	3403	5519	8817	9737	10172	7284	7284	7284	7284	7284	2987
CASHFLOW AVAILABLE FOR DEBT REPA	2552	3559	7793	11828	20660	22245	26967	26925	26879	26829	21152
Total Repayments (Principal + Interest)	0	-1527	-4034	-7520	-9790	-11373	-10609	-9747	-8748	-8015	-7480
NET CASHFLOW AFTER FINANCING	2552	2032	3759	4308	10870	10872	16357	17178	18131	18814	13672

5.6 Financial Sensitivity Analysis

The financial module of the appraisal is based on the assumption that the values of project parameters change according to the best information available. However, the reality is that the value of some of the parameters and the future behaviour of the market and costs are unknown. This section presents a sensitivity analysis, identifying variables most likely to determine the financial outcome of the project and to quantify the extent of their impacts. The sensitivity analysis assesses the impact of the variation in the parameters on the operator's, smallholder farmers' and the scheme's financial viability. Sensitivity tests are conducted by varying one variable over a range of possible values, while keeping all the other parameters constant.

Yield Rates: The yield rate of the crop is a critical factor influencing the outcome of the whole outgrower scheme. The scheme's ability to utilise the existing market potential depends on good yield rates. The yield rate affects the smallholder farmer's ability to pay back their input credit since it is directly related to the volume of paprika they deliver to the operator. Changes in yield rates will have a significant impact on the liquidity of the operator, since a 20 percent decline in the yield rate makes the farmer's cashflows insufficient to meet debt obligations in 2011, as Table 11 shows.

Table 11: Sensitivity Test of Yield Rates

Change In Yield Rate	Operator				Farmers				Scheme FNPV (bn ZmK)
	FNPV (bn. ZmK)	ADSCR			FNPV (bn ZmK)	ADSCR			
		2013	2014	2015		2013	2014	2015	
-40%	61.62	1.16	1.40	1.55	56.37	1.10	0.53	0.54	38.01
-20%	81.54	1.19	1.51	1.71	80.42	1.37	0.81	0.82	81.50
0%	101.45	1.23	1.62	1.88	104.46	1.65	1.08	1.10	124.98
20%	121.37	1.26	1.73	2.04	128.51	1.93	1.36	1.38	168.46
40%	141.28	1.29	1.83	2.20	152.55	2.21	1.63	1.66	211.94

Changes in yield have a major effect on farmers, too. A reduction of yield by 20 percent puts a farmer in great danger of falling into a liquidity trap in 2010, even though the overall NPV of farmers is still positive. Change in yield has a still greater effect on the viability of the scheme as whole. A 20 percent reduction renders the scheme unattractive. Yield rates are to a great extent, influenced by farming skills, rainfall and the availability of irrigation. The results presented in Table 11 demonstrate that the yield rate is a critical factor to the viability of smallholder farmers and the whole scheme.

Table 12: Sensitivity Test of Domestic Inflation Rate

Domestic Inflation Rate	Operator				Farmers				Scheme FNPV (bn ZmK)
	FNPV	ADSCR			FNPV	ADSCR			
	(bn. ZmK)	2013	2014	2015	(bn ZmK)	2013	2014	2015	
2%	108.26	1.28	1.70	1.96	100.64	1.62	1.02	1.04	129.52
4%	105.99	1.26	1.67	1.93	101.92	1.63	1.04	1.06	127.92
6%	103.72	1.24	1.65	1.90	103.19	1.64	1.06	1.08	126.41
8%	101.45	1.23	1.62	1.88	104.46	1.65	1.08	1.10	124.98
10%	99.18	1.21	1.60	1.85	105.73	1.66	1.10	1.12	123.61
12%	96.90	1.19	1.57	1.82	107.00	1.68	1.12	1.14	122.30
14%	94.62	1.17	1.55	1.79	108.26	1.69	1.14	1.16	121.05
16%	92.34	1.15	1.52	1.76	109.52	1.70	1.16	1.19	119.86

Domestic Inflation Rate*:* Table 12 presents the sensitivity test of domestic inflation on the project and shows that a change in the rate of inflation has little impact on the farmers but has a bit more impact on the operator and the scheme as a whole. The effects are mainly attributed to the ratio of non-tradable inputs to tradable inputs in respective activity by farmers, operator and scheme.

Table 13: Sensitivity Test of Foreign Inflation Rate

US Inflation Rate	Operator				Farmers				Scheme FNPV (bn ZmK)
	FNPV	ADSCR			FNPV	ADSCR			
	(bn. ZmK)	2013	2014	2015	(bn ZmK)	2013	2014	2015	
0.5%	100.94	1.23	1.63	1.88	104.38	1.69	1.10	1.12	124.40
1.5%	101.20	1.23	1.62	1.88	104.42	1.67	1.09	1.11	124.69
2.5%	101.45	1.23	1.62	1.88	104.46	1.65	1.08	1.10	124.98
3.5%	101.70	1.23	1.62	1.87	104.50	1.63	1.07	1.09	125.26
4.5%	101.94	1.22	1.62	1.87	104.54	1.61	1.06	1.09	125.53
5.5%	102.17	1.22	1.62	1.87	104.58	1.59	1.05	1.08	125.79
6.5%	102.39	1.22	1.62	1.87	104.62	1.58	1.04	1.07	126.05

Foreign Inflation Rate: The effect of change in the foreign inflation rate is presented above in Table 13. The impact is affected by the sale of tradable goods, exported paprika in this case, but offset by the purchase of tradable inputs used in the activity of the operator, farmer and scheme, respectively. As the market interest rate is also affected by the foreign inflation, the amount of the above offset effect also increases.

Table 14: Sensitivity Test of Real Exchange Rate

Real Exchange Rate (ZmK/US$)	Operator				Farmers				Scheme FNPV
	FNPV	ADSCR			FNPV	ADSCR			
	(bn. ZmK)	2013	2014	2015	(bn ZmK)	2013	2014	2015	(bn ZmK)
3,663	57.63	1.01	1.38	1.61	73.21	1.49	0.95	0.96	68.55
3,640	56.98	1.01	1.38	1.60	72.74	1.48	0.95	0.96	67.71
4,700	87.20	1.17	1.56	1.80	94.30	1.61	1.05	1.06	106.62
5,200	101.45	1.23	1.62	1.88	104.46	1.65	1.08	1.10	124.98
5,700	115.71	1.27	1.68	1.94	114.63	1.69	1.11	1.13	143.33
6,200	129.96	1.31	1.72	1.99	124.79	1.72	1.14	1.16	161.69
6,700	144.22	1.35	1.76	2.04	134.96	1.75	1.16	1.18	180.04
7,200	158.47	1.38	1.80	2.08	145.13	1.77	1.18	1.20	198.40

Real Exchange Rate: The real exchange rate has a substantial impact on the project. Table 14 reveals that depreciation of the kwacha against the US dollar improves the financial outcomes for both the farmers and the operators. In addition, their ability to repay the debt increases with devaluation, as can be observed from the rising debt service ratios. A rise in the real exchange rate equates to a depreciation of the domestic currency relative to the foreign currency, and this improves the earnings from crop sales when converted into domestic currency. While the foreign sales also become more valuable in terms of local currency, the net impact is positive. Both the farmers and operators are better off with a depreciation of the kwacha. On the other hand, if the exchange rate decreases from 5,200 to 4,700 ZmK/US$, the NPV of the overall scheme will decline by ZmK 14.25 billion.

Table 15: Sensitivity Test of CIF Paprika World Price

World Price (ZmK/US$)	Operator				Farmers				Scheme FNPV (bn ZmK)
	FNPV	ADSCR			FNPV	ADSCR			
	(bn. ZmK)	2013	2014	2015	(bn ZmK)	2013	2014	2015	
3,200	17.05	0.52	0.81	0.98	69.73	1.25	0.68	0.70	8.97
3,600	43.02	0.74	1.06	1.26	80.42	1.37	0.81	0.82	44.66
4,050	72.24	0.98	1.34	1.57	92.44	1.51	0.94	0.96	84.82
4,275	86.84	1.10	1.48	1.72	98.45	1.58	1.01	1.03	104.90
4,200	81.97	1.06	1.44	1.67	96.45	1.56	0.99	1.01	98.21
4,500	101.45	1.23	1.62	1.88	104.46	1.65	1.08	1.10	124.98
5,100	140.41	1.55	2.00	2.29	120.49	1.84	1.26	1.29	178.52
5,300	153.39	1.66	2.12	2.42	125.84	1.90	1.32	1.35	196.37

World Paprika Price: Table 15 demonstrates that the price of paprika received by the operator on the international market is a very sensitive parameter. At the base level of 4,500 US$/ton, the operator and farmer both generate a high NPV from the operations and have debt service ratios greater than one. In terms of the net present value, the operator enjoys a positive return even if the price is as low as 3,200 US$/ton. The operator's liquidity suffers if the price declines below 4,275 US$/ton as indicated by an ADSCR below one as early as 2013. The operator has to arrange for bridge financing. For farmers, the net present values are also favourable in all years, this is assuming that they receive 17 percent of the CIF price along the whole range of paprika price movement. On the other hand, if the price goes below 4,500 US$/ton then liquidity will suffer as indicated by the ADSCR of 0.99x in 2014.

Farm Gate Price: The farm gate price determines the inflows of the farmers, and influences the crop purchase expenditures of the operator. A sensitivity test is conducted to identify the appropriate range within which these cashflows result in an acceptable liquidity flow for both the operator and the farmer. Table 16 indicates that the proportion of the CIF price of paprika in London used for setting the farm gate price has a bandwidth corridor between 11.6 percent and 26 percent. Within that corridor, both the operator and farmers have sufficient net cashflows to service the debt. Any change in this parameter below 16 percent or above 26 percent would adversely impact on the liquidity of the farmers or operator, respectively. This corridor corresponds to the base price of paprika of 4,500 US$/ton and would change if the CIF London price fluctuates.

Table 16: Sensitivity Test Farm Gate Price Factor

World Price (ZmK/US$)	Operator				Farmers				Scheme FNPV (bn ZmK)
	FNPV	ADSCR			FNPV	ADSCR			
	(bn. ZmK)	2013	2014	2015	(bn ZmK)	2013	2014	2015	
11.6%	127.18	1.51	1.91	2.18	66.52	1.21	0.65	0.66	111.75
12.6%	122.54	1.46	1.86	2.12	73.37	1.29	0.73	0.74	114.13
14.0%	115.84	1.39	1.78	2.04	83.25	1.41	0.84	0.85	117.58
15.0%	111.04	1.33	1.73	1.99	90.32	1.49	0.92	0.94	120.04
16.0%	106.25	1.28	1.68	1.93	97.39	1.57	1.00	1.02	122.51
17.0%	101.45	1.23	1.62	1.88	104.46	1.65	1.08	1.10	124.98
18.0%	96.66	1.17	1.57	1.82	111.53	1.73	1.16	1.18	127.44
20.0%	87.06	1.07	1.46	1.71	125.68	1.90	1.32	1.35	132.38
26.0%	58.29	0.75	1.14	1.37	168.11	2.39	1.81	1.84	147.17

Table 17 presents a locus of CIF price and farm gate price combinations that affect the liquidity of both the farmer and the operators in 2015, as measured by their respective annual debt service coverage ratio. Two sensitivity tests were performed to assess the behaviour of the ADSCR 2015 for both operator and farmer, and Table 15 combines the results of the two tests. What Table 17 shows is that there is a narrow corridor within which the scheme is sustainable for both the farmer and operator. The combinations of the CIF price and farm gate price are such that in order for the scheme to succeed, the CIF price must be at least 4,400 US$/ton while the farm gate price must be within the range of 16-25 percent of the CIF price (see Table 17, bounded in bold).

Table 17: Impact of CIF Price and Farm Gate Price on Liquidity of Farmer and Operator in 2015

		CIF Paprika Price							
		3,200	**3,600**	**4,050**	**4,275**	**4,200**	**4,500**	**5,100**	**5,300**
Farm Gate Price as % of CIF London	**11.6%**								
	12.6%								
	13.0%								
	14.0%								
	15.0%								
	16.0%								
	17.0%								
	18.0%								
	19.0%								
	20.0%								
	21.8%								

Combination of Paprika Price and Share of CIF Price earned by Farmers that are sustainable for both the Operator and Farmers

Reduction in Rainfed Cultivation: The initial allocation of the project coverage is such that 1,000 hectares are under irrigation and the remaining 1,500 hectares are under the rainfed system. The question is how the financial outcomes would change if the allocation to the rainfed areas is reduced in favour of irrigation. Table 18 shows that with the decrease of rainfed area and simultaneous increase of irrigated cultivation, the financial results for the operator and the farmers improve substantially. In the case of the operator, the NPV increases from ZmK 101.45 billion to ZmK 127.35 billion when the project is undertaken as complete irrigated farming. The NPV of participating farmers would also increase with a higher share of irrigated land instead of the rainfed. It is notable that the debt service ratio for both the operator and farmers will actually decline because irrigated farming requires additional costs that have to be financed through a medium-term loan.[25] If the whole scheme is undertaken with the irrigation method, its NPV increases by ZmK 128.66 billion.

Table 18: Sensitivity Test of Reduction in Rainfed Cultivation

Reduction Of Rainfed Area	Operator				Farmers				Scheme FNPV (bn ZmK)
	FNPV	ADSCR			FNPV	ADSCR			
	(bn. ZmK)	2013	2014	2015	(bn ZmK)	2013	2014	2015	
0%	127.35	1.51	1.91	2.18	66.27	1.65	1.08	1.10	124.98
20%	122.56	1.46	1.86	2.12	73.34	1.80	1.29	1.31	150.72
40%	115.84	1.39	1.78	2.04	83.25	1.91	1.45	1.48	176.45
60%	111.04	1.33	1.73	1.99	90.32	2.00	1.58	1.61	202.19
80%	106.25	1.28	1.68	1.93	97.39	2.07	1.69	1.73	227.93
100%	101.45	1.23	1.62	1.88	104.46	2.13	1.79	1.82	253.64

While the impact on the ADSCR if the proportion of the rainfed area is reduced is rather moderate, the impact on the year to year variability of the crop yield due to the variability of rainfall will be dramatic. Although we are unable to undertake a sensitivity analysis linking rainfall to yield of rainfed production, it is clear from international experience that the riskiness of the project due to this factor will be greatly reduced with irrigation.

Table 19: Sensitivity Test of Real Interest Rate

Base Interest Rate	Operator				Farmers				Scheme FNPV (bn ZmK)
	FNPV	ADSCR			FNPV		ADSCR		
	(bn. ZmK)	2013	2014	2015	(bn ZmK)	2013	2014	2015	
1.00%	100.46	1.24	1.66	1.92	107.51	1.78	1.16	1.17	127.19
3.00%	100.92	1.24	1.64	1.90	106.11	1.72	1.12	1.14	126.18
5.00%	101.37	1.23	1.63	1.88	104.72	1.66	1.09	1.11	125.16
5.37%	101.45	1.23	1.62	1.88	104.46	1.65	1.08	1.10	124.98
6.00%	101.60	1.22	1.62	1.87	104.02	1.63	1.07	1.09	124.65

[25] Investment costs are accordingly estimated based on the coverage areas. The higher the irrigated area, the higher the investment costs.

Real Interest Rate: A lower interest rate improves the financial liquidity of both the operator and the farmer, as well as the NPV of the overall scheme (see sensitivity test of the real interest rate presented in Table 19). A reduction in the real interest rate from 5.37 percent to 3.00 percent p.a., there will be an increase in the scheme's NPV from ZmK 124.98 billion to ZmK 126.18 billion. However, the overall impact appears to be not substantial.

Table 20: Sensitivity Test of Fuel Costs for the Operator

Fuel Cost (US$/Ton)	Operator						Scheme FNPV (bn ZmK)
	FNPV	ADSCR					
	(bn. ZmK)	2013	2014	2015	2016	2017	
1000	118.45	1.42	1.81	2.07	2.26	2.31	141.18
1200	101.45	1.23	1.62	1.88	2.06	2.10	124.98
1440	81.05	1.00	1.39	1.64	1.81	1.86	105.54
1680	60.65	0.77	1.16	1.40	1.56	1.61	86.10
2500	-14.39	0.00	0.29	0.51	0.64	0.70	14.54

Operator Processing Cost of Fuel: These costs are associated with the processing of paprika by the operator, and do not affect the farmers directly. The success of the outgrower scheme is highly dependent on the financial profitability of the operator. The processing costs represent a critical factor to the success of the whole outgrower scheme. Table 20 reveals that the direct raw material costs of the operator should not be more than 2,500 US$/ton; otherwise, the operator's liquidity will be affected. In terms of the scheme's viability, a rise of the raw material costs to 2,500 US$/ton will lower the NPV of the scheme by ZmK 110.44 billion. At that level of raw materials cost, the whole scheme becomes unattractive.

Table 21: Sensitivity Test of Labour Costs of Operator

Labor Cost (US$/Ton)	Operator						Scheme FNPV (bn ZmK)
	FNPV	ADSCR					
	(bn. ZmK)	2013	2014	2015	2016	2017	
1,000,000	118.45	1.35	1.75	2.01	2.20	2.25	136.71
1,500,000	101.45	1.25	1.64	1.90	2.08	2.13	126.93
1,600,000	81.05	1.23	1.62	1.88	2.06	2.10	124.98
2,000,000	60.65	1.14	1.53	1.78	1.96	2.01	117.16
3,200,000	-14.39	0.88	1.27	1.51	1.67	1.72	93.69

Labour Costs: Labour costs associated with the processing of paprika can have significant impact on the operator and his ability to meet his debt obligations. As observed in Table 21, if the labour costs go above ZmK 3,200,000 per ton, the operator's ADSCR 2013 gets below one, and he is incapable of meeting his debt service. In terms of viability of the whole scheme, the break-even point is about 3,200,000 Zmk/ton, at which the operator is incapable of meeting his debt obligations in year 2013.

Table 22: Sensitivity Test of Costs of International Transportation

International Transportation (US$/Ton)	Operator				Farmers				Scheme FNPV (bn ZmK)
	FNPV	ADSCR			FNPV	ADSCR			
	(bn. ZmK)	2013	2014	2015	(bn ZmK)	2013	2014	2015	
200	126.58	1.51	1.90	2.17	107.51	1.65	1.08	1.10	149.16
400	109.83	1.32	1.72	1.97	106.11	1.65	1.08	1.10	133.04
500	101.45	1.23	1.62	1.88	104.46	1.65	1.08	1.10	124.98
800	76.32	0.95	1.34	1.58	104.02	1.65	1.08	1.10	100.79
1000	59.57	0.76	1.15	1.39	103.32	1.65	1.08	1.10	84.67

International Transportation: Another factor that affects the operator is the international transportation costs. The sensitivity test in Table 22 demonstrates that this cost should not be more than 500 US$/ton in order to be sustainable for the operator and the whole scheme. The international transportation cost is largely out of control of the operator, and it has a negative impact on the viability of the operator. If the international transportation cost rises from 500 to 1000 US$/ton, this will lower the NPV by ZmK 41.88 billion. In terms of the operator's liquidity, a cost above 500 US$/ton, the ADSCR will be less than one in 2013. From the sensitivity, it is clear that farmers' liquidity is not affected by fluctuations in transportation costs and the NPV is as responsive to these fluctuations as that of operators or the scheme as a whole. For the scheme, a rise of costs from 500 to 1000 US$/ton leads to an NPV decrease of ZmK 40.31 billion and a ZmK 1.14 billion decrease for farmers. Given the very substantial share that the international transportation costs are of the total value of the product, this variable should be the subject of careful analysis by government policy makers to decipher ways to manage associated risk, and to reduce the level of these costs over time.

Table 23: Sensitivity Test of Costs of Domestic Transportation

Domestic Transp (ZmK/Ton/ Km)	Operator				Farmers				Scheme FNPV (bn ZmK)
	FNPV	ADSCR			FNPV	ADSCR			
	(bn. ZmK)	2013	2014	2015	(bn ZmK)	2013	2014	2015	
15,000	118.21	1.41	1.81	2.07	107.51	1.65	1.08	1.10	141.10
20,000	109.83	1.32	1.72	1.97	106.11	1.65	1.08	1.10	133.04
25,000	101.45	1.23	1.62	1.88	104.46	1.65	1.08	1.10	124.98
30,000	93.08	1.13	1.53	1.78	104.02	1.65	1.08	1.10	116.92
33,000	84.70	1.04	1.43	1.68	103.32	1.65	1.08	1.10	108.86
39,000	76.32	0.95	1.34	1.58	101.93	1.65	1.08	1.10	100.79

Domestic Transportation: The cost increase of domestic transportation affects the operator and the whole scheme negatively. Like airfreight, domestic transportation cost is beyond the control of the operator. Changes in the domestic transportation cost may have the same consequences as airfreight and the cost would be likely be shared by the operator and farmers. If the cost of transportation increases from 33,000 to 39,000 ZmK /ton per kilometre, the NPV for the operator would decline by

ZmK 318 million, and the NPV for the farmer would also reduce by ZmK 535 million.

Table 24: Sensitivity Test of Average Distance of Farmers from Operator

Distance From Operator (Km)	Operator				Farmers				Scheme FNPV (bn ZmK)
	FNPV (bn. ZmK)	ADSCR			FNPV (bn ZmK)	ADSCR			
		2013	2014	2015		2013	2014	2015	
30	101.45	1.23	1.62	1.88	104.46	1.65	1.08	1.10	124.98
40	96.55	1.17	1.57	1.82	104.46	1.65	1.08	1.10	120.30
50	91.64	1.12	1.51	1.76	104.46	1.65	1.08	1.10	115.63
70	81.84	1.00	1.40	1.65	104.46	1.65	1.08	1.10	106.29
75	79.39	0.98	1.37	1.62	104.46	1.65	1.08	1.10	117.97
80	76.93	0.95	1.34	1.59	104.46	1.65	1.08	1.10	110.96

Average Distance of Farmers from Operators: The domestic transportation costs are influenced by the distance of farmers from the operator. In the base case, it was assumed that the participating farmers were located 30 Km from the operator. Within that radius, the operator can expect a net present value of ZmK 101.45 billion. With other things being constant, it can be seen from Table 24 if the scheme decided to operate in a radius of more than 70 km, the farmer would be unable to meet financial obligations as his debt service ratios get very low. Therefore, based on these observations, it can be said that the highest radius that can be covered should be within 70 km. Keeping this in this mind, this type of project cannot reach many of the poor farmers in Zambia, unless there is reduction in the processing costs of the operator or a reduction in the cost of airfreight charges. Its effect in this regard will be the ultimate determinant of the ability of this type of project to alleviate poverty in Zambia.

Also, as the volume of overall production of paprika in an area increases, there will likely be some efficiencies gained in the local transportation of paprika. When this happens then it will be feasible to operate such schemes farther from the location of the operator.

5.7 Conclusion of Financial Analysis

Step one in the integrated investment appraisal is the financial analysis, which considers the viability of the project from the operator's perspective, farmer's perspective and the whole scheme's point of view. The operator's participation in the scheme appears to be sustainable as he earns over the life of the project more than his target rate of return (ZmK 101.45 billion at 15 percent real discount rate). At the same time, the operator faces substantial year-to-year risks in being unable to meet debt service obligations. Considering the participating smallholder farmers, the results suggest that they should be able to recover all their investment, operating and credit costs as well as to earn a return on their equity of more than 10 percent real. Over the life of the project, the net cashflows they receive yield a net present value of ZmK 104.46 billion. Comparing this outcome with the alternative of traditional maize growing, the project provides over 5 times as much net income to participating farmers as this alternative. The financial viability of smallholder farmers was assessed in terms of their ability to repay their debt. Results also indicated situations of short-term liquidity shortage are likely to arise where a farmer from his operations alone will not have enough cashflows to pay off the credit to the operator. Hence, the farmer may get into arrears. Efforts need to be made to encourage farmers to build up their equity so as to finance some of their working capital requirements to cushion the impact of revenue variability. From the overall outgrower scheme perspective, the net present value is ZmK 124.98 billion indicating that the scheme could benefit farmers and operators. The resources provided by various donors and the government of Zambia are able to yield a return significantly greater than their country's opportunity cost of capital.

Sensitivity results indicated that the yield rates, real exchange rate, world paprika price as well as international transportation significantly impact project financial outcomes. In order for the scheme to succeed, the CIF price must be at least 4,275 US$/ton while the farm gate price must be within the range of 16-25 percent of the CIF price. It was seen that if the project was carried out as 100 percent completely irrigated, the NPV of the scheme would substantially increases from ZmK 124.98 billion to ZmK 253.64 billion, but the debt service ratios decline because of additional investment costs required for irrigation. International transportation costs are around 11 percent of the London price of paprika and they can be further reduced if measures can be taken to improve the access of Zambia to international air cargo companies. This could end up benefiting the farmers significantly through a much higher farm gate price.

Chapter 6

ECONOMIC ASSESSMENT

6.1 Economic Parameters and Assumptions

In addition to the financial parameters of the project, a number of additional parameters and assumptions have to be made for the economic analysis.

National Parameters

- The economic cost of capital for Zambia is taken as 12 percent real.[26]
- An estimation of the distortions associated with tradable goods in Zambia suggests that the value of foreign exchange premium (FEP) is 7.25 percent and the shadow price of non-traded outlays (SPNTO) is 1 percent.

Imported Good Exempted from Taxes

- Irrigation equipment is imported with the permission of the Government of Zambia and does not attract an import duty or VAT as a way of promoting investment in the agriculture sector.
- Maintenance of irrigation equipment involves replenishing and refurbishing of the irrigation infrastructure using new spare parts. No import duty or indirect taxes are imposed on this equipment.
- Seeds, fertilisers, packaging materials, pest management materials are considered tradable. No taxes or duties are applied on these inputs.

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[26] While no specific analysis was done concerning estimation of the economic opportunity cost of capital (EOCK) for Zambia, 12 percent real is assumed for the purpose of this analysis. See for example, Kuo, Jenkins, and Mphahlele, "The Economic Opportunity Cost of Capital for South Africa", South African Journal of Economics, September 2003.

- International transportation charges are completely tradable and paid in foreign currency to international air carriers. No tax is levied by the government of Zambia.

Imported Good Subject to Taxes

- Electricity supply installations are imported. They attract an import duty of 25 percent besides the value added tax of 16 percent.
- Fuel is subject to 25 percent import duty and 16 percent VAT.
- Motorbikes and bicycles are imported; they attract 25 percent import duty and are subject to 16 percent VAT.
- The unadjusted conversion factor for all tradable goods and services is assumed to be 1. Paprika, fertilisers and motorbike include 3 percent transportation charges and 1 percent handling charges. Unadjusted conversion factor for domestic transportation and handling is 0.85.

Non-Tradable Goods

- Non-traded goods and services used in the project include depot construction, electricity, domestic transportation, and training of farmers.
- Non-tradable goods and services are sourced domestically and only attract VAT of 16 percent.

Labour

- Farm labour: Land preparation and crop management activities are undertaken by either smallholder farmers themselves or hired casual workers. This type of labour should be categorised as unskilled. They do not attract personal income taxes.
- Factory labour: These types of activities fall in the category of semi-skilled labour and are also not liable for personal income tax.

- Extension, training and technical assistant labour: Capacity building and training is largely a labour-intensive activity. Extension, IPM measures training, training of trainers and all types of training are to be conducted by extension officers who are be considered to be skilled workers. Similarly, the technical assistant on the Project Management Unit falls in this category. These skilled workers' wages are high enough so that they are expected to pay personal income tax at 35 percent and social security contributions at 5 percent. Five extension workers will be assigned to conduct extension and training services to smallholder farmers of paprika.
- The economic cost of labour (ECOL) to the project is approximated using the supply price approach.[27]

Working Capital

- The change in accounts receivable is associated with the exported sales of paprika, and thus is attached with the foreign exchange premium.
- The conversion factor for changes in accounts payable is essentially a composite conversion factor based on the shares of the individual items in the total expenditures or a weighted average of their respective shares and conversion factors (CSCFs).
- The conversion factor for cash-balance changes is assumed to be one.

With this information, a series of CSCFs can be calculated and these are presented in Table 25.

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[27] That is, project wage net of personal income tax and social security contributions. ECOL is a measure of willingness to supply labour to project activities, net of taxes and social security contributions: EOCL = Gross Income^{Project} – Soc.Security^{Project} – [Taxes^{Project} – (Taxes^{Alternative} * Share^{Alternative}) – Soc.Security^{Alternative}].

6.2 Economic Feasibility

The economic resource flow statement of the proposed scheme (see Table 26) is derived from the outgrower perspective (Table 10), with the latter adjusted for various distortions. All items of the outgrower scheme statement are adjusted using the economic conversion factors presented in Table 25. The conversion factors transform cashflow items into their economic equivalent, representing the economic value of the good and services supplied and demanded by the project. On the benefit side, the sales of paprika on the international market are counted inclusive of the foreign exchange premium generated for the economy. Changes in residual values and accounts receivable are also incorporated. The economic costs comprise the initial investment costs by farmer, operator and government, plus the operating costs and changes in the accounts payable for both the farmer and operator. The resulting economic resource flow estimates the amount of the net benefits accruing to the economy of Zambia.

The annual net economic benefits over the life of the project are then discounted using the economic opportunity costs of capital of 12 percent real for Zambia, giving a PV of net benefits of ZmK 241.33 billion. This indicates that the project would raise the well-being of its citizens, especially the smallholder farmers.

Table 25: Summary of Economic Conversion Factors

Item	Commodity Specific Conversion Factor	Comments
Paprika Sales	1.075	Tradable item, financial value adjusted for FEP, no sales or export taxes apply
Irrigation Equipment		
Drip	1.075	Tradable item, adjusted for FEP, and is tax exempt
Sprinkler	1.075	Tradable item, adjusted for FEP, and is tax exempt
Drag Line	1.075	Tradable item, adjusted for FEP, and is tax exempt
Depot Construction	0.821	Non-tradable item, financial values adjusted for FEP, SPNTO, VAT
Electricity Supply Installations		
Sprinkler Irrigation	0.741	Tradable, adjusted for FEP & tax distortions
Drip Irrigation	0.741	Tradable, adjusted for FEP & tax distortions
Capacity Building & Training		
Quality Enhancement and Control		
Extension	0.760	Skilled labour, adjusted for tax distortions
Training of Farmers	1.013	Composite factor of skilled labour and materials, adjusted for taxes & FEP
Sustainable Production Investments		
IPM Measures EUREP GAP training	0.760	Skilled labour, adjusted for tax distortions
Electricity Supply Installation		
Farmer Training	1.013	Skilled labour, adjusted for tax distortion
Extension Staff Training	0.760	Skilled labour, adjusted for tax distortion
PMU and Technical Assistance		
Two Part-Time Technical Assistance	0.760	Skilled labour, adjusted for tax distortions
Support to Extension Workers		
Motorbikes	0.741	Tradable, adjusted for FEP & taxes
Bicycles	0.741	Tradable, adjusted for FEP & taxes
Training of Trainers Workshop	0.760	Materials adjusted for FEP, taxes; labour adjusted for tax distortions
Inputs		
Seeds	1.075	Tradable, adjusted for FEP
Compound B	1.132	Imported input, financial value adjusted for subsidy and FEP
CAN/LAN	1.132	Imported input, financial value adjusted for subsidy and FEP
Urea	1.132	Imported input, financial value adjusted for subsidy and FEP
Pest management	1.075	Tradable, imported input, adjusted for FEP, tax distortions
Packaging	1.075	Tradable, imported input, adjusted for FEP, tax distortions
Electricity (for irrigation)	0.875	Non-tradable, adjusted for FEP, SPNTO, and taxes
Land Preparation		
Ploughing/harrowing	1.000	Unskilled labour, their wages are below that required for personal income tax
Oxen operation	1.000	Unskilled labour, their wages are below that required for personal income tax
Crop Management		
Nursery/transplanting/planting	1.000	Unskilled labour, no taxes
Fertilizer application (oxen use for basal)	1.000	Unskilled labour, no taxes
Pest preparation	1.000	Unskilled labour, no taxes
Weeding	1.000	Unskilled labour, no taxes
Watering	1.000	Unskilled labour, no taxes
Harvesting	1.000	Unskilled labour, no taxes
Curing	1.000	Unskilled labour, no taxes
Maintenance of Equipment		
Drip	1.075	Imported, adjusted for FEP, no duty or value added taxes apply
Sprinkler	1.075	Imported, adjusted for FEP, no duty or value added taxes apply
Drag line	1.075	Imported, adjusted for FEP, no duty or value added taxes apply
Operating Costs, Operator		
Processing costs		
Labour	0.839	Labour treated as semi-skilled, no personal income tax apply
Fuel	0.741	Imported raw materials, adjusted for FEP, and duties, values added tax
Transportation		
Domestic transportation	0.766	Non-tradable, adjusted for FEP, SPNTO, and tax distortion in inputs
International transportation	1.075	Tradable, adjusted for FEP
Change in Working Capital		
Change A/R, operator	1.075	Same as sales
Change A/R, farmers	1.075	Same as sales
Change in C/B, operator	1.000	No distortions are built in the cash balance
Change in A/P, operator	0.839	No distortions are built in the cash balance
Change in A/P to Farmer by Operator		
Credit processing costs	0.760	Skilled labour is involved in procuring and disbursement of the loans and input credit
VAT input refund (exports)	0.000	This s a resource cost to the government
Forgone income from maize	1.075	Tradable item, financial value adjusted for FEP, no sales or export taxes apply

Table 26: Economic Resource Flow Statement, 2012 prices (million ZmK)

RESOURCE INFLOWS	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Sales, operator	0	5140	18195	38446	64248	77303	79154	79154	79154	79154	79154	0
Change A/R, operator	0	-445	-916	-1197	-1283	-1113	-263	-263	-263	-263	-263	4277
Liquidation values	0	0	0	0	0	0	0	0	0	0	0	0
Total Inflows	**0**	**4695**	**17279**	**37249**	**62965**	**76191**	**78890**	**78890**	**78890**	**78890**	**78890**	**5196**
RESOURCE OUTFLOWS												
Investment costs												
Additional investment	839	0	0	0	0	0	0	0	0	0	0	0
Infrastructure development	0	2016	3246	4355	3537	2800	0	0	0	0	0	0
New irrigati Drip	0	152	305	381	381	305	0	0	0	0	0	0
Sprinkler	0	767	1534	1918	1918	1534	0	0	0	0	0	0
Drag line	0	78	156	194	194	156	0	0	0	0	0	0
Rehabilitatic Drip	0	24	47	59	59	47	0	0	0	0	0	0
Sprinkler	0	137	273	342	342	273	0	0	0	0	0	0
Drag line	0	19	39	49	49	39	0	0	0	0	0	0
Depot construction	0	372	892	1412	595	446	0	0	0	0	0	0
Electricity S Sprinkler	0	297	0	0	0	0	0	0	0	0	0	0
Drag line	0	170	0	0	0	0	0	0	0	0	0	0
Capacity Building & training	54	380	483	519	314	200	0	0	0	0	0	0
Operating costs, farmers	0	0	0	0	0	0	0	0	0	0	0	0
Inputs	0	550	1788	3609	4678	5503	5503	5503	5503	5503	5503	0
Land preparation	0	56	186	386	482	556	556	556	556	556	556	0
Crop management	0	107	355	733	924	1070	1070	1070	1070	1070	1070	0
Maintenance costs, nominal	0	154	462	847	1232	1540	1540	1540	1540	1540	1540	0
Operating costs, operator	0	0	0	0	0	0	0	0	0	0	0	0
Change in working capital	0	184	379	497	533	464	112	112	112	112	112	-1787
Change in C/B, operator	0	141	291	381	410	356	86	86	86	86	86	-1372
Change in A/P, operator	0	43	88	115	124	108	26	26	26	26	26	-415
Change in A/P to Farmer by Operator	0	0	0	0	0	0	0	0	0	0	0	0
Credit processing costs	0	52	133	231	277	287	215	156	114	91	82	0
VAT input refund (exports)	0	0	0	0	0	0	0	0	0	0	0	0
Forgone income from maize	0	134	457	968	1183	1344	1344	1344	1344	1344	1344	0
Total Outflows	892	5810	15203	28471	40483	46691	44107	44101	44113	44144	44190	-1787
Net Resource Flow	-892	-1114	2076	8778	22482	29500	34783	34789	34777	34746	34700	6983

6.3 Economic Sensitivity Analysis

Yield Rates: The yield rate of paprika affects the volume of product that the country will export to the international market through this project. From Table 27, it can be seen that a decrease in the yield rates damages the economic performance of the project. A 20 percent reduction in the yield rates reduces the economic viability of the project by ZmK 135.75 billion. The yield rates can be improved through capacity building and training of farmers. This would be more effective under irrigation rather than rainfed farming

Table 27: Sensitivity Test of Yield Rates

Change in Yield Rate	Economic NPV (billion ZmK)
-40.0%	105.58
-20.0%	173.45
0.0%	241.33
20.0%	309.21
40.0%	377.08

Real Exchange Rate: The value of the paprika export revenues and the costs of imported inputs for the project are highly dependent on the appreciation/depreciation of the kwacha. Table 28 indicates that a depreciation of the domestic currency in real terms improves the economic viability of the project. For example, if the real exchange rate rises from 5,200 to 5,700 ZmK/US$, the economic NPV will increase by ZmK 30.93 billion.

Table 28: Sensitivity Test of Real Exchange Rate

Real Exchange Rate (ZmK/US$)	Economic NPV (billion ZmK)
3,663	146.25
3,640	144.83
4,700	210.40
5,200	241.33
5,700	272.26
6,200	303.19
6,700	334.12
7,200	365.05

World Paprika Price: The export price of paprika has a marked impact on project economic outcomes. Table 29 presents the sensitivity test of the paprika price on the economic viability of the scheme. A drop in the CIF price from 4,500 to 4,050 US$/ton implies a reduction in the economic NPV of ZmK 59.63 billion.

Table 29: Sensitivity Test of World Paprika Price

CIF Paprika Prices (US$)	Economic NPV (billion ZmK)
3,200	69.07
3,600	122.07
4,050	181.70
4,275	211.52
4,200	201.58
4,500	241.33
5,100	320.84
5,300	347.34

International Transportation: International transportation cost affects both the financial benefits that accrue to the operator and the economic benefits accruing to the country. If the cost of airfreight is, for any reason, raised without a corresponding adjustment in the CIF price of paprika, the only option the operator has is to lower the price of paprika purchased from the farmers, thus lowering the overall financial and economic benefits of the scheme. An increase of airfreight charges from 500 to 1,000 US$/ton makes the economic NPV of ZmK 241.33 billion to decline by ZmK 66.64 billion.

Table 30: Sensitivity Test of Costs of International Transportation

International Transportation (US$/ton)	Economic NPV (billion ZmK)
200	281.31
400	254.66
500	241.33
800	201.35
1,000	174.69

Chapter 7

STAKEHOLDER IMPACTS

7.1 Identification of Externalities

Financial and economic analysis provides the basic data required to estimate stakeholder impacts, while stakeholder analysis identifies and quantifies specific gains and losses.

Consistency of analysis is established by testing if financial NPV plus externalities' PV is equal to economic NPV, using a common discount rate. Table 30 presents project financial, economic and externalities' PVs, discounted by the economic cost of capital—12 percent real. The resulting economic NPV is the same as that shown in Table 24; however, the financial NPV is not equal to the sum of ones displayed in Table 5 and 8 and when the financial net cashflows is discounted at required rate of return by farmers at 10 percent real and by the operator at 15 percent real.

The reconciliation of the financial, economic and externality flows indicate that the gross economic benefits generated by the scheme are shared between the farmers, operator and the government. Table 31 shows that the financial gain by farmers and the operator using a discount rate of 12 percent real is ZmK 26,363 million and ZmK 38,632 million, respectively. In the meantime, the economic impact of the project is a net benefit of ZmK 102,796 million. The present value of project externalities is ZmK 41,541 million—or financial NPV minus economic NPV. The integrated approach reconciles externalities of stakeholder gains and losses. In this particular case all externalities are due to the government of Zambia.

In terms of the allocation of net impact on the GRZ, it is clear that they are either generation of foreign exchange and indirect taxes or use of foreign exchange and indirect taxes. On the benefit side of the externalities created by the project are mainly the foreign exchange premium associated with the sales of paprika abroad. The foreign exchange premium is essentially the additional tax revenues that the government will collect indirectly as the additional foreign exchange gets spent on imports that are subject to tariffs, excise taxes and sales taxes. The total amount of positive flows is ZmK 29,509 million. On the outflow side, externalities are associated with costs of foreign exchange spent on tradable capital goods and operating inputs. Also included are little indirect tax distortions related to use of project's non-tradable items. This amounts to a gain of ZmK 3,641 million. Government also incurs expenditures associated with capacity building and training amounting to ZmK 3,740 million. Thus, the net impact on the GRZ is ZmK 41,541 million less ZmK 3,740 million.

It is important to recognise that the foreign exchange externalities received by the government are essentially tax revenues received through the expansion of exports and the availability of foreign exchange. These revenues will empower the government to undertake expenditures that are beneficial to the people of Zambia. These benefits of export expansion amount to almost 30 percent of project net economic gains. The expected impact of the project on the fiscal positional of the government is a good illustration of why countries that have had effective

Table 31: Distribution of Economic Benefits, 2012 price (millions ZmK)

RESOURCE INFLOWS	PV @ EOCK Operator-Financial	PV @ EOCK Farmer-Financial	PV @ EOCK Government-Financial	PV @ EOCK Government-Externalities	PV @ EOCK Total Financial Externality
RESOURCE INFLOWS					
Sales, operator	556,714	120,428		41,754	
Change A/R, operator	(1,858)			(139)	
Change A/R, farmers		93		0	
Liquidation values		712		0	
Total Inflows	**554,856**	**121,233**	**0**	**41,614**	
RESOURCE OUTFLOWS					
Investment costs					
Additional investment				59	
Infrastructure development		15,470		42	
Electricity S Sprinkler			276	21	
Drag line			158	12	
Capacity Building & training			2,309	(360)	
Operating costs, farmers					
Inputs		39,732		3,869	
Land preparation		4,441		0	
Crop management		8,530		0	
Maintenance costs, nominal		11,091		832	
Operating costs, operator					
Purchases at farm gate price	125,245			0	
Processing costs	222,668			(52,886)	
Transportation	87,048			(1,261)	
Change in working capital	0			(37)	
Change in C/B, operator	638			0	
Change in A/P, operator	230			(37)	
Change in A/P to Farmer by Operator	93			0	
Credit processing costs	2,154			(517)	
VAT input refund (exports)	(28,669)			28,669	
Income tax, operator	51,937			(51,937)	
Forgone income from maize		10,040		753	
Total Outflows	**460,382**	**89,303**	**2,309**	**(72,774)**	
Net Resource Outflow	**94,473**	**31,930**	**(2,309)**	**114,388**	
FINANCING ADJUSTMENT					
Lending to Farmers					
Loan proceeds (medium + short-term loan)	**(74,014)**				**74,022**
Loan repayments by Farmers					
Repayments (principal + interest)	**82,143**				**(82,149)**
Loan arrears by farmers	**(2,154)**				**2,154**
Loan from Operator					
Loan proceeds (medium + short-term loan)		**4,132**			**(71,168)**
Repayment to Operator					
Repayments (principal + interest)		**(5,057)**			**78,984**
Loan arrears by farmers		**128**			**(2,071)**
Net Flow	**100,449**	**31,133**	**(2,309)**	**114,388**	**(227)**

policies to expand the export of goods and services usually have had healthy public sector fiscal positions.

7.2 Sensitivity Analysis of Stakeholder Impacts

Yield Rates: The impact of change in yield rate on externalities is presented in Table 32. For example, a decrease in yield rates by 20 percent reduces the amount of the externalities by 21.18 percent from ZmK 114.17 billion to ZmK 89.99 billion.

Table 32: Sensitivity Test of Yield Rates

Change in Yield Rates	NPV Operator	NPV Farmers	PV Externalities Government (billion ZmK)
-40.0%	61.62	56.37	66.04
-20.0%	81.54	80.42	90.21
0.0%	101.45	104.46	114.39
20.0%	121.37	128.51	138.56
40.0%	141.28	152.55	162.74

World Paprika Price: The price of paprika exported has some impact on the externalities that the project creates. Table 33 demonstrates the sensitivity test of the paprika price on the present value of externalities of the project. The effect is not substantial.

Table 33: Sensitivity Test of CIF Paprika Price

CIF Paprika Price (US$/ton)	NPV Operator	NPV Farmers	PV Externalities Government (billion ZmK)
3,200	17.05	69.73	58.09
3,600	43.02	80.42	75.35
4,050	72.24	92.44	94.76
4,275	86.84	98.45	104.46
4,200	81.97	96.45	101.23
4,500	101.45	104.46	114.17
5,100	140.41	120.49	140.05
5,300	153.39	125.84	148.68

Table 34: Sensitivity Test on Farm Gate Price

Farm Gate Price Ratio	NPV Operator	NPV Farmers	PV Externalities Government (billion ZmK)
11.6%	127.18	66.52	127.55
12.6%	122.54	73.37	125.07
14.0%	115.84	83.25	121.60
15.0%	111.04	90.32	119.12
16.0%	106.25	97.39	116.65
17.0%	101.45	104.46	114.17
18.0%	96.66	111.53	111.69
20.0%	87.06	125.68	106.74
26.0%	58.29	168.11	91.88

Farm Gate Price: The farm gate price determines the inflows of the farmer, and influences the crop purchase expenditures of the operator. A sensitivity test is conducted for the farm gate price factor. As expected, there is only a relatively small impact on the externalities generated, as shown in Table 34.

Table 35: Sensitivity Test of Real Exchange Rate

Real Exchange Rate (ZmK/US$)	NPV Operator	NPV Farmer	PV Externalities Government (billion ZmK)
3663	57.63	73.21	76.42
3640	56.98	72.74	75.86
4700	87.20	94.30	101.89
5200	101.45	104.46	114.17
5700	115.71	114.63	126.45
6200	129.96	124.79	138.73
6700	144.22	134.96	151.01
7200	158.47	145.13	163.29

Real Exchange Rate: The externalities generated by the project are affected by the appreciation and depreciation of the kwacha in real terms. Table 35 indicates that a depreciation of the domestic currency in real terms increases the size externalities due to the government. This is because a fall in the value of the domestic currency increases earnings from crop sales when converted into domestic currency. As a result, the foreign exchange premium associated with the increase in exports will rise and so will the externalities.

Chapter 8

RISK ANALYSIS

8.1 Risks vs. Sensitivity Analysis

The method of financial and economic analysis presented thus far is undermined by the assumption that project variables can be assigned definite values, producing definite estimates for project NPVs. This approach fails to account for the real-world uncertainties affecting key parameters used in project evaluation.

Risk analysis assesses variability in project financial and economic returns. In the analysis, the uncertainty associated with the critical variables of a project is expressed in terms of probability distributions. One of the most effective means of replicating real-world dynamics is a form of risk analysis known as Monte Carlo simulations, in which financial and economic analyses are run many times over, using distributions for sensitive and uncertain project variables. This allows collecting and analyzing statistically the results of the simulations to arrive at a distribution of the possible outcomes of the project and the probabilities of their occurrence.

8.2 Sensitivity Analysis

An evaluation of farmers' and operator's participation in the outgrower scheme suggests that the scheme is attractive from the perspective of both the smallholder farmers and the operator. A weakness of the base case scenario is the assumption that prices, costs, inflation rates, exchange rates and yield rates, as well as other parameters used in assessing the viability of the outgrower operation, are known with certainty. The implication is that the estimated ADSCRs and NPVs are also certain and therefore deterministic. This deterministic base case model of the financial analysis does not take into account the uncertainties and fluctuations that the scheme is expected to encounter over its life cycle. The long-term financial viability and sustainability of the scheme is largely determined by the volatility of a number of key variables.

We conduct a series of sensitivity tests for key variables in the value chain, and evaluate the downside impact of these changes on the NPV, along with their impact on the minimum and average ADSCR values. Based on the sensitivity results the key risk variables that could adversely affect the value chain are those that have a pronounced impact on the NPVs and ADSCRs. Specifically, the impact of yield rates, real exchange rate, the price of paprika in Europe and the cost of international transportation tend to have the greatest impact on the operator and smallholder farmers together.

Yield rates, γ, affect the amount of crop, Q^{fg}, that is sold by the farmer to the operator. In practice, the farm yields of the smallholder farmers are affected by a wide variety of factors ranging from agronomic conditions to weather patterns. The availability of rainfall is critical for the cultivation of paprika in non-irrigated areas. The exchange rate is a major determinant of the kwacha value of the export earnings and of the kwacha cost of the tradable inputs used in the operation. In the model, non-tradable items are valued directly in kwacha and their prices are not directly impacted by movements in the ZMK/US$ exchange rate. The cost, insurance and freight (CIF) price (in Europe) of the processed paprika is affected not only by the exchange rate but also by changes in its real or relative prices owing to global shifts in demand and supply of paprika and its close substitutes. As the output of this operation is not large enough to affect the world paprika price, from the perspective of Zambia this outgrower scheme is a price taker. Similarly, fuel prices, international transportation costs and material processing costs are tradable items affected by the dynamics of the exchange rates and global markets.

8.3 Monte Carlo Risk Analysis

The above analysis helps to identify variables that are important determinants of the variability of financial indicators such as the ADSCR and the NPV. However, it must be noted that sensitivity analysis entails an assessment of the effect of adjusting a variable while the values of other variables remain fixed. There is no simultaneity in the assessment. In reality, however, many risk variables will move at the same time and are often correlated. One of the most effective means of replicating such real-world dynamics is through a Monte Carlo simulation, which uses distributions for sensitive and uncertain variables over many iterations. These results are then analyzed statistically to arrive at a distribution of the possible financial outcomes for the operator and the smallholder farmers, and the probabilities of their occurrence[28].

For this study, we develop probability distributions for the following risk variables:

- Yield rate: The yield rate under rainfed cultivation is determined by variability in rainfall, temperature and level of use of inputs. We assume that the level of agricultural inputs of the smallholder farmers is sufficiently available and financed via the credit mechanism, so they will not be a constraint on the yield rates. However, crop yields are likely to be affected by climate variation such as

[28] Crystal Ball Software is used to conduct the simulations and produce the statistical reports.

changes in precipitation, temperature, sunshine and other meteorological factors (Sakaida, 1993). A combination of temperature and other meteorological factors has a direct impact on the rainfall, which in turn affects the crop yield level. For the simulation, the yield rate in any cultivation period will be obtained from a distribution defined as:

[redacted] (16)

The distribution of the yield rates is based on observations of yields of smallholder farmers in Zambia (Langmead 2005).

- Real exchange rate: This is a factor that has a direct impact on the domestic currency values of all tradable items in the model. In the projection of the real exchange rate for the base case, we have assumed that it remains constant at 5,200 ZMK/US$ over the evaluation period of the operation. The risk analysis model adjusts the predicated real exchange rate by using the stochastic random error η. The random component is based on the historical kwacha/dollar exchange rate for 1986–2010 (World Bank Development Indicators, 2012), and captures all the deviations from the trend of the real exchange rate with a mean of zero and a standard deviation that defines the riskiness inherent in the exchange rate.

[redacted] (17)

- CIF price of paprika: The random error of mean of zero, φ, is applied to the CIF prices of paprika. This is based on the historical producer prices of green pepper sold in Europe (FAO, 2012).

[redacted] (18)

Two other variables that have been modelled include the investment cost overruns on all the farmers' and operator's capital costs, and the price of international

Table 36: Statistics of custom distributions for risk parameters

Risk Statistics	Cost overrun	Exchange rate	CIF Paprika price	Yield rate	Freight cost
Mean	0%	0%	0%	899	0.0%
Median	1%	-2%	-1%	898	-0.2%
Standard Deviation	7%	26%	23%	369	0.8%
Variance	0.49%	6.7%	5.4%	136067	0.0%
Skewness	0.22	0.45	0.35	0.02	18.8%
Kurtosis	1.86	2.03	2.96	1.89	170.1%
Coeff. of Variability	120	-160	-117	0	-197
Minimum	-10%	-36%	-44%	250	-1.3%
Maximum	20%	54%	80%	1570	1.5%
Range Width	30%	90%	123%	1320	2.8%
Mean Std. Error	0%	0%	0%	4	0.0%

transportation. Table 36 gives a summary of the statistics of the underlying distributions of the risk variables.

8.4 Simulation Results

Using the Crystal Ball Software (Decisioneering Inc., 2005), a total of 10,000 simulations are run in order to estimate the NPVs and ADSCRs for the operator and the smallholder farmers. The base case simulations are carried out using the assumption that any risks that are likely to affect the cash flows or benefits pre- and post- farm gate are borne by each party under a constraint that does not allow any party to shoulder a greater share of the risk for the benefit of the others. In this scenario, there are no restrictions in the model, and therefore the transmitting mechanism for risks will be the share of the farm-gate price and the level of volumes of the paprika crop produced. Unlike the base case outcomes above, the outputs of the simulation are distributions of the NPVs and ADSCRs. Table 36 shows the means, the standard deviations and the probabilities of default for the distributions of the ADSCRs and the NPVs.

The mean, standard deviation and probabilities of the distributions of the NPVs (Table 37) are based on the assumption that the scheme will survive the year-to-year fluctuation in the net cash flow of each party concerned. However, the viability of the scheme on an annual basis is dependent on the ability of both the operator and the smallholder farmers to honor debt obligations. Analyzing the distributions of the ADSCRs is therefore central to the commercial and long-term sustainability of the value chain for paprika as a non-traditional export.

Table 37: Summary of simulation results

	Column	1	2	3	4	5	6	7	8	9
	Year	**2013**	**2014**	**2015**	**2016**	**2017**	**2020**	**2021**	**2022**	**FNPV**
Operator		**ADSCRs**								
1	Base case	1.23	1.62	1.88	2.06	2.1	2.45	2.59	2.72	101.5
2	Mean	1.11	1.53	1.79	1.96	2.01	2.35	2.48	2.6	101.4
3	Median	1.1	1.51	1.75	1.92	1.97	2.27	2.39	2.51	100.3
4	Standard deviation	0.69	0.64	0.65	0.67	0.67	0.84	0.94	1.02	22
5	Prob. ADSCR<1	0.45	0.19	0.1	0.1	0.05	0.03	0.04	0.04	
Smallholder farmers		**ADSCRs**								
6	Base case	1.65	1.08	1.1	1.24	1.24	1.51	1.67	1.81	104
7	Mean	1.81	1.12	1.12	1.24	1.24	1.5	1.66	1.81	100
8	Median	1.61	1.01	1.03	1.14	1.15	1.4	1.55	1.67	99
9	Standard deviation	0.96	0.57	0.52	0.54	0.53	0.65	0.72	0.8	12
10	Prob. ADSCR<1	0.21	0.49	0.48	0.39	0.37	0.23	0.18	0.14	

The means of the ADSCRs lie only slightly below the deterministic base case ratios. This observation is to be expected, since the base model is constructed based on the average values of the input assumptions. From Table 37, it can be seen that the standard deviation of the operator's ADSCRs increases over time from 0.69x to 1.20x, indicating that the riskiness of the cash flow increases steadily over the life of the operation. The volatility in the cash flows increases with time, despite the low ADSCRs seen in the earlier periods when the operator's cash flows are highly stressed owing to its on-going investment. In Figure 1, we plot bounds of two standard deviations below and above the base ADSCRs.

The lower bound of two standard deviations below the mean has a value for the ADSCR below 0.0x (in 2013) and a maximum of 0.87x. The upper bound of two standard deviations above the mean is consistently above 2.50x over the life of the operation. Figure 2 presents the probability of default, which in this case is the measure of the chance that the ADSCRs will fall below the threshold of 1.00x. While the earlier years are characterized by potential low ADSCRs with low threshold margins above 1.00x and low standard deviations, the likelihood of default on the loans to the bank in these early years is relatively higher. The probability of default significantly decreases over the life span of the operations, despite the increase in variability over the same period.

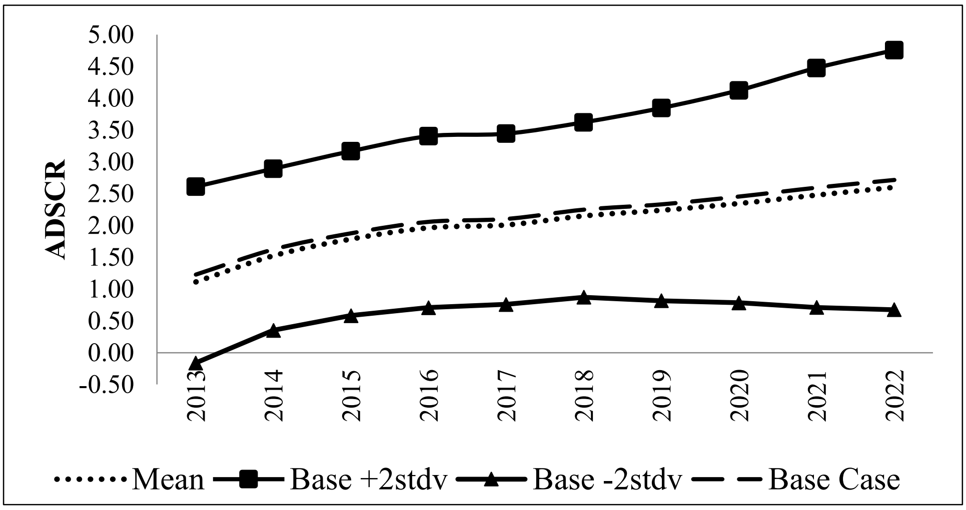

Figure 1: Summary of the Statistics for The Distributions of ADSCRs for the Operator

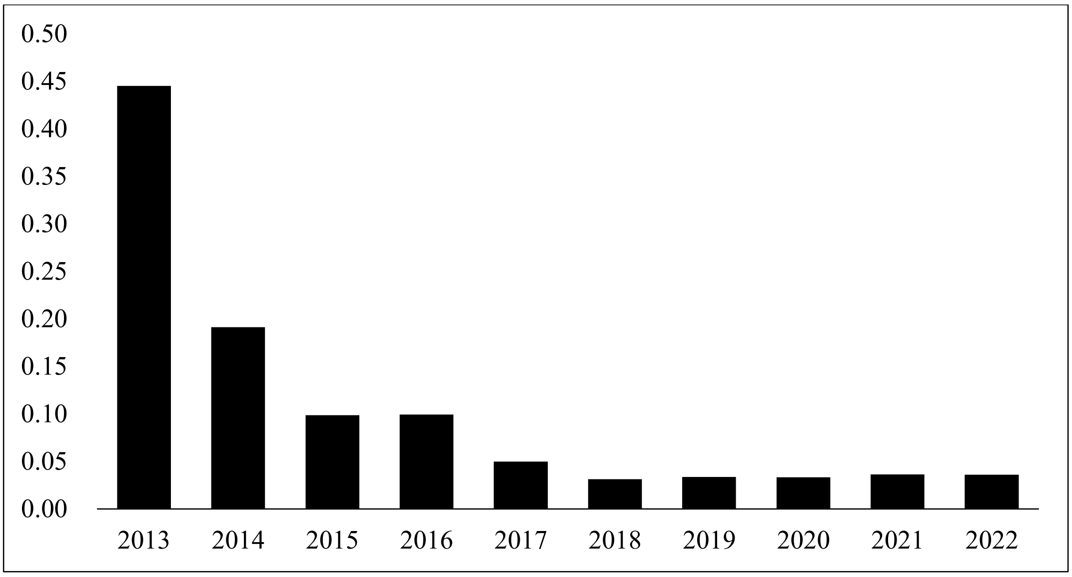

Figure 2: Probabilities of Loan Default for Operator

The statistics for the simulations for the smallholder farmers are presented in Table 37 and summarized in Figure 3. From Table 35, the expected values of the ADSCRs and the NPVs are again close to the base case results.

The profile of the statistics for the distribution of the ADSCRs for the smallholder farmers are shown in Figure 3. The projections of the ADSCRs for two standard deviations below and above the base ADSCRs clearly indicate a high downside risk with ADSCRs that are persistently below 1.0x over the operating period of the scheme. The ADSCRs that are two standard deviations below the mean have a minimum ratio of 0.0x with a maximum value of only 0.22x. These values are significantly lower than those observed in the case of the operator, which indicates that for the same level of duress, the smallholder farmers experience more risk. This is also evidenced by the standard deviation values of the ADSCRs for the smallholder farmers that have a minimum of 0.52x and maximum of 0.96x (Table 37).

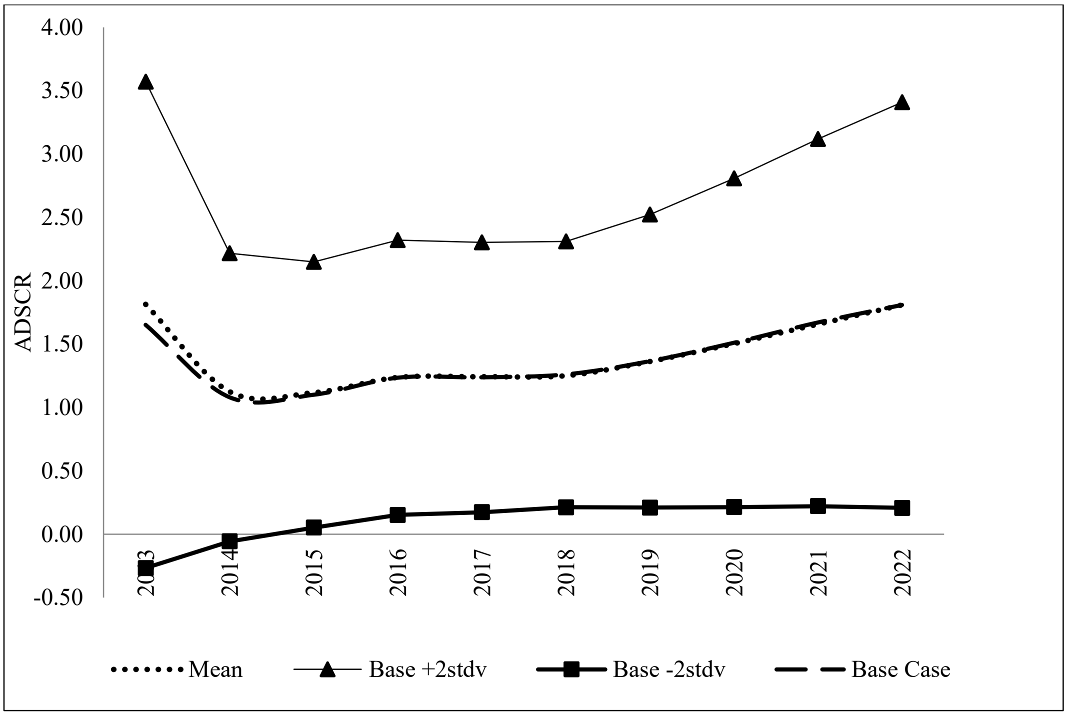

Figure 3: Statistics of Distributions of ADSCRs for Smallholder Farmers

The upside remains above 2.00x, and steadily increases over the life of the project. The probabilities of default (Figure 4) for the smallholder farmers are highest in the early years, when the smallholder farmers are making their investments, but decrease gradually from 2014. Despite this decrease during the operating period, the probabilities of default remain consistently high. In 2014, when the ratio is lowest, the probability of default is 0.49. The average probability of default stands at 0.30, which confirms a huge downside risk that the ADSCRs are likely to be below the threshold level of 1.00x.

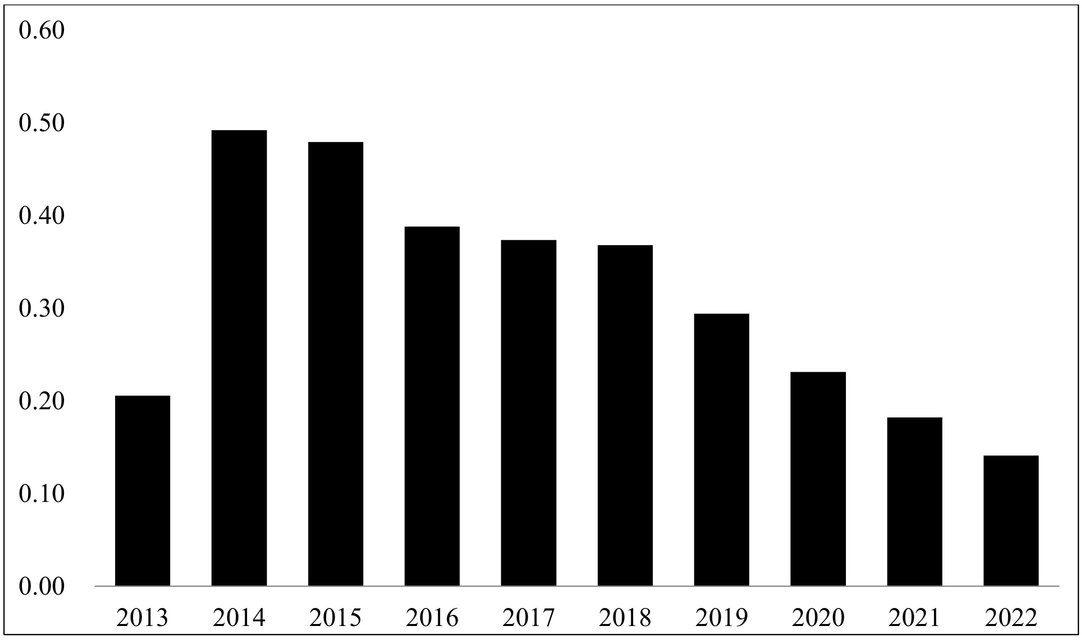

Figure 4: Probabilities of Loan Default for Smallholder Farmers

Based on the five main assumptions identified from the sensitivity testing process, the risk analysis indicates that the variability and uncertainty in the key risk variables are likely to alter the perception of the attractiveness of the outgrower operation. Despite the promising potential for the operator and the smallholder farmers, there is an inherent downside risk that the benefits of the deterministic case cannot be realized. The results show that the downside risks are so large that it is likely that the operator will not be liquid enough to meet its loan obligations. The volatility of the results is even greater for the smallholder farmers' cash flows. This casts a significant shadow on the veracity of the deterministic outcomes of the outgrower arrangement.

This analysis points to the inherent liquidity problems that arise when financing such a scheme so heavily through commercial loan finance. Even in this case the terms of the loan are based on those offered to a commercial business operator, not the typical high cost of credit that is available to smallholder farmers. Serious repayment problems are likely to arise even if the overall activity is expected to yield a positive NPV.

As part of the simulation results, we compare the contribution to the overall variation of the five risk variables. The Tornado charts for the ADSCRs for the operator (2014) and smallholder farmers (2013) are shown in Figure 5. The years 2014 and 2013 are selected because they have the lowest ratios for the operator and smallholder farmers respectively and are the years that are affected by the downside risk first. Moreover, 2013 has the highest standard deviation for the smallholder farmers.

The variability in ADSCR for the operator is largely explained by fluctuations in the real export price. The variability of the real exchange rate tends to affect the smallholder farmers most. Similar charts (not presented) obtained for the ADSCRs in other years consistently show that the contribution to variability is largely explained by the real export price and real exchange rate variability. The yield rate ranks third as a major contributor to variability. This is not surprising given the difficulty that the Zambian government has had over time in managing the exchange rate. Fluctuations in the price of Zambia's major export, copper, and the country's weak macroeconomic management have created wide fluctuations in the real kwacha/dollar exchange rate.

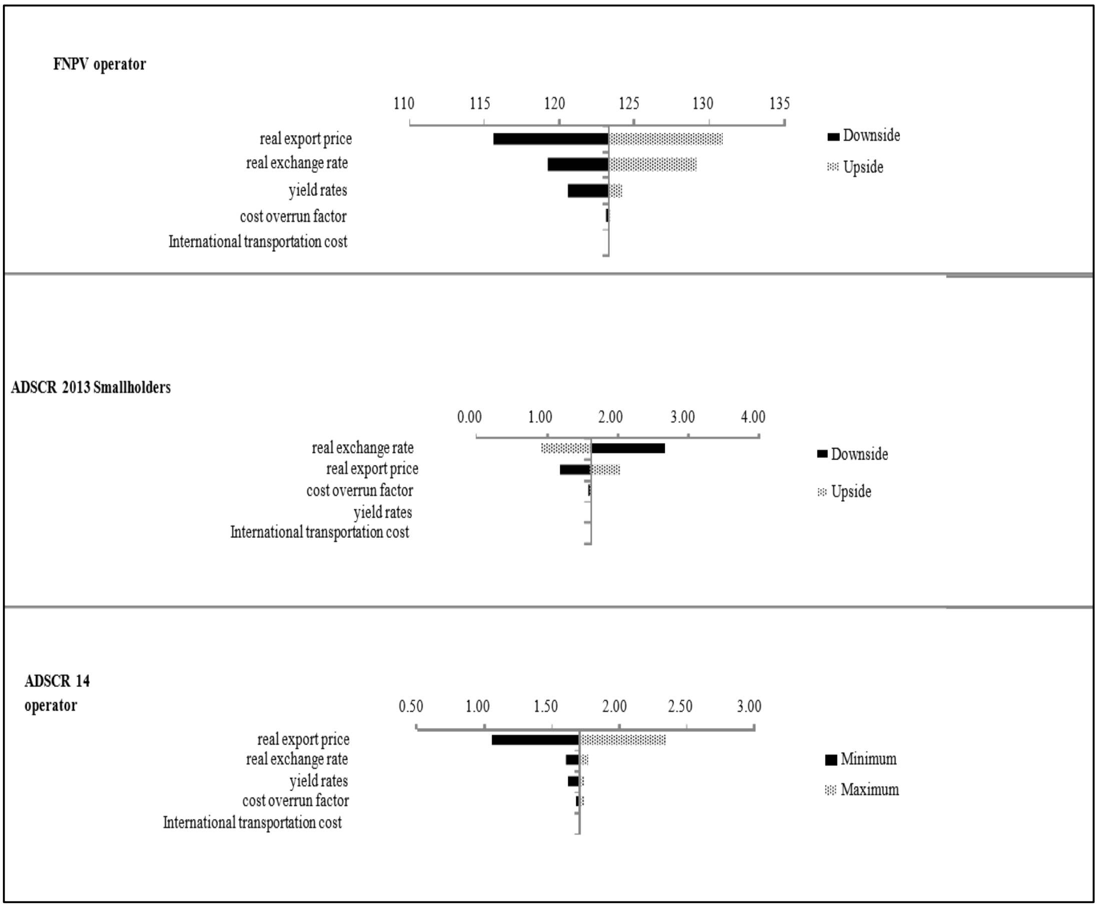

Figure 5: Tornado Charts of Contribution to Variability

Chapter 9

CONCLUSION

The analysis carried out in this paper identifies the dangers of designing an export crop program in a country without the relevant risk mitigation policy measures in place. The ability of the overall scheme to manage the wide year-to-year fluctuations of the net cash flows is critical for the continued participation of the smallholder farmers as well as the financial survival of the operator.

The results of our deterministic analysis indicate that both the operator and the smallholder could benefit from exporting paprika to international markets. This is substantiated by the Monte Carlo risk analysis that generates an expected financial net present value that is very close to the deterministic case. Each of the stakeholders appears to be able to earn a very attractive return on their investment as well as generate cash flows that are sufficient to repay their loan obligations. These conclusions are similar to the previous studies that are reported in the literature on paprika and similar crops (Langmead 2005).

However, risk simulation results reveal that as the project is now structured both the operator and the smallholder farmers are likely to experience huge downside risks arising from short term liquidity problems that could erode the outgrower scheme's long-term sustainability. The level of downside risk is higher for the smallholder farmers than for the operator. The cash flow constraint faced by the farmer arises to a large degree by the need to repay the loan each year after harvesting irrespective of farm gate price or the output. On the upside, there is a potential to generate outcomes that are even significantly higher than the base case and shows that the outgrower scheme has the potential to provide huge benefits for both the operator and the smallholder farmers. Given the strong expected return over time for both the smallholder as well as the operator a more flexible arrangement for the financing of the working capital needs of the smallholders is required. The difficulty is created by the inability of the smallholder in some years to repay their loan when the price is low. This can arise if either the international price of paprika is low or the local currency is temporarily overvalued. This is likely to prevent the smallholders from obtaining working capital of inputs in the next year and hence they are likely to exit the scheme. Perhaps if the working capital were being given in-kind by the operator to the smallholder and financed by the operator's equity a more satisfactory outcome might be possible. In this way the return to the operator in the good years could be used to offset the lean years and hence a higher degree of sustainability could be achieved. As paprika is not consumed locally in significant amounts the problem of side selling in years when the international price is high may not be a critical problem.

The analysis also indicates that the major sources of risk are likely to be the variability in the real export price, the real exchange rate and yield rates. Yield rate fluctuations can largely be controlled through the expansion of the proportion of the total area of the scheme under irrigation. Hence, public investment policies need to be coordinated with export promotion initiatives so that there is an appropriate degree of irrigation available when the scheme starts up. Appraisals of such irrigation investments should take into consideration both the impact of irrigation on crop yields and the reduction of the variability of the cash flows accruing to the farmers and operator, which will enhance sustainability. Second, in order to lower the burden of loan financing on the scheme, such irrigation facilities might be financed as part of the public investment program of the country, with perhaps the amortization of the facilities carried over a period of time that is longer than normal commercial loans and paid for through water user fees charged to the farmers. In this way the overall debt burden and the rigid debt service obligations facing the smallholder could be reduced and the risk of default also reduced.

Third, policies should be in place at the macroeconomic level to help mitigate sharp fluctuations in the real exchange rates. For example, better sterilization of the spikes in foreign exchange revenues in Zambia would reduce the risks facing the smallholders and operators engaged in non-traditional export crops. As Zambia is a major copper producer, government has set up a revenue stabilization fund that invests some of the additional revenues during periods of high copper prices in order to mitigate fluctuations in the real exchange rates. If Zambia wishes to expand its non-traditional agricultural exports, then it must increase the effectiveness of its macroeconomic stabilization policies in order to stabilize its exchange rate.

The integrated model of analysis demonstrates the critical role that institutional infrastructure such as supportive government policies can play in ensuring the long-term sustainability of new export crops. This conclusion is in line with those found in the recent economic growth literature that stresses the importance of developing institutional capacity for enabling production of more complex exports that would lead to better prospects for economic growth (Hausmann et al., 2011). Unless key public sector investment and macroeconomic management policies are put in place to mitigate the risks of such agriculture export initiatives, the sustainability of such potentially poverty reduction programs is in jeopardy.

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