A financial cost-benefit analysis of the implementation of a small-camp system in ostrich farming to allow veld restoration

by

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DECLARATION

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ABSTRACT

Before the ostrich industry started in the Klein Karoo region of South Africa in 1863, the veld was used mainly for large and small stock production. Returns per hectare (ha) from large and small stock production are low due to the low carrying capacity of the veld in this region. However, when the veld is utilised predominantly to provide space for breeding ostriches sustained mainly by lucerne-based feed supplements, the limited-feed production capacity no longer determines the long-term stocking rate. The returns, per ha, from ostrich production can therefore be much higher than from sheep, goats and cattle. This has resulted in high ostrich stocking rates, which in turn, has caused degradation to most of the veld to a greater or lesser extent. Driven by a personal conviction to manage the veld sustainably, as well as by a fear of environmental damage connotations for ostrich leather products, which could restrict market access, ostrich farmers in the Klein Karoo, represented by the South African Ostrich Business Chamber (SAOBC), increasingly place an emphasis on veld restoration.

The various phases of ostrich production are breeding and hatching eggs to produce day-old chicks, rearing chicks, raising birds, and the final phase of weight addition to slaughter. The phase that is considered in this study is the production of day-old chicks. There are two systems that can be used for producing day-old ostrich chicks, namely, the flock breeding system and the small-camp system. Shifting from the flock breeding system to the small-camp system will enable the farmer to practice genetic selection. This switch from the flock breeding system to the small-camp system requires the farmer to invest in fencing material.

The SAOBC requested a study to determine whether the expected private benefits from moving breeding ostriches to small camps in order to free up the large veld camps for veld restoration would justify investing in these small camps. If this investment is not financially justified, the veld restoration will have to be financed via payment for ecosystem services.

Both passive and active veld restoration techniques are considered in this study. Passive restoration requires the farmer to invest in fencing material needed for the erection of the small camps. Active restoration requires the farmer to invest not only in fencing material, but also in soil manipulation and seeding.

The main aim of this study is to find out if the private (financial) benefits from the switch to small camps can compensate for fencing costs, without the cost of active restoration, or if the switch to small camps can compensate for fencing costs with the cost of active restoration. Typical farm models were developed for this purpose, and the results showed that the private benefits compensate for the investment cost of fencing material used for passive restoration as well as for restoration of 10% of the veld that is heavily degraded. When the full cost of active restoration of the moderately degraded veld (30%) was added, the private benefits could not compensate for the full restoration cost.

OPSOMMING

Voordat die volstruisbedryf in 1863 in die Klein Karoo ontstaan het, is die veld hoofsaaklik gebruik vir groot- en kleinveeproduksie. Die wins per hektaar van groot- en kleinvee produksie in hierdie streek is laag weens die lae drakrag van veld. Wanneer die veld egter primêr aangewend word vir ruimte vir volstruise wat met lusern gebaseerde rantsoene gevoer word, bepaal die natuurlike drakrag nie meer die belading met volstruise oor die langer termyn nie. Die wins per hektaar uit volstruisboerdery kan dus veel hoër wees as wat met skape, bokke of beeste gegenereer kan word. Dit het hoë belading met volstruise tot gevolg gehad wat vernieling van meeste van die veld tot gevolg gehad het. Gedryf deur persoonlike oortuiging om die veld volhoubaar te benut, sowel as deur vrees dat die vernielde veld die beeld van die volstruisbedryf mag skaad en internasionle marktoegang mag belemmer, het volstruisprodusente in die Klein Karoo, verteenwoordig deur die Suid-Afrikaanse Volstruisbesigheidskamer (SAVBK), toenemend klem begin plaas op veldrestorasie.

Die verskillende fases van volstruisproduksie sluit in teling en uitbroei van eiers om dagoud kuikens te lewer, kuikens grootmaak, voëls grootmaak en massa toename tot by slag. Die verskillende fases word dikwels deur verskillende produsente behartig. Die fase waarop in hierdie ondersoek gefokus word is die produksie van dagoud kuikens. Daar bestaan twee stelsels vir die produksie van dagoud kuikens, naamlik tropparing en die kleinkamp stelsel. Die oorskakeling van tropparing na die kleinkamp stelsel stel die produsent in staat om genetiese seleksie toe te pas, maar dit verg investering in omheiningsmateriaal.

Die SAVBK het ‘n ondersoek aangevra om te bepaal of die verwagte privaat voordele wat verkry kan word uit die oorskakeling na die kleinkamp stelsel om veldrestorasie moontlik te maak, die investering in die kleinkampe sal regverdig. Indien die investering nie finansieel geregverdig kan word nie, sal verder gekyk moet word na finansiering vanuit betaling vir ekostelsel dienste wat moontlik bevorder kan word deur die veldrestorasie. Die koste van beide passiewe en aktiewe veldrestorasie tegnieke word in hierdie ondersoek gedek. Passiewe restorasie vereis alleen van die produsent om te investeer in omheiningsmateriaal vir kleinkampe. Aktiewe restorasie vereis investering in omheiningsmateriaal vir kleinkampe en betaling vir grondmanipulasie en saad vir die hervestiging van plante.

Die doel van die ondersoek is om te bepaal of die privaat (finansiële) voordele van die oorskakeling na kleinkampe kan kompenseer vir die investering in omheiningsmateriaal met aktiewe veldrestorasie en sonder aktiewe veldrestorasie (dus passiewe restorasie). Tipiese plaasmodelle is hiervoor ontwikkel. Die resultate toon dat die privaat voordele wel kan kompenseer vir die omheiningskoste van kleinkampe benodig vir passiewe restorasie en vir aktiewe restorasie van 10% van die veld wat die meeste verniel is. Wanneer die koste van restorasie van 30% van die veld wat matig verniel is, bygevoeg word, is die privaat voordele ontoereikend om die totale restorasiekoste te dek.

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ABBREVIATIONS

BCR	Benefit Cost Ratio
CARA	Conservation of Agricultural Resources Act
IRR	Internal rate of return
KKC	Klein Karoo Cooperation
LSU	Large Stock Unit
NAMC	National Agricultural Marketing Council
NOPSA	National Ostrich Processors Organisation of South Africa
NPV	Net present value
SAOBC	South African Ostrich Business Chamber
SAOPO	South African Ostrich Producers Organisation
SCOT	South Cape Ostrich Tanning

1 INTRODUCTION

The ostrich industry began in 1863 when the farmers in the Little Karoo started farming tamed ostriches. Before ostrich production took place in the Little Karoo, the veld was mainly used for large and small stock farming (Thompson et al., 2009:587). This area has a low carrying capacity; hence, the returns per hectare from livestock (cattle, sheep) production are low. This prompted farmers to venture into ostrich production, where the returns per surface area are relatively higher. The phases of ostrich production are breeding, rearing birds, and the final phase, weight addition to slaughter, which are mostly performed by different producers. The phase considered in this study is the production of eggs by breeding birds and hatching of the eggs to produce day-old chicks.

Traditionally, farmers used the flock breeding system to produce eggs in the veld. The veld provides mainly space, and contributes a limited share of the total feed intake of the ostriches, which live mainly off lucerne-based feed rations. As the ostriches do not depend on the grazing capacity of the veld, as in the case of other livestock, producers tend to stock their veld at rates far exceeding the prescribed stocking rate of 22.8 ha per ostrich for the flock breeding system (Cupido, 2005:12; Murray, 2008:5). Input prices rising faster than the prices of ostrich products is a major motivation for overstocking the veld. The resultant degradation of the veld, more due to trampling rather than overgrazing, can clearly be seen. Loss of biodiversity, the reduction in ground cover and deepening dongas, mainly in footpaths near camp fences, are growing problems justifying serious attention.

There are various restoration techniques that can be used, and these have different costs. The first restoration technique considered in this study is removing the birds from the veld, putting them in small camps and letting the veld recover on its own (hereafter referred to as passive restoration). The second restoration technique considered involves removing the ostriches from the veld to small camps and then thereafter undertaking soil manipulation and seeding (hereafter referred to as active restoration).

With the small-camp system, the breeding trios are kept in fenced camps of 0.25 ha each. The concentration of breeding birds causes the natural veld in the small camps to be completely destroyed, but as the small camps occupy only a small part of the farm, the veld on the rest of the farm is left to recover. Two percent of the total farm area to be sacrificed to small camps is accepted as a general guideline. This implies the sacrifice of a small part of the farm under small camps and restoration of the remainder of the veld supported by greater or lesser restoration efforts. However, this switch from the flock breeding system to the small-camp system requires the farmer to invest in fencing material.

1.1 Problem statement

There is a need to restore the natural vegetation to the state it was in before ostrich production started. Therefore, there is a need to switch from the flock breeding system to the small-camp system in order to allow the larger part of the veld to be restored. The small-camp system presents an opportunity for higher productivity and higher income. However, this switch requires the farmer to invest in fencing material. The intention with this research study was to determine whether private (financial) benefits from the switch to small camps could compensate for fencing costs without the cost of active restoration (only passive veld restoration), or for fencing costs with the cost of active restoration.

1.2 The hypotheses

1.2.1 The private benefits of the small-camp system will exceed the cost of switching to the small-camp system with no veld restoration costs added (passive restoration).

1.2.2 The private benefits of the small-camp system will exceed the cost of switching to the small-camp system with veld restoration costs added (active restoration).

1.3 Justification for the study

Human beings enjoy the benefits of ecosystem services, even though these ecosystem services are not reflected in market transactions. Policy makers base their decisions on economic and non-economic analyses. Hence, identification and quantification of the benefits and costs of restoration projects give policy makers the information they need to rank the efficiency of public projects (Holmes et al., 2004:20). This study could be useful in justifying the benefits of restoring degraded land, and this could help to generate a better and more comprehensive information base for the policy formulation and decision-making process. Such policies could become essential in the conservation of ecosystems, as people are becoming increasingly willing to conserve ecosystems.

A financial analysis of the costs and benefits of a rehabilitation programme from the point of view of a private landowner is critical in any rehabilitation programme (Herling et al., 2009:9). If the financial analysis proves that the rehabilitation programme is financially feasible at a farm level, this implies less dependence on benefits from ecosystem services and payment for these services on a larger scale.

1.4 Assumptions

- It is assumed that the prices of inputs and outputs will be affected by approximately the same inflation rate; hence, constant prices are used in the cash flow analysis.
- It is assumed that the main goal of farmers is to maximise profit. Whether farmers would be willing to use some of their profits from ostrich farming on active veld restoration would mainly be determined by moral obligation. The main intention with this study is to determine whether the small-camp system can deliver (more) profits, some of which could be spent on active veld restoration.
- It may be that some farmers keep (some) chicks for weight gain but the associated income and costs are kept separate from that of the breeding operation.

1.5 Delimitation

- The only phase of ostrich production investigated in this study is the breeding phase, i.e. from breeding up to the point of day-old chicks.

1.6 Definition of terms

- **Restoration:**

This is the process of returning a degraded system to its original state prior to the disturbance (Lubke & Avis, 1998:548).

- **Degradation:**

Degradation refers to the steady alteration of ecological integrity and health (Society for Ecological Restoration, 2004:5).

- **Ecosystem:**

An ecosystem is made up of plants, animals, and microorganisms in a certain area, the environment that sustains them, and their relations (Society for Ecological Restoration, 2004:4).

- **Ecosystem services:**

These are the benefits human beings enjoy from natural ecosystem functions (Chee, 2004:549).

- **Biodiversity:**

Biodiversity refers to the total collection of organisms within a certain geographic area in terms of taxonomic and genetic diversity, all the forms of life present within that place, and all the ecological roles carried out (Society for Ecological Restoration, 2004:6).

- **Financial analysis:**

Financial analysis is a method undertaken to access whether a proposed project is viable to the firm or enterprise implementing the project (Perkins, 1994:3).

- **Cost-benefit analysis:**

This is a technique used to evaluate the costs and benefits of a certain project to a society over a given time period (Ward, 2006:93).

1.7 Structure of the thesis

The first chapter presents an introduction to the current situation in the respective areas of study. The problem statement, hypothesis, justification for the study, assumptions, delimitations and definition of terms are also presented in the first chapter. The second chapter presents the background to the South African ostrich industry. Chapter Three describes the extent to which the veld around Oudtshoorn is degraded. The costs of restoring the different classes of degraded veld are also given in this chapter. Chapter Four provides a review of the literature on approaches to farm modelling. Chapter Five presents the research methodology used in the study. Chapter Six presents the results of the study. Chapter Seven states the conclusions based on the research findings and the summary of the study.

2 BACKGROUND TO THE SOUTH AFRICAN OSTRICH INDUSTRY

2.1 Introduction

This chapter provides background information on the South African ostrich industry. The impacts of the flock breeding system on the veld are outlined in this chapter. The costs and benefits of the flock breeding system and the small-camp system are also discussed.

2.2 Historical background to the South African ostrich industry

South Africa started exporting ostrich feathers to Europe in 1838. As a result of the high demand for ostrich feathers due to the fashion market, the taming and breeding of ostriches led to a decline in the numbers of wild ostriches. Thus, the ostrich industry became established around 1863, with the introduction of wire fencing, lucerne production and the invention of the incubator in 1869. The incubator stimulated ostrich farming to such an extent that from 1870 ostrich farming became a very profitable business (NAMC, 2003:14). In 1882 ostrich feathers were South Africa's most valuable export product after gold, diamonds and wool (Oudtshoorn Municipality, 2005:14; Murray, 2007:4).

In 1914, there were about one million ostriches in South Africa. World War I, changing fashion, over-production of feathers and disorganised marketing led to the collapse of the South African ostrich industry. By 1930 the number of ostriches plunged from about 770 000 to 23 000, but the world population started increasing after World War II (Murray, 2007:4), and from then onwards ostrich breeding, raising and marketing also become an active industry in other parts of the world such as the US, Australia, Canada, China, Philippines and Israel (Oudtshoorn Municipality, 2005:14). Other historical developments worth noting include the establishment of the one-channel marketing system in 1959, the first ostrich abattoir in 1964, a tannery that started functioning in 1970, and the deregulation of the industry in 1993 (Murray, 2007:4).

About 50% of the total number of ostriches in South Africa are located in the Oudtshoorn district. Roughly 10% are found in the rest of the Western Cape; 34% in the Eastern Cape; and 6% in other provinces (Oudtshoorn Municipality, 2005:14-15). Most of the farmers in Oudtshoorn produce ostriches, with about 150 000 to 200 000 ostriches being reared on 500 farms. The agricultural sector of Oudtshoorn is biased towards the export market; this can be attributed to the large volumes of processed ostrich products produced and the large volumes of seeds produced in this area, which are exported. Approximately 70% of the agricultural income in Oudtshoorn is directly (seed) or indirectly (ostrich production through processed ostrich exports) export oriented. About 24% of total output in Oudtshoorn (75% from agriculture and 86% from manufacturing) comes from the ostrich industry. For the period 1998 to 2004, it is approximated that the ostriches:seed:other ratio of income from farming activities was in the region of 75:23:2 (Outdshoorn Municipality, 2005:14-15). In Oudtshoorn, the agricultural sector directly provides 21% of all employment and indirectly contributes greatly to other employment in areas such as wholesale, retail, transport and commercial services, if one takes into account the multiplier effect of the agricultural economy within Oudtshoorn (Murray, 2008:10).

The Klein Karoo Corporation (KKC) is based in Oudtshoorn, and it generates nearly 70% of its total income from ostrich processing. The KKC belongs to 1300 farmers and is responsible for the first stages of ostrich processing, namely, slaughtering, feather processing, and leather manufacturing. Although the KCC performs those functions, some farmers perform the ostrich processing (e.g. egg decoration, manufacturing feather dusters and producing leather products) themselves (Oudtshoorn Municipality, 2005:15).

2.3 Structure of the South African ostrich industry

In 1998 the South African Ostrich Business Chamber (SAOBC) was formed. The SAOBC represents the ostrich farmers in Oudtshoorn and the other parts of the country. It is seen as an umbrella body for the ostrich industry, as it is made up of producers, represented by the South African Ostrich Producers Organisation (SAOPO), and processors, represented by the National Ostrich Processors Organisation of South Africa (NOPSA) (Oudtshoorn Municipality, 2005:15). Ostrich producers are members of the ostrich producing provincial organisations of their respective provinces. The provincial organisations are affiliated to SAOPO. NOPSA represents the processors, that is, the ostrich abattoirs and ostrich leather tanneries. (NAMC, 2003:3).

The NAMC (2003:19) points out that the main aim of the SAOBC is to make the ostrich industry sustainable and economically viable through the collaboration of stakeholders. Other objectives of the SAOBC include:

- to support, organise, manage and look after the interests of all the duly registered businesses involved in the production and processing of ostriches and ostrich products;
- to promote the know-how of production;
- to uphold good relations between the stakeholders in the industry;
- to help in the creation of an international environment conducive to export;
- to influence any proposed legislation;
- to offer a communication channel; and
- to start strategic research.

Seven provinces are members of the South African Ostrich Producers' Organisation (SAOPO). Most South African ostrich producers are members of their respective provincial ostrich producer organisations. About 77% of the registered export farms are situated in the Western Cape Province, followed by the Eastern Cape Province with 17% of registered ostrich export farms, and the other provinces with 6%. The objectives of SAOPO are as follows (NAMC, 2003:21-22):

- to be the voice of ostrich producers of South Africa;
- to promote collaboration among ostrich producers;
- to support lines of production of ostriches and ostrich products that are profitable;
- to support the organised marketing of ostriches and ostrich products;
- to promote collaboration between ostrich producers and other role-players in the ostrich value chain;
- to mediate with counterparts in other ostrich-producing countries; and
- to communicate with governmental institutions.

NOPSA promotes the interests and efforts of processors. Member organisations of NOPSA include Camdeboo Meat Processors Ltd (Camexo), Exotan (Camexo), Grahamstown Ostrich Abattoir, Klein Karoo International (Pty) Ltd, Gondwana Marketing (Oryx Game and Ostrich Abattoir), Mosstrich, Oasis Tanning, Ostrimark SA (Pty) Ltd, Philippe Genuine Ostrich Products, Rancho Las Plumas, South Cape Ostrich Tanning (SCOT), Swartland Volstruise and IMPEC (NOPSA, 2004:1). NOPSA was formed in 1995 and it has 21 members. The objectives of NOPSA include (NAMC, 2003:21):

- to promote the interests of the ostrich processing industry in South Africa;
- to liaise with government (in collaboration with the SAOBC), to manage any issues directly or indirectly affecting the affairs of the ostrich-processing industry;
- to gather and distribute market information and statistics;
- to provide a platform for regular dialogue among its members: and
- to promote ostrich products through advertising and marketing assistance.

2.4 Production

In 2002, world production of slaughter ostriches was approximately 560 000, with South Africa accounting for 340 000 ostriches. In 1997, the number of ostriches slaughtered in South Africa was more than 300 000 for the first time, and this led to a global surplus of ostrich leather, a dropping of leather prices and the unavoidable liquidation of a number of farmers (NAMC, 2003:3-27). It is estimated that between 1999 and 2000, the number of ostriches slaughtered declined to 240 000 per annum, but increased during 2001 and 2002 to more than 300 000 ostriches per annum. In 2002, there were about 588 registered export farms, and of these farms, 453 were in the Western Cape Province, 102 in the Eastern Province and 33 farms in the rest of the country. In 2002, about 340 000 birds were slaughtered (NAMC, 2003:3-27). In the 2005/06 season, the number of slaughtered birds declined to 257 000 ostriches as a result of the outbreak of Avian Influenza that led to an export ban that lasted 15 months. It is estimated that about 222 000 birds were slaughtered in South Africa for the 2008/09 season (Department of Agriculture, Forestry and Fisheries, 2010:64).

The increase in the number of ostriches has a negative effect on the veld if the veld is overstocked. The overstocking of ostriches results mainly from farmers aiming to maximise their profits, yet these profits come at the expense of the veld.

Approximately 75% of output originates from the Western Cape, with the Klein Karoo dominating production. At least 65% of the world's ostriches are found in South Africa. South Africa contributes 90% of ostrich products traded internationally, with these contributing R1.2 billion per annum to the South African economy (SAOBC, 2004:1). In South Africa, ostrich production is in the top twenty of the agro-based industries, and it is highly ranked for exports. The total investment in ostrich production and processing activities (not including value adding manufacturing, businesses and tourism) is more than R2.1 billion (SAOBC, 2004:1). There are about 1 040 ostrich farms in South Africa. However, there is a belief within some quarters of the ostrich industry that this figure relates to 'production units' rather than numbers of farmers. The number of farms stated above refers to the total number of producers in all the different stages of the ostrich industry (Murray, 2007:5-6). As the Klein Karoo dominates in terms of ostrich production, it follows that negative publicity concerning veld degradation will have a major detrimental impact on the image of the South African ostrich industry

As stated previously, main emphasis in this study is on the breeding and production phase of day-old ostrich chicks. It is mainly the breeding phase in ostrich farming that has the biggest impact on the quality of the veld.

2.5 Marketing

South Africa is the leading country in terms of international ostrich trade, with about 80% of the ostrich products traded globally coming from South Africa. Leather products comprise 65% of the value of South Africa's ostrich output, with meat comprising 30% and feathers comprising 5% (Murray, 2007:7). South Africa's major competitors for finished products are Namibia and Zimbabwe. Other competitors are Mexico and Korea, with the low production costs of their tanning industries, and Brazil and China, whose governments subsidise their ostrich industries (Murray, 2007:7).

Japan and the USA are the main markets for high-value leather products, while lower value products are mainly exported to Mexico and China. For many years, meat was regarded as a by-product of ostrich processing in South African (Murray, 2007:7). In 1993, ostrich meat contributed 15% of the total income from a slaughter bird, compared to 30% in 2009. South Africa exports 35% of its meat to Belgium and Holland, 20% to Switzerland, 15% to France, and 12% to Asia. Mosstrich and the KKC are the two main marketing channels available to producers (Murray, 2007:7).

Consumers (especially high-income buyers) are becoming more sensitive to the negative environmental impacts of production processes. Much attention has been paid to environmental issues in recent years, reflecting public concern and environmental awareness (Wagner, 2003:1). There is significant evidence that most western markets have been affected by so-called 'green' consumer behaviour, that is, behaviour that shows concern about the effects of production and consumption on the natural environment. Over the past decade, many companies have felt the impact of consumers who are concerned about the environment, and their boycotting behaviour, resulting from media reporting and pressure group activity (Wagner, 2003:1).

It is estimated that up to 70% of consumers have occasionally considered environmental issues in their shopping behaviour. Surveys of the behaviour of consumers concerned about the environment show that the number of consumers who include environmentally oriented considerations in their buying decisions has been relatively stable (Wagner, 2003:1). About 10% of British consumers are said to have constantly included environmental issues in their buying behaviour. In other markets such as the USA, Canada, Germany, the Netherlands or the Scandinavian countries, the market segment of highly committed green consumers may be somewhat bigger (Wagner, 2003:1).

Driven by the personal conviction to manage their veld sustainably, as well as by a fear of environmental damage connotations for ostrich leather products, which may restrict market access, ostrich farmers in the Klein Karoo, represented by the SAOBC, now place more emphasis on veld restoration. Restoring the veld will prevent damage to the image of the product. With so many environmental issues receiving attention in Europe, where South Africa markets some of its ostrich products, avoiding veld degradation or restoration of the degraded veld is extremely important if South Africa is to retain its markets in Europe.

2.6 Various ostrich breeding systems

There are various breeding systems in ostrich farming, and each has its own effect on the veld. The production systems include the following (Murray, 2007:5):

- Paired breeding – this is where two breeding females and a male (a trio) are kept in a fenced camp of 0.25 ha. This system makes it possible to keep records and to selectively breed stock. This system is also referred to as the small-camp system.
- Incubator hatching – eggs are collected and artificially hatched.
- Paired breeding, plus incubator – on average 25 chicks per breeding pair (2 females and 1 male) are produced per annum.
- Flock breeding – flocks are kept in extensive camps for breeding purposes. This system has a negative effect on the natural vegetation. This system is also known as the 'tropparing' system.
- Raising of chicks – involves purchasing chicks of different ages and raising them to another stage of growth.

Of main interest in this study are the 'paired breeding' and the 'flock breeding' production systems. These two production systems have different impacts on the veld, and their cost structures and profits differ.

2.7 The flock breeding system

Flock breeding ('tropparing') is a farming practice in which large numbers of breeding birds are kept in a free-range system in the veld. This practice represents the main threat to biodiversity (Gouritz Initiative, 2007:3). About 63% of the farmers in the greater Klein Karoo use the flock breeding system. This is largely due to the lower capital cost of the flock breeding system compared to the small-camp system, and because some farmers perceive there to be higher fertility rates with the flock breeding system than with the small-camp system (Cupido, 2005:57).

The Department of Agriculture prescribes a stocking rate of 22.8 ha per ostrich (Murray, 2008:1). This stocking rate is enforced by Regulations 10 and 11 of the Conservation Agricultural Resources Act (CARA) of 1983. Regulation 11 of CARA states that landowners have a legal obligation to:

> "(restrict) the number of animals, expressed as large stock units, kept on the veld of his/her farm unit to not more than the (…) applicable grazing capacity referred to in Regulation 10 (…), providing that such number may on occasion be exceeded on condition that the average number of animals kept on the veld of the farm unit concerned during a period of 12 months shall not exceed such a number" (Cupido, 2005:78).

At the stocking rate of 22.8 ha per ostrich prescribed by the Department of Agriculture, the farmer will not be able to farm profitably; hence, the farmer ends up overstocking. At the same time, shifting from the flock breeding system to the small-camp system requires capital to erect the small camps (Cupido, 2005:146-147). The substantial capital requirement acts as a disincentive for the farmer to shift from the flock breeding system to the small-camp system, due to having to access the required capital, which may be difficult for some farmers.

The veld used by the farmers is mainly used for space rather than as a source of feed. The breeding birds are normally fed with processed feed. A study by Murray (2008:4-5) was done in the area between Calitzdorp and De Rust. He noted the following:

- Of the ten farmers he interviewed, only two were using the small-camp system (as well as the flock breeding system), and on a small scale relative to their total breeding effort. The pens looked smaller than the stipulated maximum 0.25 ha, and the birds in these pens received a full breeding ration.

- For the farmers practicing the flock breeding system, all the birds in the veld were fed a full breeding ration. Only one farmer alleged that the birds got a maximum of 20% of feed requirements from the veld, while the rest claimed that the birds obtained no feed from the veld.

- For the flock breeding system, the Department of Agriculture recommends three separate large camps for each flock, allowing for a resting period of two seasons following the utilisation of a camp. Only 50% of the farmers used a three-camp system, while 30% used a two-camp system. The remaining 20% of the farmers used a 'no fixed system', that is, the farmers used methods not recommended by the Department of Agriculture (Cupido, 2005:59).

- The Department of Agriculture prescribed a stocking rate of 60 ha per large stock unit (LSU) as a guideline for this region. The prescribed LSU for an adult ostrich is 0.38/LSU. This translates into a commercial ostrich stocking rate of 2.63 ostriches per 60 ha, or 22.8 ha per ostrich. If a three-camp system is used, where ostriches are kept in the camp throughout the year, then the stocking rate can be 7.6 ha per ostrich. However, for a three-camp system where ostriches are kept in a camp for the eight-month breeding period within the year, the stocking rate can be 5 ha per ostrich. The stocking rate analysis shows that 50% of the farmers used the recommended three-camp system and only 50% of the farmers removed the birds from the veld during the four-month rest period in the breeding cycle. The result also shows that the current stocking rate is 8.1 ha per ostrich, which is nearly three times higher than the 22.8 ha per ostrich prescribed by the Department of Agriculture. This means the area is overstocked by 182% (Murray, 2008:4-5).

A study carried out by Cupido (2005:77-109) in the Klein Karoo shows that only 44% of the farmers practice the three-camp system, with only one farmer using a four-camp system. Cupido also noted that the area was overstocked by 68%. Even though the percentage by which the Klein Karoo is overstocked differs from the studies done by Murray and Cupido, it can still be concluded from their studies that the Klein Karoo is overstocked. The sample size used by Murray in his study was small; hence, it may not be necessarily be representative of the whole area, but his findings do give an insight into the situation at the time of these studies. If an area is overstocked, the excess ostriches have to be taken off the veld. This implies that there should be a form of compensation for the loss incurred due to the reduction in the number of ostriches removed from the veld.

2.7.1 Disadvantages and benefits of the flock breeding system

The disadvantage of this system is that it limits the farmer from being able to perform genetic selection of the breeding ostriches (Cupido, 2005:147). This implies that productivity will remain constant over a long period. The farmer runs the risk of keeping non-performing breeding ostriches (‘passengers’). With the flock breeding system, the farmer spends more time as well more money on transport costs during feed distribution and egg collection (Murray, 2008:2).

The main benefit of this method is the smaller amount of fencing material needed; thus, less capital is required (Cupido, 2005:146-147). A secondary benefit, even though this is debatable, is the feed obtained from the veld, and this depends on the condition of the veld (Murray, 2008:7). Murray (2008:9) obtained the gross margin of the flock breeding system from a study in the area between Calitzdorp and De Rust (see Table 1.1).

2.8 Costs and benefits of the small-camp system

About 18% of farmers use the small-camp system (Cupido, 2005:58). A change from the flock breeding system to the small-camp system entails a considerable capital expenditure in fencing material. Even though the small-camp system has a higher capital investment than the flock breeding system, it is still a better method in terms of protecting the veld, since a smaller area of the veld will be exposed to the trampling effects of the ostriches. (Cupido, 2005:84).

Murray (2008:2) points out that the main cost of the small-camp system is the capital cost required for material and labour to build the small camps. The cost of erecting a single 0.25 ha small camp is R5 035. The other cost comes from the feed obtained from the veld, which farmers will lose out on if they switch from the flock breeding system to the small-camp system. This amount of feed obtained from the veld is debatable and depends on the state of the farmer's veld.

The benefits of the small-camp system derive from lower transport costs and the time incurred during feed distribution and collection of eggs (Murray, 2008:2). Another benefit is that farmers are able to keep records and improve the genetic selection of the breeding ostriches, and hence, there will be an increase in productivity (Cupido, 2005:77). The benefits of the small-camp system will likely differ from farmer to farmer, depending on the farmer's management skills.

Table 1.1 Gross margin of the flock breeding system

Income and direct cost items	**Per breeding ostrich (R)**	**Per egg (R)**	**Per chick (R)**	**Per ha veld (R)**
Total value of breeding flock output	**4620.84**	**145.41**	**274.75**	**713.51**
Flock replacement and mortality	203.20	6.79	13.36	31.21
Feed costs	1650.12	55.14	108.50	253.47
Transport (mainly on-farm)	75.55	2.52	4.97	11.60
Veterinary medicines	128.94	4.31	8.48	19.81
Labour	128.52	4.29	8.45	19.74
Other	30.25	1.01	1.99	4.65
Total direct costs	**2216.57**	**74.06**	**145.75**	**340.48**
Gross Margin	**2404.27**	**71.35**	**129.00**	**373.03**

Source: Murray, 2008:9

2.9 Conclusions

This chapter presented background information for the South African ostrich industry in terms of the production and marketing of ostriches. Different ostrich farming methods were presented in this chapter as well as their costs and benefits.

The majority of farmers in the Klein Karoo are practicing the flock breeding system. This system can have a negative impact on the natural vegetation if the veld is overstocked. The small-camp system is an alternative system that offers an opportunity for higher income. However, for farmers to switch from the flock breeding system to the small-camp system, they must invest in fencing material. The next chapter provides information on the extent of veld degradation around Oudtshoorn and the cost of restoring the degraded veld.

3 EXTENT OF VELD DEGRADATION IN OUDTSHOON AND THE COST OF VELD RESTORATION

3.1 Introduction

This chapter provides information on the extent to which the veld around Oudtshoorn is degraded due to overstocking with breeding ostriches kept in flocks on the veld. Thus, in this study, the veld is put into four classes depending on the extent of its degradation. The cost of restoring each class and the time it takes for each class to recover over a given period of time are also given.

3.2 Extent of veld degradation around Oudtshoorn

In order to get the data of the extent of veld degradation in the study area and the costs of restoring degraded veld, a workshop was held in Oudtshoorn. The workshop was attended by the leading farmers in the Oudtshoorn who are keen in veld restoration. Some of the farmers have already started restoring their degraded veld. Members of the SAOBC, and conservation ecologists also attended the workshop.

The financial data was obtained from the farmers, conservation ecologists and SAOBC members. The farmers have been restoring the veld with the help of SAOBC hence they do know the actual costs of veld restoration.

The conservation ecologists who attended the workshop have done a lot of research in the study area hence they are knowledgeable of the extent of veld degradation in the study area. During a workshop in Oudtshoorn attended by ostrich farmers, conservation ecologists and representatives of the SAOBC, it was established that about 10% of the veld around Oudtshoorn is heavily degraded, 30% is moderately degraded, 30% is slightly degraded and 30% is undamaged. The undamaged veld does not need any restoration; therefore, it will not be discussed any further. The other three classes require different restoration treatments with different restoration costs for each class.

There are various restoration techniques that can be used, and these restoration techniques bear different costs. The first restoration technique considered in this study entails removing the birds from the veld, placing them in small camps, and allowing the veld to recover on its own (hereafter referred to as passive restoration). Participants in the workshop were unanimous that there was no need to undertake active restoration for slightly degraded veld. The farmer will simply rest the slightly degraded veld so that it recovers within about five years, to an extent that it will be able to carry livestock at the prescribed stocking rates. The second restoration technique considered in this study involves removing the ostriches from the veld and then undertaking soil manipulation and seeding thereafter (hereafter referred to as active restoration).

3.3 The cost of active veld restoration

3.3.1 Cost of restoration of heavily degraded veld with dongas

For heavily degraded veld *with* dongas, the workshop participants were of the view that if the farmer hires an earth moving contractor to restore the veld on the farmer's behalf, it will cost the farmer R90 800 per ha. This figure is based on the experimental cost of veld restoration done in Oudtshoorn. If the farmer uses farm labour and machinery, the restoration cost will be around R20 000 per ha.

3.3.2 Cost of restoration of heavily degraded veld without dongas

For heavily degraded veld, the maximum ground cover that can be achieved through restoration is 50%. Table 3.1 shows the budget for the cost of veld restoration per hectare of heavily degraded veld with no dongas.

Table 3.1 Cost of restoring one hectare of heavily degraded veld without dongas

Item	**Cost (R/ha)**
Hollowing and seeding (60 labour days/ha @ R60 per day)	3600
Seed (4kg/ha @ R400/kg)	1600
Thorn Branches (12 labour days @ R60 per day)	720
Mulch	1200
Total	**7120**

If the farmer decides to let the veld recover on its own, it will take about 25 years to achieve a ground cover of 50%. However if the area has rocks it will take between 15 to 20 years to get a ground cover of 50% without implementing active restoration. If the farmer decides to put R7120.00 per hectare into restoration, it will take about 8 years to achieve a ground cover of 50%. Figure 3.1 shows the rate at which the veld will recover over a period 25 years depending on the money spent on veld restoration.

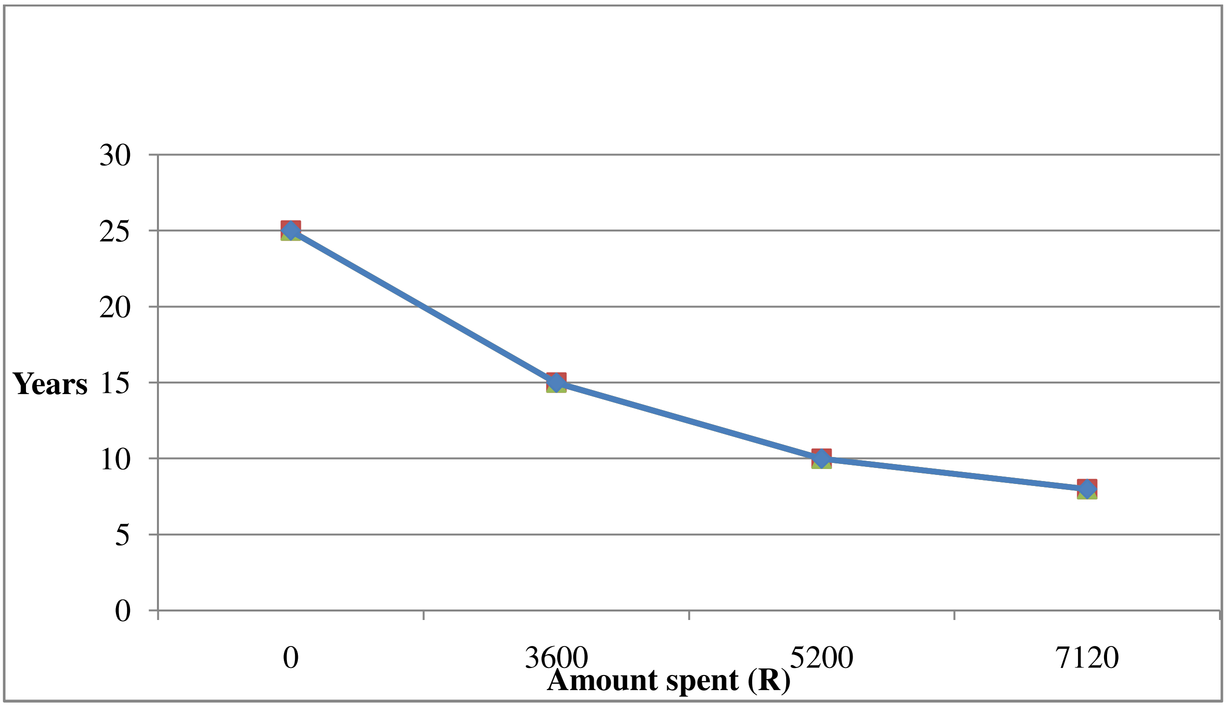

Figure 3.1 Years taken to achieve a ground cover of 50% for various amounts of money spent on veld restoration

3.3.3. Cost of restoration of moderately degraded veld without dongas

The measure used to rate the response of veld to restoration is palatability. The maximum palatability that can be achieved through restoration is 60%. Table 3.2 shows the cost of restoring moderately degraded veld.

Table 3.2 Cost of restoring one hectare of moderately degraded veld without dongas

Operation	Cost (R/ha)
Pulling out non-palatable plants (12 labour days @ R60 per day)	720
Seeding	1500
Planting cuttings (3 days x 12 labour days @ R60 per day)	2160
Total	**4380**

The effect of each rand spent on veld restoration, on palatability was estimated. Figure 3.2 shows the relationship between the amount spent on restoring moderately degraded veld and the resultant change in palatability.

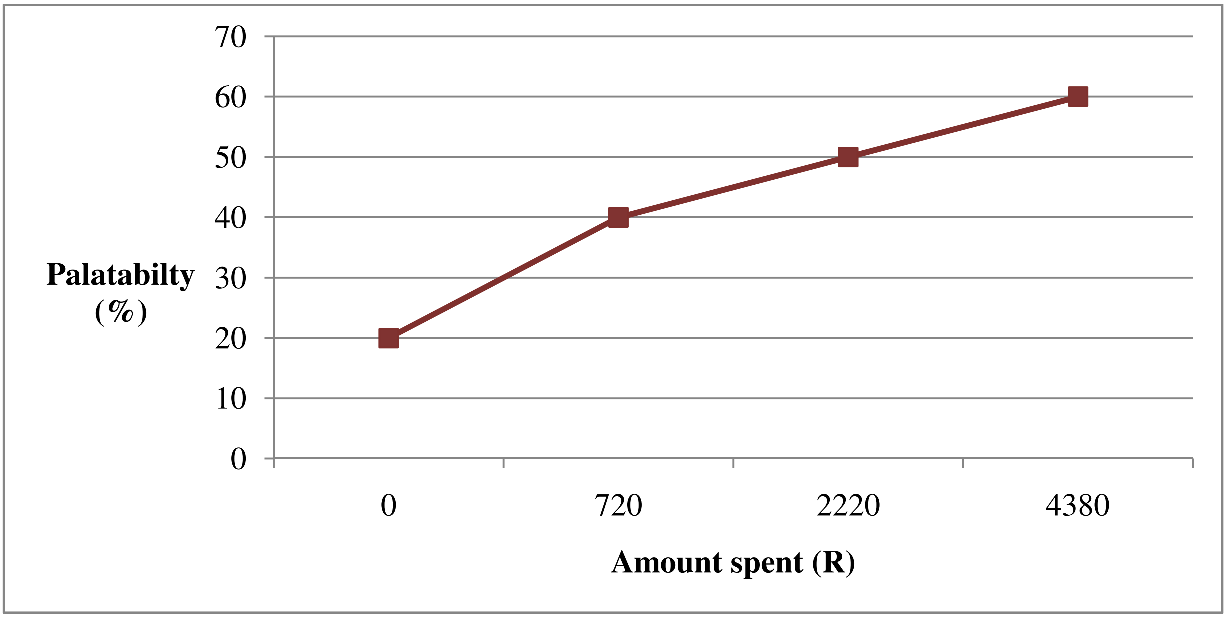

Figure 3.2 Relationship between the percentage change in palatability and amount of money spent on veld

The cost of active restoration included in this study includes fencing material and the cost of restoring both moderately and heavily degraded veld without dongas or only heavily degraded veld without dongas.

If the farmer is to restore the heavily and moderately degraded areas it will cost the farmer R2 633 800. If the farmer restores the heavily degraded veld only it will cost the farmer R925 600. Restoring the moderately degraded veld only will cost the farmer R1 708 200. The latter chapters will show if the income from the small-camp system will be able to cover the costs of veld restoration.

3.4 Conclusions

This chapter provides information on the extent to which the veld around Oudtshoorn is degraded. About 10% of the veld around Oudtshoorn is heavily degraded, 30% is moderately degraded, 30% is slightly degraded, and 30% is undamaged. The cost of restoring each class of degraded veld and the time it will take for each class of veld to recover over a given period was discussed in this chapter.

4 LITERATURE REVIEW

4.1 Introduction

This chapter focuses on the literature on farm modelling. The first part of this chapter reviews the literature on the various methods that can be used in developing farm models. The applicability as well as the limitations and advantages of the various modelling techniques are discussed thereafter. The chapter concludes by giving the reasons why the model used in this study was chosen.

4.2 Issues to be considered in whole-farm modelling

Brockington (1979:7-8) defines modelling as a "process of simplification for some defined purpose(s)". Models are simplifications of reality, thus they help in understanding some of the particular aspects of a real object.

The simplification and exclusion of minor details are generally the main two issues that should be considered in whole-farm simulation. Such simplification enables the inclusion of all the various key interdependences in models, which are consequently simple to manipulate. With these models, the main emphasis is on the viewpoint rather than on the details. The objective of the study and the environment in which the simulation is conducted are the factors that determine what is emphasised and what is not taken into account in the whole, interrelated system of management (Csaki, 1985:106).

Complex simulation models of agricultural enterprises require the inclusion of three main issues. The first issue requires the modelling of economic decisions or planning issues on the farm. The second issue requires a description of the techno-biological interdependences of production activities. The third issue requires the inclusion of financial conditions, economic consequences, and interdependences describing the marketing of goods produced (Csaki, 1985:107).

In simulation modelling of overall company operations, the decision-making process has not yet been modelled directly. Management policy under study has been treated mainly as an exogenous variable. Such types of farm models usually have four main components (Csaki, 1985:107):

- Interdependences describing the production of different goods
- A description of the relationships among different production activities
- A description of the sale of goods, presented mathematically
- The modelling of financial processes.

4.3 Types of models

There are two basic types of models, namely, deterministic and stochastic models (Thornley & France, 2007:7). These two types of models are discussed below.

4.3.1 Deterministic modelling

Deterministic models make definite forecasts for quantities such as all input values for the various input variables, and with these models, it is also assumed that the interrelationships between various elements within the model are definite. Deterministic models do not take into account risk, due to the definite nature of the values of the variables, and also the definite nature of the interrelationships among the various elements of the model. Thus, deterministic models are used in a situation where there is a need to simulate certain outcomes given a particular set of inputs (Thornley & France, 2007:7; Richardson, 2003:2). The main problem with deterministic models is that they assume that there is no risk, which might not necessarily always be the case (Strauss et al., 2008:359).

4.3.2 Stochastic modelling

Stochastic models take into account a random element as part of the model. Thus, the models are unpredictable in terms of the values of some of the input variables. The interrelationships among the different elements within the model are also unpredictable (Thornley & France, 2007:7; Richardson, 2003:2). Stochastic models take risk into account by assigning probability distributions to certain exogenous and endogenous variables. The simulated output variables are represented by probability and cumulative distributions. The role of the probability and cumulative distribution functions is to measure and compare the risks related to different scenarios and decisions (Strauss, 2005:15). Stochastic models can be technically complicated to construct and hard to test or falsify (Thornley & France, 2007:7).

4.4 Approaches to farm-level modelling

There are two basic approaches to farm-level modelling, depending on the type of agricultural system being modelled. These two basic approaches are the normative approach and the positivistic approach.

4.4.1 Normative approach

The normative approach optimises a system or shows what should happen to a certain system, while the positive approach describes a system or tries to measure what is likely to happen (Richardson, 2003:2).There are a number of methods that have been used under the normative approach to farm simulation. These methods are as follows (Csaki, 1985:22):

- Mathematical programming
- Mathematical statistics
- Production functions
- Input-output analysis
- Network analysis.

Mathematical programming models generally comprise mathematical relationships and constraints that are solved so that an optimal solution for a system can be calculated given certain constraints. Thus, normative solutions are attained using the mathematical programming models (Richardson, 2003:2). The following issues should be taken into account if mathematical programming models are to be used for a simulation study (Dent & Blackie, 1979:10):

- Mathematical programming methods are based on a fixed framework; hence, they impose a rigidity on the structure of the model

- The inclusion of comprehensive interactive data is usually difficult using mathematical programming methods
- Mathematical programming models give a solution in relation to a particular criterion. Multi-criteria mathematical models are cumbersome and computer-time consuming, except if the criteria are given as a linear combination.
- It is difficult to put stochastic and dynamic elements into mathematical programming models.

An input-output model only calculates what occurs in terms of variations in the outputs as a result of changes in the inputs. Thus, it does not compute how or why those responses came about. In other words, the main purpose of the input-output model is to characterise the system modelled as closely as possible, with no explanation given for the internal relationships between the system's elements (Brockington, 1979:11). Input-output analyses have been used for many years to analyse agricultural and policy decisions. Input-output analysis does not take time into account; thus, it assumes that relationships are taking place at a given moment. Mathematical programming, mathematical statistical methods, production functions, and input-output analyses are analytical methods that can be used to get an optimal solution for the problem being studied (Csaki, 1985:23).

4.4.2 Positive approach

When a positive approach is used in farm simulation models, it generally comprises statistical relationships, as approximated from historical data, as well as accounting identities, which are used to simulate a system so that positive solutions can be found, which are what the expected outcome of the system entails. The approach bases a system's interrelationships on real past actions and makes assumptions concerning the stability of interrelationships in future in order to try to reflect reality as practically as possible (Richardson, 2003:2). One of the shortcomings of positivistic simulation models is that it is not easy to validate and verify the model, and using them is time consuming due to the possible lack of accurate and detailed data required. The main function of a positivistic simulation model is to simulate reality as perfectly as possible; hence, validation and verification of the model is essential before the model can be used to help in decision-making (Strauss et al., 2008:359).

There are four main methods of building complex farm simulations, and these are the following (Strauss, 2005:20; Csaki, 1985:108):

- Production-oriented model – these models are used to simulate farm production processes.
- Budget model – these models are based on the accounting system of a farm, and their function is to illustrate the financial processes and relationships of the farm in relation to the physical processes occurring on the farm.
- Simulation of farm models – these models are based on the principles of industrial dynamics, with the main aim of these models being to illustrate basic management activities in relation to production activities by means of flow speeds, levels and delays.
- Enterprise simulation model – these models include planning and decision-making processes.

Optimisation and simulation models are both systems of equations and/ or inequalities created to imitate farm-level activities linked to production, marketing, finance etc. (Weersink et al., 2002:131). The main difference between the optimisation and simulation models is that optimisation specifies the behavioural assumption (e.g., profit maximisation), while this is not the same with the simulation models. Farm-level simulation models have some similarities with accounting models (budget models) because simulation models typically involve the specification of accounting relationships, such as profit, cash flow, etc (Weersink et al., 2002:138).

The advantage of optimisation models is that they can provide the solution that best achieves the specified objective, and most importantly allowing for a detailed specification of farm-level activities. Specification of farm-level considerations is also possible with simulation models, but with more flexible structures than are typically possible with the optimisation models (Weersink et al., 2002:133). However, simulation models are non-optimising; therefore there it is not certain that the best option or solution will be identified.

4.5 Budget modelling of a farm

This section describes the budget modelling, since this is the type that is used in this study. Budgeting is probably one of the most widely used methods of financial planning. Budgeting is a non-optimising method and it evaluates plans in physical and financial terms (Hoffmann, 2010:33). Budgets are mainly used as comparable techniques and play a critical role in benchmarking. The development of computer technology brought a dimension to budgeting methods, allowing budgets to be used as dynamic planning and decision making tools. Therefore budgets can also be classified as simulation models that are based on accounting principles and methods, rather than purely mathematics (Pannell, 1996:374). If they are used cautiously alongside other holistic methods, budgets can be useful tools in evaluating needs, aiding planning and undertaking participatory research and decision-making (Dorward et al., 1997:249).

Budgeting methods have been used since the inception of agricultural economics and extension. They have been based on standard accounting methods to generate comparable information for analyses and to serve as benchmark information (Malcolm, 1990:35). Ever since then, budgeting method has been there and continually used throughout the development of other sophisticated quantitative methods. However, budgeting was seen as straight forward and practical, and did not warrant much attention in academic literature (Malcolm, 1990:35)

Whole-farm budget models are in essence simulation models, usually developed using spreadsheet programmes. Within spreadsheet programs complex and sophisticated calculations and relationships can be expressed in a relatively simple way (Hoffmann, 2010:33). The budget models are sophisticated in the sense that they allow for detail, adaptability and user-friendliness (Keating & McCown, 2001:557).

This type of modelling is based on the traditional accounting system, which is used to simulate company operations, and the results are given in categories of financial balances (Csaki, 1985:116). Farm-level accounting models use budgets (capital, enterprise, or partial) to assess farm-level activities (Weersink et al., 2002:132). The approach is close to that used by company managers, and the results can be easily understood. Such models, which are simplified along the lines of a valid accounting system and pattern of financial interrelations, may also be of paramount importance in agricultural operations (Mattesich, 1964:117).

The budgeting model shows the entire production process in a combined manner; thus, the model does not simulate the various production operations of different commodities, or the operation of various farm production unitsetc. This kind of simulation uses production indices as they are in the accountancy records. The following groups of factors are often notable in production (Csaki, 1985:117):

- Physical units of inputs used in production processes
    - Amounts/quantities of materials used
    - Labour used
    - Energy used
    - Yields
    - Indicators of production, such as mortality rate
- Indicators for production processes, put in monetary terms
    - Total of all types of direct production costs
    - Total overhead costs
    - Revenue from production activities.

The budgeting-type model covers the characteristics of production in a way that is similar to the common methods of calculating costs in agricultural practice. With this type of modelling, the essential indicators for products will be given both in normal units of measurement and monetary terms (Csaki, 1985:117). Although this method looks simple, it permits both different technological solutions and the impacts of changes in a given technical production method to be studied. It is also possible to have a simpler model that includes data for the production of different goods expressed only in value terms. However, with simpler models, the extent to which the technical or technological aspects of production can be studied is limited (Csaki, 1985:117).

The budgeting model emphasises the financial aspects of management. Thus, the main aim of simulation is to sum up revenue and costs in a particular situation. With this type of modelling, the time unit for a budget is a year. This is due to the summative nature of this type of modelling. Periods less than a year are not taken into account (Csaki, 1985:118). Figure 4.1 shows the flowchart for budget-type simulation. Firstly, the costs and yields of production are defined by commodity. Secondly, a summary of costs and revenue is developed at enterprise level. Thirdly, the calculation of revenue and costs, and the preparation of a financial balance sheet are done at farm level.

The basic structure of a farm model can be represented diagrammatically as shown in Figure 4.2. The model is made up of three parts, namely, input, calculation and output. The information from the first part feeds into the next component, and the information in the second component feeds into the third component (Von Doderer, 2009:31).

The basic structure of the model can easily be summarised into three blocks as shown in Figure 4.3. These three blocks are the input block, the calculation block and the output block. The input block is made up of two parts, namely, control variables and exogenous variables. The calculation block comprises sections of gross margin, fixed asset replacement and debt repayment. The output section shows the cash flow statements, income statements and deterministic outputs such as gross margin (Strauss et al., 2008:349). The basic structure of the farm model is shown in Figure 4.3.

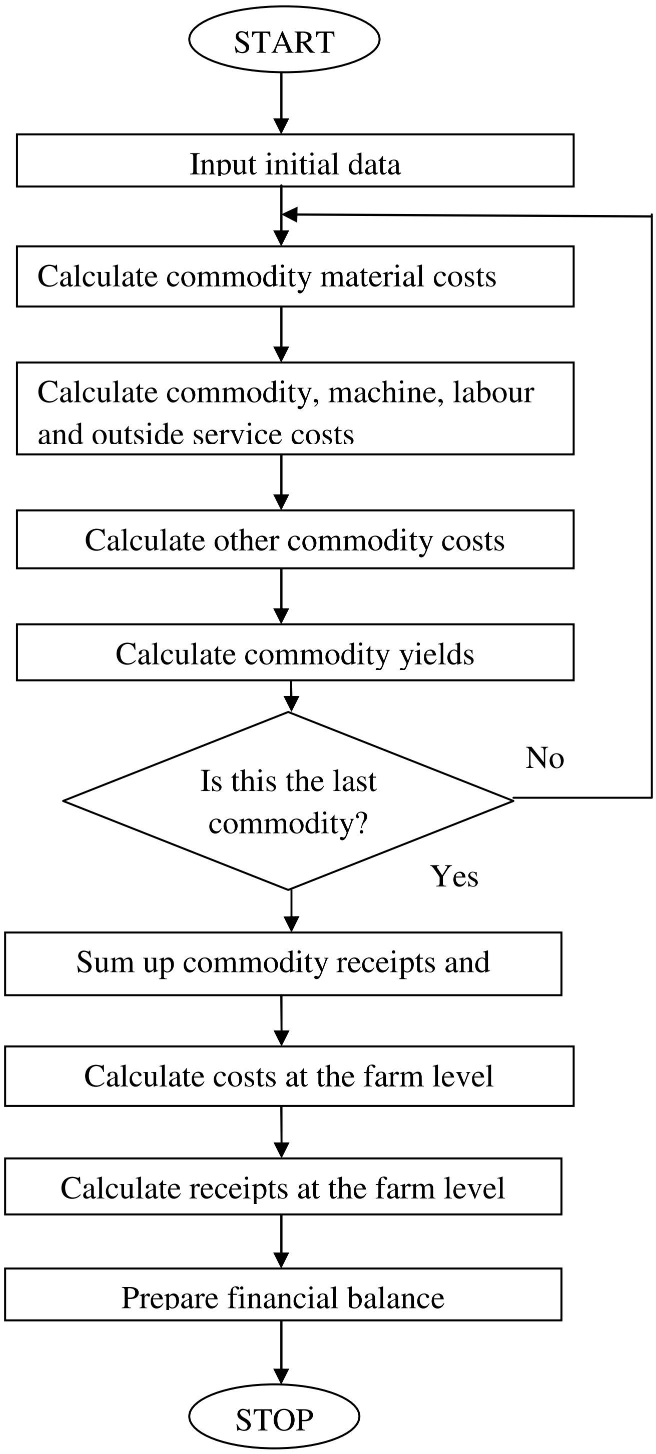

Figure 4.1 Flow chart for a farm-budget model

Source: Csaki, 1985:118

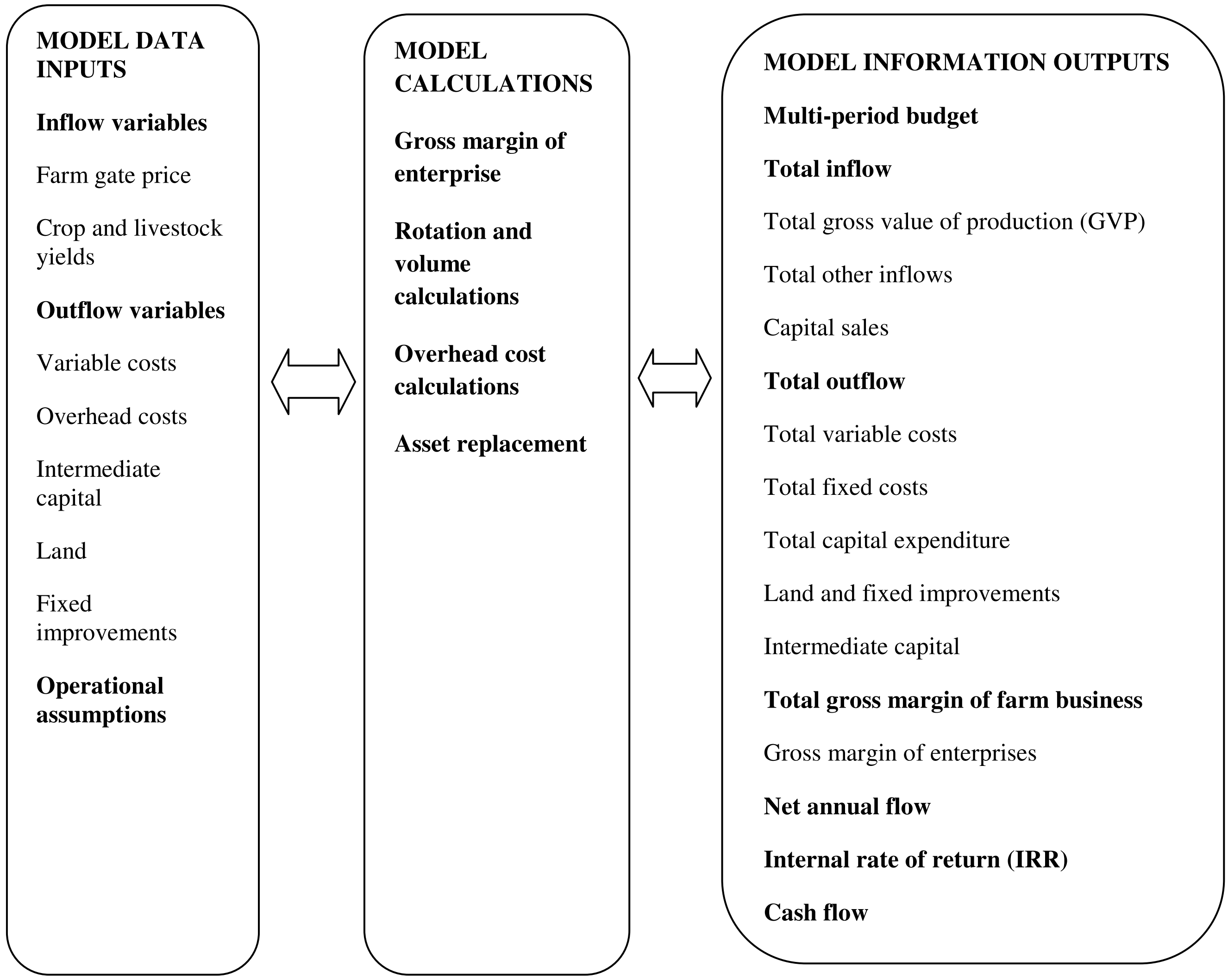

Figure 4.2 Basic structure of a farm model

Source: Von Doderer 2009:31

4.6 Reasons for budget modelling a typical farm

Budget modelling is used in this study because it takes into account three main issues that are important in farm modelling. The first issue is the modelling of economic decisions or planning issues on the farm. The second issue is the description of techno-biological interdependencies of the production activities. The third issue is the financial conditions, the economic consequences, and the interdependences describing the marketing of goods produced. Coverage of these three main issues was the motivation for the model being used in this study.

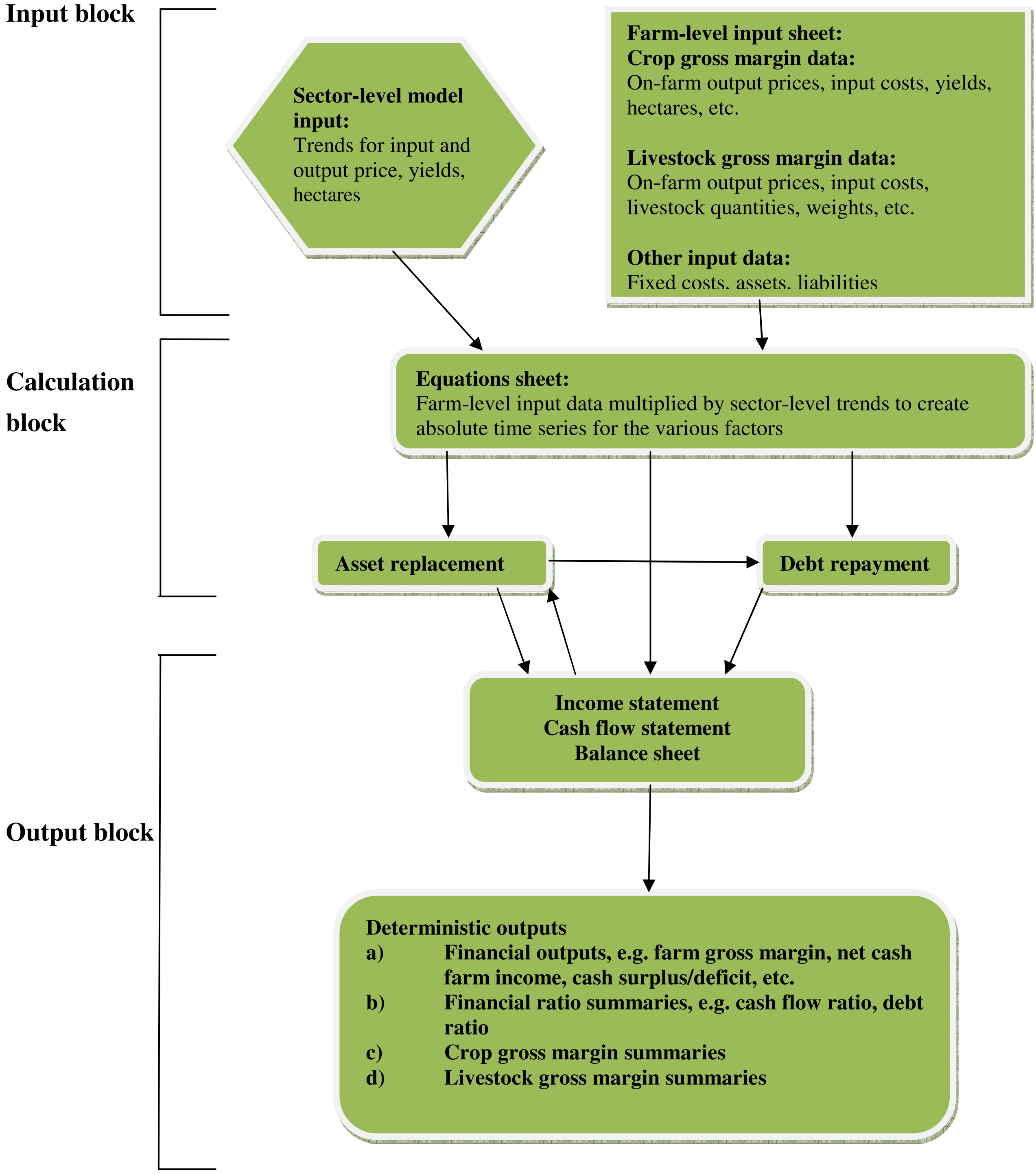

Figure 4.3 Structure of a farm model

Source: Strauss et al., 2008:350

This type of model expresses all of the production activities into a figure that can be used to measure the profitability of the farming system being used. The study aims to quantify the costs and benefits of veld restoration for ostrich farming in the Oudtshoorn area over a period of 15 years. The budget model makes it possible to express all of the production, selling, economic and financial activities into mathematical relationships that can be used to measure the profitability of the farming systems being studied.

4.7 Conclusions

The first section of this chapter focused on farm modelling literature. Two approaches to farm modelling, namely, the positivistic approach and the normative approach were discussed in the first section of the chapter. Two types of models, that is, deterministic and stochastic models were also reviewed in the first part of the chapter. Budget modelling of a farm is the method that is used in this study; hence, the literature on it was presented in the first part of this chapter. The reasons for selecting a budget model for this study were presented in this chapter.

Given the main aim of this study and the insights from the literature review, a descriptive and explanatory model will be developed. Thus a deterministic model will be constructed, using a positivistic approach. The main emphasis of the typical farm model to be develpoed is on the profitability of various ostrich farming systems. In order to determine the degree of profitability of these various ostrich farming systems, a budget modelling of a typical farm based on statistical relationships and accounting principles will be developed. The budgeting based on accounting principles is the appropriate method for this study. This is because budgeting makes it possible to evaluate various factors affecting the long-term profitability of the whole farm. The other reason for using the budgeting is because it is relatively simple, despite its ability to capture a various variables.

5 METHODOLOGY

5.1 Introduction

This chapter outlines the data collection strategies, the methods used to test the hypotheses, and a justifications of the methods used. Typical farm models were developed for the study site. These typical farm models were used to answer the research questions for this study. The typical farm models are discussed in detail in this chapter. The advantages and limitations of the methods used are also discussed in this chapter.

5.2 Data collection

The costs (physical inputs used for restoration) and benefits (the output produced due to the implementation of the restoration project) of the restoration project were obtained from personal interviews and workshops, records of the farmers, as well as the organisations involved in the restoration projects. Part of the collected data can be seen in Annexure 1. Some of the benefits of the restoration projects were obtained from ecologists and hydrologists who are also doing their research at the study sites.

5.3 Financial analysis

Three farm-scale models were developed for a typical farm in the study area to show the profitability of the production of day-old chicks for three different periods. The first period is “before” veld restoration, where the farmer uses the flock breeding system on a degraded veld. The second period is “after” change, where the farmer uses the small-camp system. The third period is “during” transition period of shifting from the flock breeding system to the small-camp system. All the periods were assumed to be fifteen years long.

The first model (Model A) shows the benefits and costs of the production of day-old chicks using the flock breeding system on degraded veld over a period of fifteen years. The second model (Model B) shows the costs and benefits of the production of day-old chicks using the small-camp system combined with cattle on restored veld for a period of fifteen years assuming that the farmer has fully invested in the small-camp system. Thus the farmer no longer uses the flock breeding system. The third model (Model C) shows the flow of costs and benefits of day-old chick production over a transition period of fifteen years, of switching from the flock breeding system to the small-camp system. For models B and C, it is optional for the farmer to farm cattle; hence, the models provide options for farming ostriches with or without cattle. Some farmers are not interested in farming ostriches with cattle, while others are interested in doing this; hence, the models cater for both options.

The models were used to measure the benefits and costs to the farmer, and to compare the profitability of the flock breeding system with that of the small-camp system. Benefits and costs were discounted to accommodate project effects occurring at different points in time. All the costs and benefits were valued at constant prices. By using constant prices, it was assumed that the rate of inflation is the same for the prices of inputs and outputs. The NPV, BCR, and IRR were used as the decision criteria.

On a project basis analysis can be done before tax because one is interested in the implications on farm level only (Standard Bank, 2005). All the scenarios in this study were done on a before tax basis, therefore all the scenarios can be easily compared.

5.4 Basic structure of the model

The models consist of five components, which are the farm description, assumptions, prices of inputs and outputs, gross margin and the multi-period budget (see Annexure 1). The farm description shows the land (veld, non-usable land and irrigated/cultivated land) expressed in hectares as well as in monetary terms. The veld is subdivided into three categories because in the study area some farms have different veld types on the same farm, and this may imply that the stocking rates could be different. These categories of veld are subdivided into three further categories, namely, good, medium, and bad. This classification is based on the current stocking rate of the veld. The condition of the veld determines the number of ostriches a given farm can carry. For the flock breeding system, the condition of the veld determines the amount of feed obtained by the birds from the veld. This in turn determines the additional lurcene the farmer should provide the birds. Since the veld was subdivided into various classes, amount of feed obtained by the birds from each class was estimated and the shortfall will be provided by the farmer. For the small-camp system, the birds do not obtain any feed from the veld. The farmer provides the birds with their daily feed requirements. All these interdependencies were accommodated in the typical farm models (see Annexure 1). It should also be noted that there is no certainty on the exact amount of feed obtained by the birds from the veld. That is why in this study ranges of the level of feed obtained from the veld were used. The second part of the farm description shows the farm inventory for a typical ostrich farm. Farm inventory includes the land, machinery, breeding ostriches and equipment found on a typical ostrich farm. This section also shows the fixed costs and the machinery replacement schedule.

The second component of the model shows the assumptions. It should be noted that some of the assumptions can be relaxed within a given range. Thus, the model allows for flexibility. The idea of having flexibility within the model is to try to cater for all the issues raised by the farmers. Some of the important assumptions per female ostrich are the average number of eggs laid, the average number of chicks produced, the amount of feed obtained from the veld, and the change in productivity (average number of chicks per female bird over a given period of time).

The third component shows the quantities and prices of the inputs used for the production of day-old chicks. The amount of feed consumed by the ostriches is also shown in this part of the model. The amount of feed consumed is very important because the feed costs make up the greater part of the allocatable variable costs. Prices of outputs are also shown in this component of the model. In order to allow for greater flexibility, the quantities and prices of inputs and outputs can easily be changed.

The fourth component of the model shows the gross margin budgets, that is, the total gross revenue less the total allocatable variable costs. For Model A, there is only a gross margin for the production of day-old chicks, while for Models B and C there are gross margins for the production of both day-old chicks and beef. It should be noted that it is optional for the farmer to venture into beef production.

The fifth component of the model shows the multi-period budget. This is a summary of all the cash inflows and outflows for a period of 15 years. The multi-period budget consists of a revenue component and an expense component. The total annual figures for gross farm income, variable costs, non-allocatable variable costs, fixed costs, capital investments, and a summary of the cash flows are shown for a period of fifteen years in the multi-period budget. All the figures from the other four parts of the model feed into the multi-period budget. This component is where the net present value (NPV) and internal rate of return (IRR) are calculated (see Figure 5.4).

Throughout the modelling process standard accounting principles were applied, which necessitates a counter entry to the assumption that land and fixed improvements are "bought" in year one, which is contrary to practice where the farm is a running concern, but necessary to evaluate the profitability over time (Standard Bank, 2005:39). In the last year of the modelling period, land and fixed improvements are thus "sold", therefore the income for the last year include land and fixed improvements, and is subsequently higher.

For Models B and C, there is a sixth component that shows the restoration costs (see Annexure 1). For the restoration activity, there are three options farmers can choose. The first option is for farmers to do nothing (passive restoration). Once farmers take the ostriches off the veld into the small camps, they can simply allow the veld to recover on its own. With this first method, farmers do not incur any costs for restoration. The second option is for farmers to hire professionals who do the restoration on their behalf, but this method is expensive. The third option is where farmers do the restoration on their own, using their labour to collect seeds. The third option is cheaper than the second option. Only the first and third options were included in this study, and these two options are shown in Models B and C. Model A does not include the aforementioned sixth component. It is important to note that there are different farming systems that different farmers prefer. This necessitated attempting to capture all the various farming systems. In order to capture all the various farming systems, different versions of models were developed, and these models are described further on. Figure 5.4 summarises the structure of an ostrich farm model.

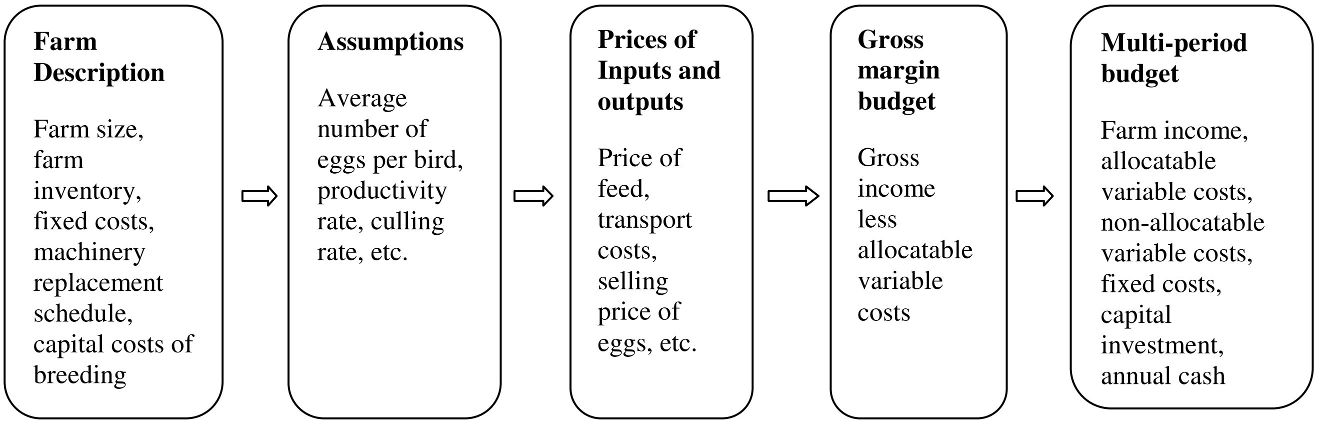

Figure 5.1 Structure of an ostrich farm model

A typical farm can be used to determine farm profitability and the effect of variations in a range of variables on farm-level profitability. In such a situation, a typical model for each homogenous area is required (Hoffmann, 2010:71). Using typical farm models imply that the models cannot be applied directly to a specific farm. Typical farm information is not directly applicable to providing direct managerial guidance (Hoffmann, 2010:71). However, the typical farm model does however allow evaluation and comparison of the effect of different managerial decisions and options. Typical farm models are mainly used to measure major managerial implications (Blackie & Dent, 1974:166). The advantage of using typical farm models as research method is that it is more cost and time efficient than surveys (Hoffmann, 2010:71).

Typical farm models were first used in the 1930s in the USA. Their first noticeable advantage was the shift in focus away from the traditional production-cost approach towards a whole-farm approach. The whole-farm approach gives a more reliable basis for evaluating the potential effect of variables on which to base policies and programmes (Hoffmann, 2010:72). In the beginning, the concept of the typical farm was defined in terms of 'normality'. The idea was to avoid good or poor farms with regards to management quality, profitability, size, access to markets and life expectancy (Carter, 1965:1449). Later descriptions of the typical farm were based on existing enterprises, practices and environmental factors (Hoffmann, 2010:72). Feuz and Skold (1991:44) define a typical farm as 'a model farm in a frequency distribution of farms in the same universe'.

In this study ostrich farmers were consulted in developing the typical farm models for the study area. Officials from the Department of Agriculture, lecturers at Stellenbosch University and SAOBC were also consulted. At first the farmers were asked for their input individually, and then a workshop was held in Oudtshoorn were farmers, members from the SAOBC and academics had a chance to critically analyse the typical farm models. A full description of a typical farm model is shown in Annexure 1.

5.4.1 Model A

There are four versions of Model A. The first version of model A shows the profitability of the current practice (flock breeding system) where the farmers use the official stocking rate of 22.8 ha/bird, given that the assumed amount of feed obtained from the veld varies between 0 and 30%. It should be noted that the amount of feed obtained from the veld varies from one veld type to another. Hence, this model allows for the changes in the percentage of feed obtained from the veld. There is a need to vary the amount of feed obtained from the veld because some farmers claimed that their ostriches do not get any feed from the veld, while others claimed their ostriches get up to 30% of their feed from the veld. The model shows all the costs and benefits incurred over a period of fifteen years.

The second version of Model A shows the breakeven stocking rates for the production of day-old chicks with the flock breeding system on degraded veld. The model shows all the costs and benefits incurred during the fifteen years. In this model, the assumed amount of feed obtained from the veld is varied from 0 to 30%. Thus, the breakeven stocking rate for each level of the amount of feed obtained from the veld is calculated.

The third version of Model A shows the stocking rate using the flock breeding system that will give an IRR of 6% as a typical return for extensive livestock farming in the Karoo. The stocking rate giving an IRR of 6% was calculated for each level of feed obtained from the veld varying between 0 and 30%.

The fourth version of Model A shows the profitability of producing day-old chicks with the flock breeding system given that the farmer uses a typical stocking rate of 8.1 ha/bird. The amount of feed obtained from the veld by the birds is varied from 0 to 30%.

5.4.2 Model B

The goal with Model B is to compare a mature, fully operational small-camp system with the flock breeding system (Model A). This model is based on the assumption that the farmer has already fully invested in the small-camp system, that it is fully operational, that no eggs are produced on the veld anymore and that cattle are kept on the restored veld. There are three versions of Model B.

With the first version, it is assumed that the breeding stock is kept in a concentration camp of which the size is a maximum 2% of the total veld area. With this system, the farmer sacrifices a maximum of 2% of the total veld area in order to restore and protect 98% of the farm. The farmer provides the ostriches with feed; thus, ostriches do not rely on any feed from the veld in the concentration camp. It is assumed that for the 'after' period, the slightly degraded veld has recovered during the transition period (through passive restoration) to an extent that it can carry cattle at the prescribed stocking rate. With this model, it is assumed that the farmer keeps cattle on the formerly slightly degraded veld and the undamaged veld. The model shows all the costs and benefits incurred during the fifteen-year period.

The second version of Model B shows a scenario of farming on restored veld using small camps of 0.25 ha. The model shows all the costs and benefits incurred, also over fifteen years to be comparable with Model A. In this case, the farmer keeps all the breeding birds in small camps, that is, a breeding trio in each small camp of 0.25 ha. The farmer provides all the feed for the breeding ostriches. The main difference between this model and the other two versions of Model B is that for this model there is higher investment in fencing material than for the first version but lower investment than for the third version.

The third version of Model B shows the farming system after restoration of the veld where the farmer uses the ‘combination system’. With this system, the farmer keeps the best breeding trios in small camps (0.25 ha each) to produce birds for the mother stock. The farmer keeps the second-best breeding birds in the large breeding camp(s) for producing chicks to be sold or to be kept as slaughter birds. The total area under small and large camps does not exceed 2% of the veld. In both camps, the ostriches do not get any feed from the veld; thus, the farmer supplies the ostriches with feed. The model shows all the costs and benefits incurred during the fifteen-year period.

5.4.3 Model C

The goal with Model C is to show the financial implications over a transition period of fifteen years. During this phase, the farmer erects the small camps gradually as new breeding trios enter the small-camp system and old birds on the veld are allowed to finish their productive lives on the veld. Experience has shown that older birds reared on the veld do not adapt readily to small camps.

It is assumed that no active veld restoration takes place during the transition period, as the decreasing number of breeding ostriches in the veld will still cause damage to the veld and restored areas. There are three versions of Model C.

The first version shows the period of fifteen years over which shifting from the flock breeding system to the single-concentration-camp system takes place (2% of veld in size). With this farming system, the farmer removes all the ostriches at once from the veld and puts them in a small camp of 2% of the veld in size. The model shows all the costs and benefits incurred during the fifteen-year period. After ten years, it is assumed that the slightly degraded veld has recovered through passive restoration to an extent that it can carry cattle at the prescribed stocking rate. Therefore, from year ten to year fifteen, cattle will be introduced gradually on the formerly slightly degraded veld and the undamaged veld.

The second version of Model C shows the period of moving from the flock breeding system to one trio per small camp 0.25 ha. From years ten to fifteen, cattle are phased in gradually on the formerly slightly degraded veld and the undamaged veld. All the costs and benefits associated with the period of switching from the flock breeding system to the small-camp system are shown with this model.

The third version of Model C covers the period of switching from flock breeding to a combination of a large concentration camp and small camps of 0.25 ha. The model shows all the costs and benefits incurred during the fifteen-year period. From years ten to fifteen, cattle are phased in gradually on the formerly slightly degraded veld and the undamaged veld. The farmer keeps the superior breeding trios in 0.25 ha small camps for breeding the mother stock, and the less productive breeding ostriches in the large concentration camp for producing chicks to be sold or to be reared as slaughter birds. The area under the large and small camps should not exceed 2% of the total veld area.

5.5 Decision criteria

The NPV, internal rate of return (IRR), and benefit-cost ratio (BCR) were used as the decision criteria.

5.5.1 Net present value (NPV)

$$NPV = \sum_{t=0}^{n} \frac{(B_t - C_t)}{(1+r)^t}$$

where

B_t are project income in period t

C_t are project costs in period t

r is the appropriate discount rate

n is the number of years over which the income and costs of the project are taken into account (Perkins, 1994:67). The NPV was used as one of the decision criteria. The project with the highest NPV will be the one that will be preferred.

5.5.2 Benefit-cost ratio (BCR)

The greater the BCR, the more financially attractive the project appears to be. However, the difference between the benefits and costs is what really matters. This greatest difference, and thus the highest net benefit, is where marginal benefit is closest to marginal cost. The difference and the ratio (BCR) between benefits and costs were considered.

$$BCR = \sum_{t=0}^{T} \frac{B_t}{(1+r)^t} \div \sum_{t=o}^{T} \frac{C_t}{(1+r)^t}$$

Where

$\sum$ is the sum of values

B_t is the income at time t,

C_t is the cost at time t,

T is the timescale of the project,

t=0 denotes the starting time of project, and

r denotes the discount rate (Zheng et al., 2008:3).

5.5.3 Internal rate of return (IRR)

The IRR is the discount rate used if discounting the project's costs and benefits will equate the project's NPV to zero (Perkins, 1994:72). The project with the highest IRR will be preferred.

$$NPV = \sum_{t=0}^{n} \frac{(B_t - C_t)}{(1+r)^t} = 0$$

where

B_t are project income in period t

C_t are project costs in period t

r is the appropriate discount rate

n is the number of years over which the income and costs of the project are taken into account (Perkins, 1994:72).

5.6 Methodology justification

5.6.1 Financial analysis

This approach includes marketable goods and services valued at current market prices. It uses actual cash flows and is suitable from the point of view of the farmer.

If the NPV is positive then the project is profitable. The IRR shows the degree of profitability of the project. Generally, the selection criterion for the IRR measure of project worth is to accept all projects having an IRR above the opportunity cost of capital. Financial analysis is critical in showing the financial implications of a project under consideration (USAID, 2008:2). In this case, financial analysis is very important to the farmer because financial implications and profitability are of paramount importance to the farmer.

5.7 Conclusions

This chapter outlined the data collection strategies employed in the study. Most of the data was collected from the farmers, organisations involved in the restoration projects and the ecology and hydrology students working on the restoration sites. Typical farm models were developed for each of the breeding systems. These models were used to test the hypothesis. The next chapter presents the results obtained in the area under consideration.

6 FINANCIAL IMPACT OF SWITCHING FROM THE FLOCK BREEDING SYSTEM TO THE SMALL-CAMP SYSTEM

6.1 Introduction

The previous chapter discussed the structure of the farm models and the financial models used in this study. There are two reasons why profitability analysis was done for three periods namely "before", "during" and "after". The first reason is that the study aims to compare "before" and "after" as two stable/normal conditions. The second reason is that the study wants to show the financial implications of carrying restoration cost from a cash flow point of view "during" veld restoration (this include real flow of funds to buy fencing material for small camps). This chapter gives the results of the typical farm models for each scenario. Firstly, results for the profitability of producing day-old chicks with the flock breeding system before veld restoration are presented. Secondly, results for the profitability of producing day-old chicks during veld restoration are given. Thirdly, results for the profitability of producing day-old chicks after veld restoration are presented. Fourthly, results for the ability of the small-camp system to carry the costs of active veld restoration are presented. Lastly, results of a sensitivity analysis to show the effect of the average number of day-old chicks per bird on the profitability of the production day-old chicks after veld restoration are presented. This is followed by the conclusions. Figure 6.1 shows all the scenarios presented in this chapter with their corresponding section numbers.

6.2 Profitability of producing day-old chicks with the flock breeding system

Four versions of Model A were developed to show the production of day-old chicks using the flock breeding system before veld restoration. The first model measured the profitability of producing day-old chicks using the flock breeding system at the prescribed stocking rate at various feed levels obtained from the veld. The reason of varying the amount of feed obtained from the veld is because there is no certainty on the exact amount of feed obtained from the veld. This amount varies from one veld to another depending on the condition of the veld. Farmers are of the view that the amount of feed obtained from the veld varies from 0 – 30% depending on the condition of the veld. The second model calculated the breakeven stocking

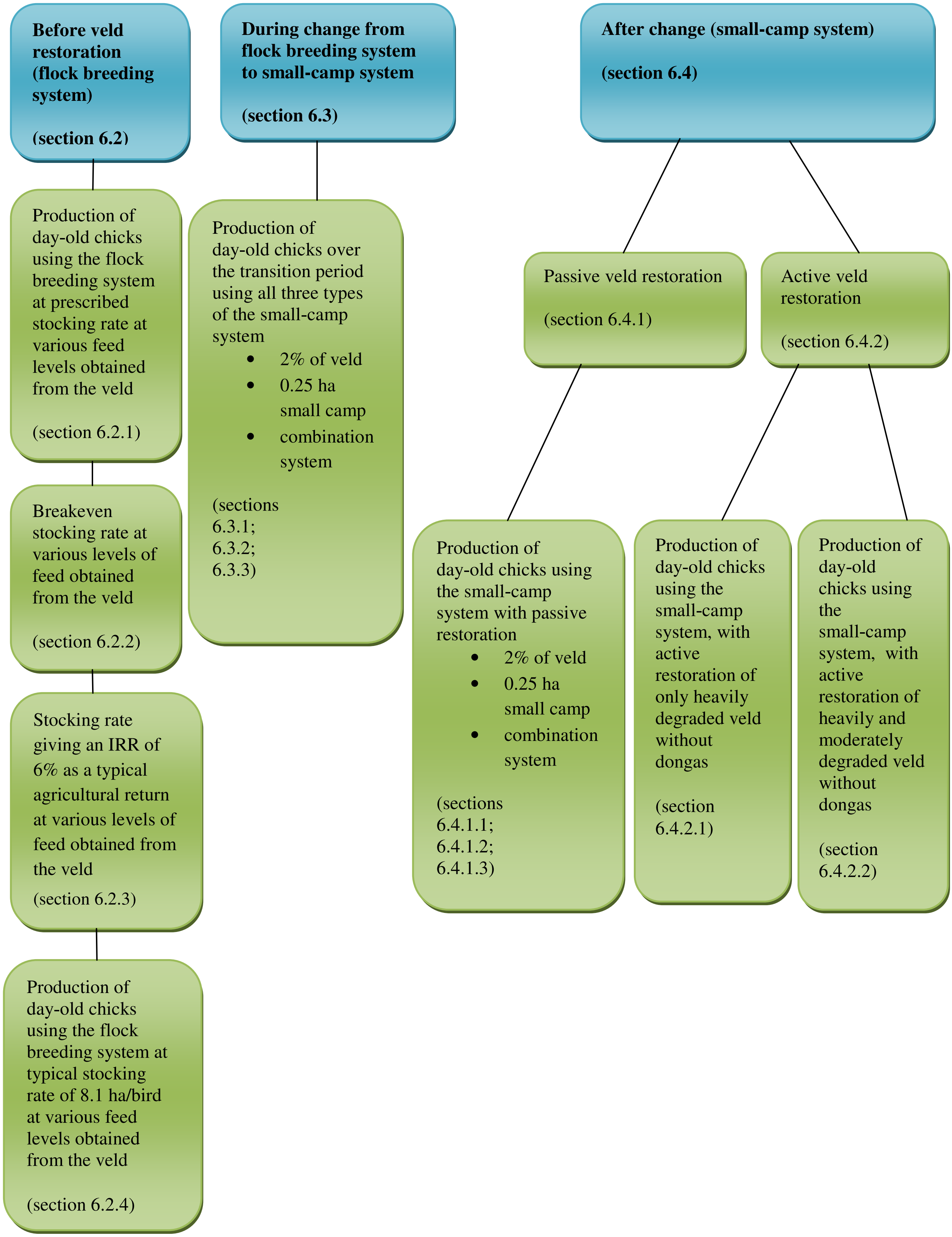

Figure 6.1 The scenarios of ostrich chick production – veld restoration

rate at various levels of feed obtained from the veld. This was done to show at what stocking rate does the farmer break even and the effect of such a stocking rate on the condition of the veld. The third model calculated the stocking rate giving an IRR of 6% as a typical agricultural return at various levels of feed obtained from the veld. The fourth model measured the profitability of producing day-old chicks using the flock breeding system at a typical stocking rate of 8.1 ha/bird for various levels of feed obtained from the veld. The following sections present the results for these four versions of Model A.

6.2.1 Profitability of the production of day-old chicks at prescribed stocking rates for various levels of feed obtained from the veld

This model represents a scenario of farming ostriches using the flock breeding system at a stocking rate of 22.8 ha per bird, as prescribed by the Department of Agriculture. This stocking rate is enforced by Regulations 10 and 11 of CARA of 1983 (Cupido, 2005:78: Murray, 2008:1). The amount of feed assumed to be obtained from the veld is varied from 0% to 30% in order to establish the effects on profit. The reason for varying the amount of feed obtained from the veld is that some farmers claimed that the ostriches obtain up to 30% of their feed from the veld, while others claimed that the ostriches do not get any feed from the veld. Varying the amount of feed obtained from the veld will allow one to assess the impact of farm-produced feed on the profitability of the farming system. Table 6.1 shows the NPV, IRR and BCR.

Table 6.1 shows the results of farming ostriches using the flock breeding system at a stocking rate of 22.8 ha per bird, assuming that the amount of feed obtained from the veld varies from 0% to 30%. The NPV shows the present value of the future streams of revenue produced by an investment. In this case, the NPV is negative, which implies that investing in this flock breeding system of farming ostriches using the stocking rate of 22.8 ha per bird, assuming that the birds get 0% of their feed from the veld, is not a good investment. The NPV is less than zero; thus, it would be financially rewarding to invest in other businesses where the NPV is positive. The IRR shows the return per rand invested in a business. In this case, the IRR is negative (assuming the birds do not get any feed from the veld). Thus, for every rand invested in this farming business, the farmer makes a loss of R0.09.

Table 6.1 Influence of the percentage of feed obtained from the veld on the profitability of producing day-old chicks on the veld at the prescribed stocking rate

Feed obtained from the veld (%)	NPV (R)	IRR (%)	BCR
0	-4 470 683	-9	0.786
10	-3 919 162	-8	0.815
15	-3 643 401	-7	0.830
25	-3 091 880	-5	0.862
30	-2 816 119	-5	0.880

Note: A stocking rate of 22.8 ha/ breeding bird is assumed

For a situation where the birds get 10% of their feed from the veld, the NPV is -R3 919 162. The corresponding IRR and BCR are -8% and 0.815 respectively (see Table 6.1). The production of day-old chicks on degraded veld, assuming the farmer is using the flock breeding system at a stocking rate of 22.8 ha/ostrich and that the birds get 10% of their feed from the veld, is not profitable.

The NPV for the scenario where the stocking rate is 22.8 ha per bird and 15% of feed is obtained from the veld is negative (-R3 643 401) but slightly lower than that of the scenario where only 10% of the feed is obtained from the veld. The IRR for this scenario is -7%, and this shows that for every R1 invested by farmers, they will make a loss of R0.07. The BCR is 0.83; thus, the discounted benefits are less than the discounted costs.

Table 6.1 shows that when the birds get 25% of their feed requirements from the veld, the NPV is –R3 091 880. Thus, the NPV is still negative despite the fact that the birds get 25% of their feed from the veld. This shows that the stocking rate is still very low. The IRR is -5%; hence, the farmer will not make any profit. The BCR is 0.862, and this implies that the sum of discounted costs is greater than the sum of discounted benefits; hence, such an investment is not profitable.

If the birds get 30% of their feed from the veld, the NPV is -R2 816 119; hence, such an investment is still not financially viable. The IRR of -5% means that farmers will make a loss of R0.05 for every R1 they invest in this business. The BCR of 0.880 implies that the sum of discounted benefits is less than the sum of discounted costs. Thus the investment is not profitable.

As the amount of feed obtained from the veld increases, the NPV and the IRR improve. The BCR and the difference between benefits and costs also increases as the amount of feed obtained from the veld increases. Thus, the feed obtained from the veld is an important cost saving factor that affects the profitability of ostrich farming, because the costs of feed contribute a large percentage of the allocatable variable costs. Despite the increase in feed obtained from the veld, the NPV and IRR for this scenario remain negative, and this can be attributed to the low stocking rate. Ostrich Farming using the flock breeding system at a stocking rate of 22.8 ha per bird is still not profitable where it is assumed that the birds get up to 30% of their feed from the veld. This was confirmed by farmers and was used as a motivation for why they exceed the prescribed stocking rate. Severe overstocking of ostriches will lead to the degradation of the veld, and hence, the amount of feed obtained from the veld by the ostriches will decrease over time, while dependence on processed feed will increase.

6.2.2 Breakeven stocking rate at various levels of feed obtained from the veld

This model was used to calculate the breakeven stocking rates for the flock breeding system before veld restoration given that the amount of feed obtained from the veld is varied from 0 to 30% (see Table 6.2). This analysis was done to show why the farmers overstock their veld and the resultant veld degradation. The breakeven point is where the BCR is equal to one and

NPV is equal to zero. The breakeven stocking rate was calculated as 8.28 ha per bird given that the birds do not get any feed from the veld. If the birds get 10% of their feed from the veld, then the breakeven stocking rate is 10.09 ha/bird. When 15% of the birds' feed requirement is obtained from the veld, the breakeven stocking rate is 10.99 ha/bird. For a situation where the birds get 25% of their feed from the veld, the breakeven stocking rate is 12.80 ha/bird. The breakeven stocking rate for a scenario where 30% of the feed is obtained from the veld is 13.70 ha/bird. This stocking rate is almost twice the maximum stocking rate of 22.8 ha per ostrich stipulated by the Department of Agriculture, showing that the legislated maximum stocking rate is not financially viable. Table 6.2 summarises the breakeven stocking rates for various levels of feed obtained from the veld.

Table 6.2 Breakeven stocking rate for day-old chicks produced before veld restoration

Feed obtained from the veld (%)	**Breakeven stocking rate (ha/ostrich)**
0	8.28
10	10.09
15	10.99
25	12.80
30	13.70

6.2.3 Stocking rate giving an IRR of 6% as a typical agricultural return at various levels of feed obtained from the veld

This typical farm model shows the stocking rates giving an IRR of 6% as a typical agricultural return for various levels of feed obtained from the veld (see Table 6.3). If the birds do not get any feed from the veld, then a stocking rate giving an IRR of 6% is 6.73

ha/bird. In a scenario where the birds get 10% of their feed from the veld, the stocking rate giving an IRR of 6% is 8.365 ha/bird. If the birds obtain 15% of their feed from the veld, then a stocking rate giving an IRR of 6% is 9.185 ha/bird. A stocking rate of 10.825 ha/bird, given that the birds get 25% of their feed from the veld, gives an IRR of 6%. In a case where the veld provides 30% of the feed to the birds, then the stocking rate giving an IRR of 6% is 11.645 ha/bird. It can be deduced from Table 6.3 that if farmers want to make a profit of R0.06 per every rand invested, then they must use a stocking rate that greatly exceeds the prescribed stocking rate, even if the birds get up to 30% of their feed from the veld. However, this will result in degradation of the veld and a loss of biodiversity.

The IRR was rounded off to the second decimal. From Table 6.3 it can be deduced that as the amount of feed obtained from the veld and stocking rate increases, the NPV steadily decreases. As the stocking rate increases that imply fewer birds can be carried on a given farm hence the income decreases. The decrease in NPV shows that the stocking rate has a bigger impact than the amount of feed obtained from the veld has on the profitability of the flock breeding system.

Table 6.3 Stocking rate for flock breeding system with an IRR of 6% as a typical agricultural return

Amount of feed obtained from the veld (%)	NPV (R)	IRR (%)	Stocking rate (ha/bird)
0	1 463 544	6.00	6.730
10	1 321 153	6.00	8.365
15	1 266 735	6.00	9.185
25	1 182 631	6.00	10.825
30	1 149 463	6.00	11.645

6.2.4 Profitability of producing day-old chicks using the flock breeding system before veld restoration at a typical stocking rate of 8.1 ha/ostrich

The results in this section show the profitability of day-old chick production based on a more typical stocking rate applied in the flock breeding system in the study area (see Table 6.4). The financial returns are clearly very dependent on the assumed amount of feed obtained from the veld, as this implies the level of saving on lucerne-based rations. Table 6.4 clearly shows that a stocking rate of 8.1 ha/ostrich is financially rewarding regardless of the level of the feed obtained from the veld. It also shows that the more the farmer saves on feed the more profit the farmer makes. This profitability analysis was done to show the reason why farmers exceed the prescribed stocking rate since earlier sections showed that the farmers will lose money if they adhere to the prescribed stocking rate. However, such a heavy stocking rate will result in the degradation of the veld.

In a scenario where the ostriches do not get any feed from the veld, the IRR is 3%. The corresponding NPV and BCR are R39 515 and 1.058 respectively. The total sum of the discounted benefits is greater than the total sum of the discounted costs.

In a scenario where the ostriches get 10% of their feed from the veld, the IRR is 7%. For the same scenario, the NPV is R1 591 946. Thus, the present value of the future value of streams of benefits is positive. The corresponding BCR is 1.117 (see Table 6.4).

If the ostriches get 15% of their feed from the veld, then the IRR is 8%. Therefore, farmers get a return of R0.08 per every rand they invest. The NPV is positive (R2 368 162), and thus, the present value of the future value of streams of benefits is positive. The corresponding BCR is 1.15, implying that the total sum of the discounted benefits is greater than the total sum of the discounted costs.

If 25% of the ostriches' feed is obtained from the veld, the IRR is 12%. The NPV is R3 920 593, and thus, the present value of the future value of streams of benefits is positive. The corresponding BCR is 1.22.

Table 6.4 shows that if the ostriches obtain 30% of their feed from the veld, the IRR is 13%. Farmers get a return of R0.13 per every rand they invest. The corresponding NPV and BCR are R4 696 808 and 1.259 respectively.

Table 6.4 Profitability of producing day-old chicks using the flock breeding system at a typical stocking rate of 8.1 ha/ostrich

Feed obtained from the veld (%)	NPV (R)	IRR %	BCR
0	39 515	3	1.058
10	1 591 946	7	1.117
15	2 368 162	8	1.149
25	3 920 593	12	1.220
30	4 696 808	13	1.259

6.3 Profitability of producing day-old chicks over the transition period of switching from the flock breeding system to the small-camp system

The profitability of three types of small-camp system was calculated (see Table 6.5). It was assumed that the farmer does passive restoration. During this period, the farmer switches from the flock breeding system to the small-camp system. Therefore, the farmer will be investing in fencing material used for the erection of the small camps. This section shows the impact of the gradual shift from the flock breeding system to the small-camp system during the transition period, as the investment in fencing material places a heavy burden on the farmer. In other words, this scenario shows the financial implications of carrying the cost of fencing material from a cash flow point of view during the transition period. This includes the real flow of funds in buying fencing material for small camps. It was assumed that the fencing material will be replaced after 30 years. No active restoration costs were included in this model because the birds are removed from the veld gradually, and hence, some birds will still be on the veld, making it not worthwhile to start with the restoration of the veld. The ostriches tend to walk on the same path, and thus, even though there are only a few ostriches on the veld, they will still walk on the same path, damaging it.

6.3.1 Breeding camp of 2% of veld in size

The IRR for the small camp of 2% of the veld is 5%. Thus for every rand invested by the farmer, the farmer will make a profit of R0.05. For the same breeding camp of 2% of the veld, the NPV is R981 820. The NPV of the future streams of income is positive, and thus, the investment is desirable. The BCR is 1.13, and thus the sum of discounted benefits is greater than the sum of discounted costs.

The system of using a small camp of 2% of the veld is the least profitable of the three systems. With this system, the farmer sacrifices 2% of the veld and this sacrificed piece of veld is likely to be degraded by the ostriches, since the farmer will have to keep a relatively large number of birds on this small piece of veld to break even. The main benefit of this method is that less money is needed for fencing material compared with the small-camp system. Another benefit is the saving on the cost of egg collection. The one disadvantage is the loss of feed obtained from the veld. The amount of feed obtained from the veld varies depending on the condition of the veld. However, some farmers claim that the birds do not get any feed from the veld, while others claim that they do get some of their feed from the veld. The second disadvantage of this system is that genetic selection is not possible as with the small-camp system; hence, the increase in productivity is low compared with the small-camp system.

It was assumed that the farmer is able to increase the average number of chicks per bird from 24 to 40 over a period of 10 years. This was based on one example of the successful genetic selection of ostriches on a farm near Still Bay. The producer is an experienced beef farmer who ventured into ostrich production. This farmer uses the small-camp system and keeps records of the production of day-old chicks for each female bird, and eliminates the non-performing ostriches. This has enabled him to increase the average number of chicks per female from 25 to 44 within ten years (Nel, 2010). His success has already motivated other farmers in Oudtshoorn to start experimenting with genetic selection.

6.3.2 Small camps of 0.25 ha per breeding trio

With the system of small camps, each small camp being 0.25 ha, the IRR is 7%; thus, for every rand invested, the farmer gets a return of R0.07. The NPV for the same system is R1 719 874, and this implies that the NPV of the future streams of income is positive, and hence, the project is desirable. The sum of discounted benefits is greater than the sum discounted costs since the BCR is 1.158 (see Table 6.5).

This system of using only small camps of 0.25 ha is the second best. This system allows for genetic selection; hence, the farmer is able to eliminate the nonperforming birds ('passengers'). By constantly selecting the best breeding stock, the farmer will be increasing productivity. The disadvantage of this method is that substantial investment capital is required to erect the small camps. All the feed has to be supplied by the farmer as no grazing can take place.

6.3.3 Combination system

The IRR of the combination system is 9%, and thus, for every rand invested the farmer realises a return of R0.09. The NPV for the same system is R2 727 390, which implies that the project's present value of future streams of benefits is positive. The BCR for the combination system is 1.208 (see Table 6.5).

The combination system is the most profitable of the three systems. This system has lower expenditure for fencing material compared with the system where the farmer uses only small camps of 0.25 ha for all breeding birds. But more capital is required for the fencing material for this system than is required for the system involving using a combination of small camps totalling 2% of the veld, and a larger concentration camp. With the combination system, the farmer is able to keep records, and the farmer is also able to identify the passengers and cull them. Hence, the farmer does not keep the birds that cause a lowering of profit. This system also allows genetic selection, and thus, the farmer can select the best breeding stock. In doing so, the farmer is able to increase productivity. With this system, the farmer provides the birds with all their feed, and this is the main cost with this system. The profitability of the three types of small-camp system obtained from the typical farm models is summarised in Table 6.5.

Table 6.5 Profits realised from producing day-old chicks over the transition period from flock breeding to small camps, with passive veld restoration

Small-camp system	**NPV (R)**	**IRR (%)**	**BCR**
Small camp of 2% of veld in size	942 197	5	1.125
Small camp of 0.25 ha per breeding trio	1 671 977	7	1.158
Combination system	2 676 309	9	1.208

6.4 Profitability of a fully operational small-camp system for producing day-old chicks

The previous section showed the financially implications of a gradual shift from the flock breeding system to the small-camp system. This section assumes that the transition period is finished and the farmer has totally invested in the small-camp system. Thus the small-camp system is now fully operational. Firstly, the results for the profitability of producing day-old chicks using the small-camp system with passive veld restoration are given. Secondly, the results for the profitability of producing day-old chicks using the small-camp system with active veld restoration are given.

6.4.1 Profitability of producing day-old chicks for the small-camp system with passive veld restoration

Three sets of models where developed to show the three different ways of farming ostriches using the small-camp system. Veld restoration costs were not included. These three sets of models show the profitability of farming ostriches on restored veld using three different types of small-camp system. The first model represents farming ostriches where the farmer sacrifices 2% of the veld. Thus, the farmer takes the birds off the veld and puts them in a small camp of 2% in size of the veld. The second model shows a scenario where the farmer uses the combination system. The farmer keeps the second-best breeding flock in a large camp(s) for commercial purposes. The farmer keeps each best breeding trio in a small camp of 0.25 ha for breeding the mother stock. The total area under the large and small camps does not exceed 2% of the veld. The third model shows a system where the farmer uses only small camps of 0.25 ha.

6.4.1.1 Breeding camp of 2% of veld

The IRR for the system using small camp of 2% of the veld is 10% if the farmer undertakes passive restoration. For the same system, the NPV is R1 633 0.17. The corresponding BCR is 1.163. These figures show that if farmers undertake passive restoration, they make more profit (see Table 6.6).

6.4.1.2 Small camps of 0.25 ha per breeding trio

For this system, the IRR is 11% if the farmer undertakes passive restoration. The corresponding NPV is R1 874 341. If the farmer undertakes passive restoration then the BCR is 1.183.

6.4.1.3 Combination system

The combination system is the most profitable of all three systems. This method has an IRR of 12% in the case where the farmer undertakes passive restoration. The corresponding NPV is R2 093 699. Thus, the NPV of the future value of streams of benefits is positive. The BCR is 1.201 if the farmer undertakes passive restoration. The profitability of the three types of small-camp system is summarised in Table 6.6.

Table 6.6 Profitability of the three types of small-camp system, with passive veld restoration

Type of small-camp system	NPV (R)	IRR (%)	BCR
2% of the total area of veld	1 692 702	10	1.177
0.25 ha small camp	1 952 612	11	1.196
Combination system	2 171 963	12	1.206

The income from beef on restored veld is based on a sustainable stocking rate of one LSU per 60 ha, which takes dry years into account. The stocking rate assumes that medium-frame cattle, like Bonsmara, will be kept on the veld. This renders a beef cattle income of only R25.15/ ha per annum. This limited contribution to the farm income can clearly not be the driving force towards the small-camp system and cannot finance significant veld restoration efforts at speeding up restoration to reach the sustainable beef cattle stocking rate sooner. The profitability of switching to the small-camp system is the main consideration in this study. The question to be answered in the latter sections is to what extent this profit can absorb active restoration costs.

This section proved the first hypothesis to be correct. The private benefits from the small-camp system are able to cover the costs of passive veld restoration. The profitability of the production of day-old chicks during this period is influenced by the type of the small-camp system used and the number of day-old chicks produced per bird. Having proved the first hypothesis to be correct, the next sections test the second hypothesis.

6.4.2 Capacity of the fully operational small-camp system to absorb active veld restoration costs

The previous sections showed that it is worthwhile switching from the flock breeding system to the small-camp system. This section shows the ability of the fully operational small-camp system to absorb active veld restoration costs. The combination of small camps and a concentration camp will be used to represent the small-camp system in this part of the analysis, as it is more profitable than the other types of small-camp system.

As the farmer shifts from the flock breeding system to the small-camp system over the 15 years of the transition period, the birds are gradually removed from the veld. One would expect the moderately degraded veld without dongas to recover as the birds are removed from the veld; however, experience has shown farmers that the moderately degraded veld without dongas will not recover even though there are only a few birds remaining on the veld. This is because the ostriches tend mainly to walk along the fences, thereby causing serious damage to a small part of the camp. Thus, after the 15 years of the transition period, the whole moderately degraded veld without dongas will need to be actively restored. Therefore, the cost of restoring the whole moderately degraded veld without dongas was included in the analysis.

6.4.2.1 Profitability of producing day-old chicks for the small-camp system with active restoration of only heavily degraded veld without dongas

Producing day-old chicks is profitable if the farmer actively restores only the heavily degraded veld that will barely restore without active support. The moderately degraded veld is left to restore through passive restoration over an estimated long term of 20 years. In this scenario, the IRR is 8%, and thus, for every rand invested, the farmer gets a return of R0.08. The NPV is R1 371 679, and thus, the present value of the future value of streams of benefits is still positive (see Table 6.7).

6.4.2.2 Profitability of day-old chick production for the small-camp system with active restoration of heavily and moderately degraded veld without dongas

If the farmer undertakes active restoration of both heavily degraded veld (10% of the veld) and moderately degraded veld (30% of the veld) then the IRR will be 3%, which is below the interest rate at which capital can be invested, the opportunity cost of capital. The NPV is -R258 343 and the BCR is 0.905 (see Table 6.7). The benefit to be derived from switching to the small-camp system combined with the limited contribution from beef production is not sufficient to cover the cost of active restoration of both heavily degraded veld and moderately degraded veld.

Table 6.7 shows a comparison of the profitability of day-old chick production under conditions of passive restoration, active restoration of heavily degraded veld only, and active restoration of moderately and heavily degraded veld.

Table 6.7 Ability of the fully operational small-camp system to absorb active veld restoration costs

Level of restoration	**IRR (%)**	**NPV (R)**	**BCR**
Passive restoration	12	2 093 699	1.201
Active restoration of heavily degraded veld only	8	1 371 679	1.158
Active restoration of moderately and heavily degraded veld	3	-258 343	0.905

Note: It was assumed that 10% of the veld is heavily degraded and 30% is moderately degraded.

It was assumed that birds do not get any feed from the veld

When an active veld restoration strategy is followed, the ostrich farm can still render an IRR of 8% (for the combination system) if only the heavily degraded veld is restored only through soil manipulation and seeding. On average, some 10% of the veld of ostrich farms around Oudtshoorn is heavily degraded. No cost of restoring veld with dongas is included, as this is a size order higher and can obviously not be covered by ostrich farming profits.

Some 30% of the veld in the Oudshoorn area is moderately degraded. When the restoration of this larger area per farm is added, the total active restoration cost cannot be absorbed by ostrich farming profits. The farm then delivers an IRR of 3% and a negative NPV (for the combination system). Only passive restoration can then be applied to restore the moderately degraded veld, a process that will take around 20 years to deliver comparable results.

The active restoration of moderately degraded veld and the restoration of heavily degraded veld with dongas will require external funding. Only a strong moral obligation will motivate farmers to allocate a significant part of the profit from day-old chick production with the small-camp system to the restoration of the heavily degraded veld without dongas, as the direct financial return from beef cattle on the restored veld will be far too low.

This section concluded assessing the second hypothesis. The second hypothesis is true to some extent that is the private benefits from the small-camp system are able to cover the costs of restoring the heavily degraded veld only. The private benefits from the small-camp system are not able to cover the full cost of veld restoration (cost of restoring heavily and moderately degraded veld) and in this case the second hypothesis becomes incorrect. The private benefits from the small-camp system are able to compensate the cost of restoring the heavily degraded veld only because the heavily degraded veld is just a small part of the veld (10% of the veld).The private benefits from the small-camp system cannot cover the costs of full restoration because the moderately degraded veld is a large area (30% of the veld) hence the cost of restoring it is high.

6.4.3 Sensitivity analysis of the production of day-old chicks with the small-camp system

The other important variable that influences the profitability of the small-camp system is the average number of day-old chicks produced per bird. The above analysis was done using an average of 40 day-old chicks per bird. This section shows the effect of varying the number of day-old chicks produced per bird on the profitability of the production of day-old chicks with or without active veld restoration. The number of day-old chicks was varied from 30 to 45 chicks per bird.

Table 6.8 shows the profitability of the production of day-old chicks using the small-camp system with passive veld restoration, given that the number of day-old chicks per bird is varied from 30 to 45. If the number of day-old chicks per bird is 35, 40 or 45, the farmer makes money regardless of the type of the small-camp system the farmer uses. However, if the number of day-old chicks per bird is 30, the farmer makes loss regardless of the type of the small-camp system used. The more the number of day-old chicks produced per bird the more the profit the farmer makes.

Table 6.9 shows the ability of the small-camp system to absorb the costs of veld restoration, given that the number of day-old chicks per bird is varied. In this case only the combination system was considered since it is the most profitable of the 3 types of the small-camp system. The financial benefits from the small-camp system is able to cover the costs of restoring a heavily degraded veld only, provided that the number of day-old chicks per bird is at least 35. If the number of the day-old chicks is 30, then the financial benefits from the small-camp system cannotr cover the costs of restoring a heavily degraded veld only. In this case the IRR is -2%, and the corresponding NPV and BCR are -R1 746 035 and 0.954 respectively (see Table 6.9).

If the number of day-old chicks per bird is 30 or 35, the benefits from the small-camp system cannot compensate for the costs of full veld restoration because the corresponding IRR's are -5% and -1% respectively. From Table 6.9, it can be deduced that the benefits from the small-camp system can only cover the costs of full veld restoration if the number of day-old chicks per bird is 45.

Table 6.8 Profitability of the production of day-old chicks for various levels of number of chicks produced per bird

Type of small-camp system	Number of day-old chicks per bird	NPV	IRR	BCR
2% of veld	30	-1 484 697	-2	0.957
	35	74 160	4	1.061
	40	1 633 017	10	1.163
	45	3 191 874	18	1.262
0.25 ha small camp	30	-1 243 373	-1	0.974
	35	315 484	4	1.080
	40	1 874 341	11	1.183
	45	3 433 198	19	1.283
Combination system	30	-1 024 014	-1	0.991
	35	534 843	5	1.097
	40	2 093 699	12	1.201
	45	3 652 556	20	1.302

Strictly, the second hypothesis is not true with levels of number of day-old chicks per bird used in the previous sections. However there is room for improvement based on the benefits of the small-camp system. With the highest level of the number of day-old chicks produced per bird used in the sensitivity analysis, the private benefits will be able to cover the full cost of veld restoration. Figure 6.2 shows the scenarios covered in this chapter and their corresponding IRR.

Table 6.9 The ability of the small-camp system to absorb the costs of veld restoration given that the number of day-old chicks per bird is varied

Level of restoration	Number of day-old chicks per bird	NPV	IRR	BCR
Active restoration of heavily degraded veld only	30	-1 746 035	-2	0.954
	35	-187 178	3	1.058
	40	1 371 679	8	1.158
	45	2 930 536	13	1.256
Active restoration of moderately and heavily degraded veld	30	-3 376 057	-5	0.878
	35	-1 817 200	-1	0.974
	40	-258 343	3	1.067
	45	1 300 514	6	1.159

6.5 Conclusions

The first hypothesis is correct and the degree of profitabilty of the small-camp system is mainly influenced by the number of day-old chicks per bird. For the flock breeding system, if the farmer sticks to the prescribed stocking rates, the farmer will not make profit and this is the main reason why farmers end up exceeding the prescribed stocking rate. This results in the degradation of the veld. The small-camp system allows the farmer to make profit at the same time making it possible for the large part of the veld to be ecologically sustainable. However, the small-camp system destroys completely the small area of the veld occupied by

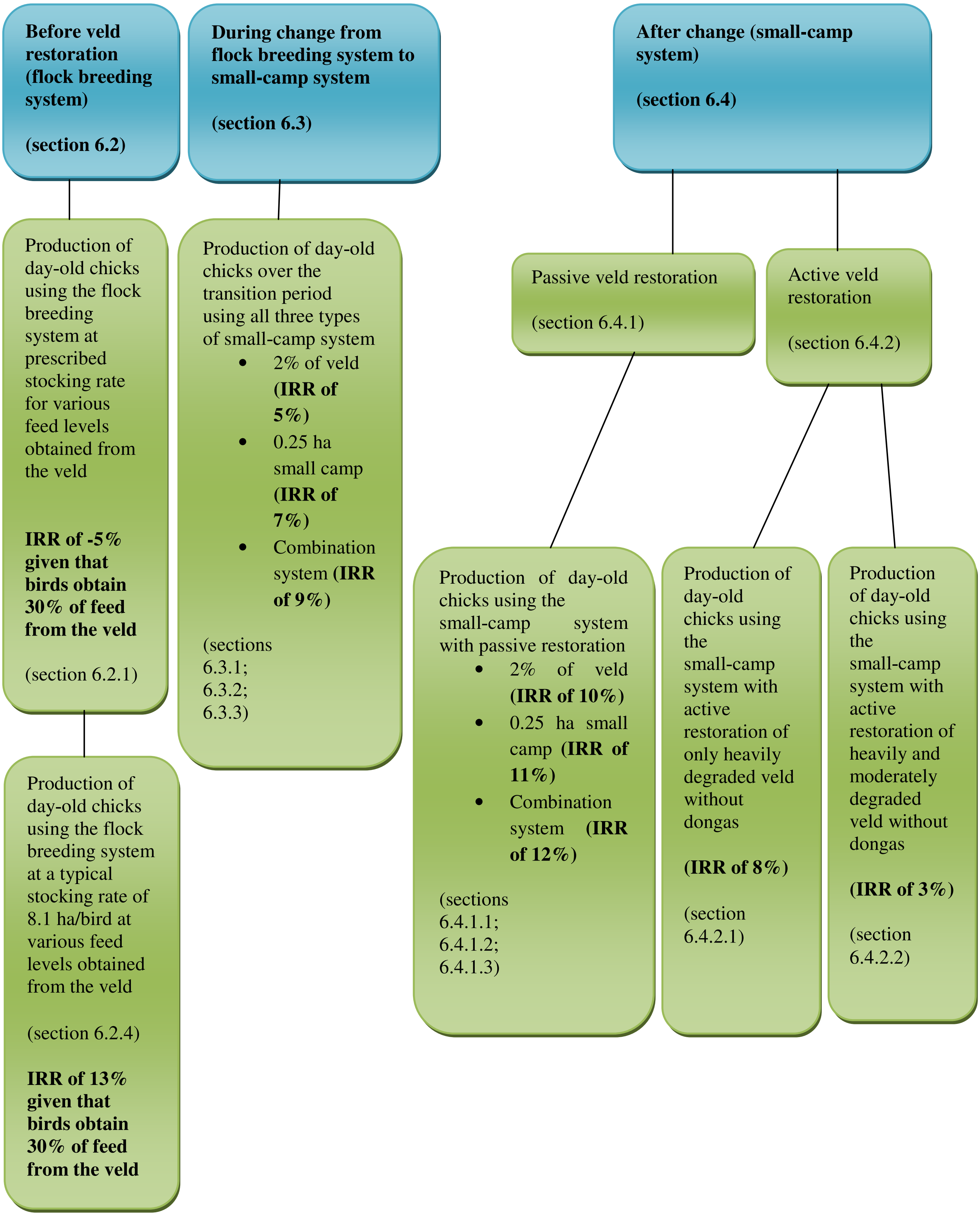

Figure 6.2 The scenarios of ostrich chick production – veld restoration and their corresponding IRR's

the small camps. The sacrifice of this small area allows the farmer to make profit and keep the large area of the veld ecologically sustainable.

The second hypothesis is not necessarily true. The benefits generated are not enough to cover the costs of full veld restoration. However, the benefits generated can cover the costs of restoring a heavily degraded veld only. Even though the costs of restoring a heavily degraded veld are high, the heavily degraded veld is still a small percentage of the total veld.

The flock-breeding system is the cheapest ostrich-breeding system, but is not profitable when a farmer adheres to the prescribed rate of stocking the veld with breeding ostriches. With production costs rising more rapidly than income (the classic ‘farm problem’), farmers tend to overstock their veld in order to maintain profitability. This happens at the expense of ecological sustainability, as the veld is degraded through trampling. It is possible to overstock the veld over the long term, as breeding ostriches rely on the veld as a source of feed only to a limited extent (or not at all), as they are fed lucerne-based rations. Typical farm modelling of an ostrich farm aimed at producing day-old chicks to sell, as the start of an ostrich supply chain, shows that the breakeven stocking rate of breeding ostriches on the veld is more or less double the prescribed rate, depending on the assumed amount of feed taken from the veld.

The small-camp system allows the farmer to constantly select the best breeding stock, and by doing so, the farmer is able to increase the profits for producing day-old chicks. The three types of small-camp system have different profit levels, with the combination system being the most profitable, with the highest IRR of 12%. This is because the combination system allows monitoring and selection of the most productive birds to produce chicks for the breeding stock (or ‘stud’) on the farm, thus allowing for genetic improvement. This system requires less capital for fencing material compared with the 0.25 ha small-camp system. The opportunity to practice genetic selection presented by the small-camp system enables the farmer to increase the profitability of producing day-old chicks. This makes it financially viable for a farmer to switch from the flock breeding system to the small-camp system.

It will take around 15 years for a complete switch to the small-camp system. The farmer builds the small camps gradually, not only to avoid financial strain, but also to bring only new, young breeding trios (two females and a male) into the small camps, allowing the breeding birds on the veld to finish their productive lives. Experience has taught farmers to avoid the risk of shifting veld ostriches to small camps, as they normally do not adapt well to the confined space. The gradual increase in productivity made possible by genetic selection is able to compensate for the investment in fencing material during this phase. No active restoration costs were included in this analysis; only the cost of the fencing material was included.

When the small-camp system is fully operational, it can carry the cost of restoring heavily degraded veld without dongas and give an IRR of 8%. However, if the cost of restoring both the heavily and moderately degraded veld without dongas is added, the IRR will drop to 3%, with an NPV of -R258 343. Thus, the private benefits from producing day-old chicks can only cover the costs of restoring heavily degraded veld without dongas. External funding will be needed to cover the costs of restoring both the heavily and moderately degraded veld without dongas

A sensitivity analysis showed that the average number of day-old chicks per bird plays a big role on the degree of profitability of the production of day-old chicks. If the number of day-old chicks per bird is 30, the farmer loses money even though the farmer does passive restoration. In the case where the average number of day-old chicks per bird is at least 35, the farmer makes money. If the number of day-old chicks per bird is 40, then the private benefits from the small-camp system (combination system) can cover the costs of restoring a heavily degraded veld only. For the combination system, an average of 45 day-old chicks per bird will be required in order for the private benefits to cover the the costs of full veld restoration.

7 CONCLUSIONS AND SUMMARY

7.1 Conclusions

The production of day-old chicks using the flock breeding system at the prescribed stocking rate, assuming that the ostriches get up to 30% of their feed from veld, is not viable. For the farmer to break even, assuming that the ostriches do not get any feed from the veld, the stocking rate must be 8.3 ha per ostrich. Assuming that the ostriches get 30% of their feed from the veld, the breakeven stocking rate will be 13.70 ha per ostrich. These stocking rates are almost double the stocking rate prescribed by the Department of Agriculture. Such heavy stocking rates will result in the degradation of the veld and, consequently, a loss of biodiversity.

Having shown the breakeven stocking rate, the study also determines the stocking rates giving an IRR of 6% as a typical agricultural return. If the birds do not get any feed from the veld, then a stocking rate giving an IRR of 6% will be 6.8 ha per ostrich. In a case where the ostriches get 30% of their feed from the veld, the stocking rate giving an IRR of 6% is 11.5 ha per ostrich. It should therefore be clear why farmers, in order to survive financially, use a significantly a higher stocking rate than the officially prescribed rate of 22.8 ha per ostrich.
During the transition period, the gradual increase in productivity will cover the costs of fencing material. The IRR for all three types of small-camp system are positive, with the combination system giving the highest IRR of 9%. Despite the fact that the farmer is investing in fencing material, the positive impact of the small-camp system can already be seen in its absorption of the costs of the fencing material. The farmer has to build the small camps gradually to avoid financial strain, at the same time bringing only new, young breeding trios (two females and a male) into the small camps, thereby allowing the breeding birds on the veld to finish their productive lives. Only the cost of the fencing material was included in this analysis. The cost of active veld restoration was not included, because restoration of the veld cannot start while some ostriches are still on the veld.

For the ‘after’ period, the profitability of three different types of small-camp system was calculated. These three types of small-camp system are the single, large 2%-of-the-veld concentration camp, small camps of 0.25 ha per breeding trio, and the combination system. For this 'after' period, it is assumed that the farmer has already fully invested in the small-camp system, that it is fully operational, and that chick production on the veld does not occur anymore.

The combination system is the most profitable with an IRR of 12%; followed by the system involving 0.25 ha camps per breeding trio, with an IRR of 11%; and lastly, the system involving a large concentration camp of 2% of the veld, with an IRR of 10%. The combination system has the same benefit of genetic selection as the system involving 0.25 ha camps per breeding trio, but requires less capital for the fencing material compared with the system involving 0.25 ha camps per breeding trio. The system involving 2% of the veld requires the least investment in fencing material, but genetic selection is not possible as in the other two systems, and thus, it allows less income generation.

It is concluded that it is financially viable for a farmer to switch from the flock breeding system to the small-camp system. This switch will allow the farmer to practice genetic selection, thereby increasing the IRR to 12% (with the combination system). This proves the first hypothesis to be true since the private benefits are able to cover the costs of switching from the flock breeding system to the small-camp system.

The switch from the flock breeding system to the small-camp system allows the larger area of veld to be freed up and restored. The study investigated the capacity of the fully operational small-camp system to absorb the costs of veld restoration. The private benefits from producing day-old chicks can cover only the costs of restoring heavily degraded veld without dongas. Thus, the private benefits cannot compensate for the costs of restoring both the heavily and moderately degraded veld without dongas. This means that the small-camp system will allow the farmer to address the more serious veld degradation, leaving the moderately degraded areas to recover over a longer period without active restoration. The cost per hectare of restoring dongas is so high that the profits derived from the small-camp system will only allow for the restoration of a relatively small area with dongas. This proves that the second hypothesis is correct in the sense that the private benefits can cover the costs of restoring a heavily degraded veld only. However, the second hypothesis is not true in the sense that the private benefits cannot cover the costs of restoring both heavily and moderately degraded veld.

A sensitivity analysis was conducted to show the effect of the average number of day-old chicks per bird on the profitability of the production of day-old chicks. An average of 45 day-old chicks per bird is required for the private benefits to cover the costs of full veld restoration. An average of 40 day-old chicks per bird can only cover the costs of restoring heavily degraded veld only. Based on the example of the farmer based in Still Bay, an average of 45 day-old chicks per bird might be attainable, but it requires the farmer to practice genetic selection very well.

The government should try to set up a market of payment for ecocystem services in order to try to encourage the farmers to shift from the flock breeding system to the smalll-camp system and restore the degraded veld. Payment for ecosytsem services can be defined by 5 criteria namely (Wunder, 2008:1):

- A voluntary transaction in which.
- A well-defined ecosystem service.
- Is bought by at least one buyer.
- The service is provided by at least one supplier.
- The transaction only takes place upon provision of the service.

Setting a payment for esoystem services market might be possible if there is an agency or private organisation that can pay the farmers to restore their veld so that the quality of the veld is improved. Thus the farmers taking part in this payment for ecosytem services programme will agree to implement certain restoration or conservation schemes in their lands for a particular time period in exchange for a payment. Such organisations might be interested in promoting conservation of biodiversity, eco-labelling of products produced in these areas in eco-friendly way or might be interested in promoting tourism.

7.2 Summary

The main aim of this study was to investigate the financial implications of a gradual shift from the flock breeding system to the small-camp system. This switch will free up space in order to allow veld restoration to take place, as the small camps occupy only a small part of the farm (maximum 2% of the total extent of the veld).

Typical farm models for the study area were developed to assess the abovementioned financial implications. Three farm models were developed to assess the phases before, during and after veld restoration. There are three main reasons for using a model for each of the three periods. The first aim of the study was to compare the before veld restoration period and the after veld restoration period as two stable/normal conditions. The second aim of the study was to show the ability of the fully operational small-camp system to absorb active veld restoration costs. The third aim of the study was to show the financial implications of carrying the cost of fencing material from a cash flow perspective during veld restoration. This includes the real flow of funds in buying fencing material for the small camps.

The first chapter gave an introduction to the current situation in the area of study, namely, Outdshoorn. The problem statement, hypothesis, justification of the study, assumptions, delimitations and definition of terms were also presented in the first chapter.

The second chapter presented a background to the South African ostrich industry. The ostrich farming systems being practiced in Oudtshoorn were discussed. The majority of the farmers are using the flock breeding system, and it is this system that is the main threat to biodiversity. The benefits and costs of the flock breeding system and the small-camp system were also discussed in this chapter.

Chapter Three provided information on the extent to which the veld around Oudtshoorn is degraded. Thus, the veld was put into four classes depending on the extent of the degradation. The cost of veld restoration for each class was given in this chapter.

Chapter Four reviewed the literature on farm modelling. Different types of modelling were discussed, and the reasons for choosing the method used in this study and omitting other methods were given in this chapter.

Chapter Five presented the research methodology used in this study. A set of three typical farm models were developed for three periods, namely, before veld restoration, after veld restoration, and during veld restoration. The typical farm models were developed to show the costs and benefits of producing day-old chicks during the periods mentioned above. The restoration period was assumed to be 15 years.

Chapter Six presented the results obtained from this study. The profitability of producing day-old chicks was determined for three different scenarios. The first scenario is where the farmer uses the flock breeding system at the prescribed stocking rate of 22.8 ha per bird. The amount of feed obtained from the veld was varied from 0 to 30%. In this scenario, producing day-old chicks is not profitable. The breakeven stocking rates using the flock breeding system while varying (between 0 and 30%) the amount of feed obtained from the veld were determined. The stocking rates giving an IRR of 6% as a typical agricultural return for various levels (0 to 30%) of feed obtained from the veld were calculated. All the stocking rates were found to be almost double the prescribed stocking rates. The profitability of producing day-old chicks using the flock breeding system at a typical stocking rate of 8.1 ha/bird for various levels of feed obtained from the veld was calculated. At such a stocking rate, an IRR of 13% can be obtained, assuming that birds obtain 30% of their feed from the veld. However, such a heavy stocking rate will result in veld degradation.

For the second scenario, the profitability of producing day-old chicks was calculated for a 15 year period while shifting from the flock breeding system to the small-camp system. This scenario showed the financial implications of carrying the cost of fencing material from a cash flow perspective during veld restoration. This includes the real flow of funds in buying fencing material for the small camps. No active restoration costs were included in this sceanrio, because some birds stay on the veld, making it impossible to start active veld restoration. The profitability of producing day-old chicks using the three different types of small-camp system was calculated. All three types of the small-camp system were found to be profitable, with the combination system having the highest IRR of 9%.

For the third scenario, the profitability of producing day-old chicks after veld restoration, using three different types of small-camp system was calculated. For this scenario, it was assumed that the small-camp system is fully operational. No active veld restoration costs were included in this scenario. Only the cost of fencing material used in the erection of the small camps was included. All three systems were found to be profitable, with the combination system being the most profitable, with an IRR of 12%.

Chapter Six also presented the results for the ability of the small-camp system to carry the cost of active veld restoration. The combination system was the only type of small-camp system considered here, because it is the most profitable. It was assumed that the farmer has fully invested in the small-camp system. The private benefits from the production of day-old chicks are only able to cover the costs of restoring a heavily degraded veld without dongas.

Results of a sensitivity analysis were also shown in Chapter Six. The number of day-old chicks was varied from 30 to 45. The ranges of the average number of day-old chicks required to cover the costs of veld restoration were shown.

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Annexure

Annexure 1: A sample of the basic structure of the typical farm model

	Percentage	ha
Total Farm Size (ha)	100%	1500
Veld/Grazing Land (ha)	97%	1455
Non usable land (ha)	2%	26
Irrigated/Cultivated	1%	20

Veld Types

Veld Type 1	**30%**	**Percentage**	**Ha**	**Stocking Rate (ha/bird)**	**Rotation Factor**	**No. of Breeding birds**
Good		10%	145.5	22.8	0.33	19
Medium		10%	145.5	22.8	0.33	19
Bad		10%	145.5	22.8	0.33	19
Total		**30%**	**436.5**			**58**

Veld Type 2	**30%**	**Percentage**	**Ha**	**Stocking Rate (ha/bird)**	**Rotation Factor**	**No. of Breeding birds**
Good		10%	145.5	22.8	0.33	19
Medium		10%	145.5	22.8	0.33	19
Bad		10%	145.5	22.8	0.33	19
Total		**30%**	**436.5**			**58**

Veld Type 3	40%	Percentage	Ha	Stocking Rate (ha/bird)	Rotation Factor	No. of Breeding birds
Good		15%	218.3	22.8	0.33	29
Medium		15%	218.3	22.8	0.33	29
Bad		10%	145.5	22.8	0.33	19
Total		**40%**	**582**			**77**

Total Number of breeding birds **193**

Farm Inventory

Item	Quantity	Price	Total Amount
Breeding Birds	193	4000	773524.72
Hay loader on 1 tractor	1	30000	30000
Feed Mixer	1	100000	100000
Hammer Mills	1	25000	25000
Trailer (4 tonne)	2	35000	70000
Hay baler	1	40000	40000
Land:			
Irrigated	19.5	30000	585000
Veld and non-usable	1480.5	1000	1480500
Tractor 1	1		0
Tractor 2	1	139000	139000
Tractor 3	1		0
Hay Bine	1	50000	50000
Hay Rake	1	32957	32957
LDV1	1	221319	221319
LDV2	1	119124	119124
Total			**3666424.72**

Fixed Costs

Item	Cost
Depreciation	62055.00
Maintenance: Fixed improvements	30000
Labour	60000
Telephone	12000
Auditor	30000
Banking Cost	8000
Office requirements	3000
Maintenance of machinery	10000
Membership fees	1500
Tax on water and other	3900
Fuel	104880
Insurance	20000
Electricity and water costs	20000
Salary 1	42000
Salary 2	130000
Diverse	10000
Total	**547335.00**

Machinery Replacement Schedule

Item	Scrap Value	Replacement Value
Hay loader	3000	27000
Feed Mixer	10000	90000
Hammer Mills	2500	22500
Trailer (4 tonne)	7000	63000
Hay baler	4000	36000
Tractor 1	0	0
Tractor 2	13900	125100
Tractor 3	0	0
Hay Bine	5000	45000
Hay Rake	3295.7	29661.3
LDV1	22131.9	199187.1
LDV2	11912.4	107211.6
Total		**744660**

Machinery to be replaced after 12years
Scrap Value is 10% of the purchase price

Assumptions

Number of breeding birds in flock	193

Explanation of production givens

126	females
68	males
47	average number of egg per female
5908	total number of eggs
60%	average hatch percentage
24.0	day old chicks per female (marketable)
3017	total number of day old chicks
709	total egg shells sold
97%	Survival rate

Breeding Bird Replacement	3%
Hygiene Costs	3867.62
Slaughter Fee	185
Slaughter Levy	16.5
Average carcass mass in kg	42

Standard hatching cost	25	Rands per live chicken (that includes everything)
Electricity cost	2.5	per egg

All day old chicks are sold

Feed supplied by the Veld

	Percentage	Feed (kg)	Amount (Rands)
Feed supplied by the veld	0.0%	0.00	0.00

Prices of Inputs

Non Lucerne Component

Item	Price per packet (R)
Maize	720
Minerals vitamins premix	500
Soya	250
Total	**1470**

Cost per Bird for non lucerne component for a week	**R 49.00**	
Cost per Bird for non lucerne component for 9 months	**R 1 909.53**	
Cost per Bird for non lucerne component for 3 months	**R 77.94**	
Total Annual non lucerne component cost per bird for a year	**R 1 987.47**	
Breeding Pellets	**R 2 900.00**	**per tonne**

Lucerne:	
Lucerne: Bought price per kg:	R 3.00
Variable cost: Own production per kg: (only allocatable costs)	R 2.50

Prices of Outputs

Item	Unit	Quantity	Price (R)	Total Amount (R)
Sale of eggs	eggs	5908	160	945247.21
Sale of day old chicks	chicks	3017	250	754186.60
Sale of egg shells	shells	709	15	10634.03
Sale of feathers (breeders)	breeder	193	300	58014.35
Skin	skin	193	800	154704.94
Meat	kg	8702	20	174043.06

FEED

Breeding Period			
* Feed intake per bird per day (5% spillage included)	2.6 kg	**Cost per kg**	2.50
* Intake/bird/breeding period	638 kg		
Resting Period			
Feed intake per bird per day (10% spillage included)	2.8	**Cost per kg**	2.50
Intake/ bird/ breeding period	336 kg		
Transport	**Rands**		
Per Breeding Ostrich	75.55		
Per Egg	2.52		
Per Chick	4.97		

Estimated Costs and Income of the production of day old chicks

Item	Unit	Number	Rand Per Unit (Rands)	Flock (Rands)	Day Old Chick (Rands)	Breeding Ostrich (Rands)	Per Egg (Rands)
Allocatable Variable Costs							
Purchased Feed	kg		3.00				
Feed: Breeding period of 8 months (243 days)	kg	123353.02	2.50	308382.55	102.22	1594.69	52.20
Feed: Rest period of 4 months (122 days)	kg	64879.39	2.50	162198.46	53.77	838.75	27.45
Less feed supplied by the veld	kg	0.00	2.50	0.00	0.00	0.00	0.00
Breeding bird replacement	bird	6	4000.00	23205.74	7.69	120.00	3.93
Transport (fuel, repairs, maintenance)	rand			14609.95	4.97	75.55	2.52
Electricity	rand	5908	2.5	14769.49			
Hygiene	rand			3867.62	1.28	20.00	0.65
Labour	rand	1	42000	42000.00	13.92	217.19	7.11
Total Allocatable Variable Costs				**569033.82**	**183.86**	**2866.18**	**93.87**
Income							
Sale of day old chicks	chicks	3017	250	754186.60	250.00	3900.00	127.6595745
Sale of egg shells	shells	709	15	10634.03	3.53	54.99	1.8
Sale of feathers	bird	193	300	58014.35	19.23	300.00	9.82
Total Income				**822834.99**	**272.76**	**4254.99**	**139.28**
Margin above allocatable variable costs (Gross Margin)				**253801.17**	**88.90**	**1388.81**	**45.41**

Multi period Budget

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Inflows															
Farm Income															
Sale of day old chicks	754187	754187	754187	754187	754187	754187	754187	754187	754187	754187	754187	754187	754187	754187	754187
Sale of egg shells	10634	10634	10634	10634	10634	10634	10634	10634	10634	10634	10634	10634	10634	10634	10634
Sale of feathers	58014	58014	58014	58014	58014	58014	58014	58014	58014	58014	58014	58014	58014	58014	58014
Total Farm Income	**822835**	**822835**	**822835**	**822835**	**822835**	**822835**	**822835**	**822835**	**822835**	**822835**	**822835**	**822835**	**822835**	**822835**	**822835**
Allocated Variable Costs															
Feed	470 581	470 581	470 581	470 581	470 581	470 581	470 581	470 581	470 581	470 581	470 581	470 581	470 581	470 581	470 581
Less amount of feed supplied by the veld	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Breeding bird replacement	23 206	23 206	23 206	23 206	23 206	23 206	23 206	23 206	23 206	23 206	23 206	23 206	23 206	23 206	23 206
Transport (fuel, repairs, maintenance)	14 610	14 610	14 610	14 610	14 610	14 610	14 610	14 610	14 610	14 610	14 610	14 610	14 610	14 610	14 610
Hygiene	3 868	3 868	3 868	3 868	3 868	3 868	3 868	3 868	3 868	3 868	3 868	3 868	3 868	3 868	3 868
Total	**512 264**	**512 264**	**512 264**	**512 264**	**512 264**	**512 264**	**512 264**	**512 264**	**512 264**	**512 264**	**512 264**	**512 264**	**512 264**	**512 264**	**512 264**
Non Allocatable Variable Costs															
Fuel, repairs, maintenance	104 880	104 880	104 880	104 880	104 880	104 880	104 880	104 880	104 880	104 880	104 880	104 880	104 880	104 880	104 880
Total	**104 880**	**104 880**	**104 880**	**104 880**	**104 880**	**104 880**	**104 880**	**104 880**	**104 880**	**104 880**	**104 880**	**104 880**	**104 880**	**104 880**	**104 880**

Fixed Costs (excluding interest on capital, property rent)

Maintenance:															
Fixed improvements	30 000	30 000	30 000	30 000	30 000	30 000	30 000	30 000	30 000	30 000	30 000	30 000	30 000	30 000	30 000
Labour	60 000	60 000	60 000	60 000	60 000	60 000	60 000	60 000	60 000	60 000	60 000	60 000	60 000	60 000	60 000
Telephone	12 000	12 000	12 000	12 000	12 000	12 000	12 000	12 000	12 000	12 000	12 000	12 000	12 000	12 000	12 000
Auditor	30 000	30 000	30 000	30 000	30 000	30 000	30 000	30 000	30 000	30 000	30 000	30 000	30 000	30 000	30 000
Banking Costs	8 000	8 000	8 000	8 000	8 000	8 000	8 000	8 000	8 000	8 000	8 000	8 000	8 000	8 000	8 000
Office requirements	3 000	3 000	3 000	3 000	3 000	3 000	3 000	3 000	3 000	3 000	3 000	3 000	3 000	3 000	3 000
Maintenance of machinery	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000
Membership fees	1 500	1 500	1 500	1 500	1 500	1 500	1 500	1 500	1 500	1 500	1 500	1 500	1 500	1 500	1 500
Tax on water and other	3 900	3 900	3 900	3 900	3 900	3 900	3 900	3 900	3 900	3 900	3 900	3 900	3 900	3 900	3 900
Hatching cost	75 419	75 419	75 419	75 419	75 419	75 419	75 419	75 419	75 419	75 419	75 419	75 419	75 419	75 419	75 419
Insurance	20 000	20 000	20 000	20 000	20 000	20 000	20 000	20 000	20 000	20 000	20 000	20 000	20 000	20 000	20 000
Diverse	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000
Salary	130 000	130 000	130 000	130 000	130 000	130 000	130 000	130 000	130 000	130 000	130 000	130 000	130 000	130 000	130 000
Electricity and water costs	20 000	20 000	20 000	20 000	20 000	20 000	20 000	20 000	20 000	20 000	20 000	20 000	20 000	20 000	20 000
Total Fixed Cost (as specified)	**413 819**	**413 819**	**413 819**	**413 819**	**413 819**	**413 819**	**413 819**	**413 819**	**413 819**	**413 819**	**413 819**	**413 819**	**413 819**	**413 819**	**413 819**

Farm Capital

Breeding Birds	773 525		773 525
Hay loader	30 000	27 000	20 250
Feed Mixer	100 000	90 000	67500
Hammer Mill	25 000	22 500	16875
Trailer (4 tonne)	70 000	63 000	47250
Hay baler	40 000		0
Irrigation	585 000		585 000
Veld	1 480 500		1 480 500
Tractor	139 000		0
Cutter bar	50 000	45 000	33750
Hay Rake	32 957	29 661	22245.975
LDV1	221 319	199 187	149390.325
LDV2	119 124	107 212	80408.7
Total	**3 666 425**	**744 660**	**3 276 695**

Total Annual Outflow	**4 697 388**	**1 030 963**	**1 030 963**	**1 030 963**	**1 030 963**	**1 030 963**	**1 030 963**	**1 030 963**	**1 030 963**	**1 030 963**	**1 030 963**	**1 775 623**	**1 030 963**	**1 030 963**	**1 030 963**
Total Annual Inflow	**822 835**	**822 835**	**822 835**	**822 835**	**822 835**	**822 835**	**822 835**	**822 835**	**822 835**	**822 835**	**822 835**	**822 835**	**822 835**	**822 835**	**4 099 530**
Net Annual Flow	**-3 874 553**	**-208 128**	**-208 128**	**-208 128**	**-208 128**	**-208 128**	**-208 128**	**-208 128**	**-208 128**	**-208 128**	**-208 128**	**-952 788**	**-208 128**	**-208 128**	**3 068 567**

NPV	R -4 470 683
IRR	-9%

Real Interest Rate Calculations:

Inflation	7.5	**0.075**		**Real Rate**
Nominal Interest Rate			Real Interest Rate	
Positive	8.5	0.09	0.9302	0.9%
Negative	11	0.11	3.2558	3.26%

Cash Flow

Start Balance	0	-3874553	-4082681	-4290809	-4498937	-4707065	-4915193	-5123321	-5331449	-5539577	-5747705	-5955833	-6908621	-7116749	-7324877
Inflow	822835	822835	822835	822835	822835	822835	822835	822835	822835	822835	822835	822835	822835	822835	4099530
Outflow	4697388	1030963	1030963	1030963	1030963	1030963	1030963	1030963	1030963	1030963	1030963	1775623	1030963	1030963	1030963
End Balance	-3874553	-4082681	-4290809	-4498937	-4707065	-4915193	-5123321	-5331449	-5539577	-5747705	-5955833	-6908621	-7116749	-7324877	-4256310

$$BCR = \sum_{t=0}^{T} \frac{B_t}{(1+r)^t} \div \sum_{t=o}^{T} \frac{C_t}{(1+r)^t}$$

9659210.071 divided by 1229139

BCR = 0.7858517

Hay baler and tractor not to be replaced