AN EVALUATION OF THE FEASIBILITY OF A SUSTAINABLE COMMUNITY BASED INTEGRATED AQUACULTURE SCHEME IN THE MAFIKENG LOCAL MUNICIPALITY

by

FRASER ROBERTS KIZZA KADAMA

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SUPERVISOR: PROF. S. A. MATERECHERA

SEPTEMBER 2002

DEDICATION

The compilation of this dissertation involved a lot of reading, writing, additions and subtractions, the basics of which were taught to me by my mother. As I wrote this dissertation, my memory kept flashing back to the time when she taught me how to hold and use a pencil. I therefore would like to dedicate this dissertation to the loving memory of my late mother - Concordia Nababi Kadama.

Maama, Wumula Mirembe.

DECLARATION

I, Fraser Roberts Kizza Kadama, declare that the mini dissertation for the degree of Master in Business Administration at the University of North -West hereby submitted, has not been previously submitted by me for a degree at this or any other university, that it is my own work in design and execution and that all material contained herein has been duly acknowledged.

Signed: .....

Date: SEPTEMBER 2002

ACKNOWLEDGEMENTS

I am grateful to the Lord for his comforting presence and for keeping me healthy and strong. This gave me the fortitude to complete this task. Am also grateful to my lecturers and several friends who in one way or another helped in the compilation of this dissertation. But due to limitations by space, I cannot individually mention their names.

However, because of their specific contributions, I feel obliged to mention the following by name: My special thanks go to my supervisor Prof. S. A. Materechera, who diligently guided and helped me to plot my way through the maze. The ease with which he could be approached for consultation expedited the process of writing this dissertation. I would also like to thank Dr. S. R. Katashaya, who, when it became apparent that I would not meet my deadline, forsook his plans and offered a computer that I used to complete my work. I am also grateful to the following; Dr. D. Isabirye, Mrs. T. Lwanga and Mr. A. Bukenya, who facilitated my literature search and the printing of this dissertation. Last but not least, I would like to thank my wife Jennifer and our children Joanita and Nelson. I am truly grateful for the assistance you offered in typing, printing and compilation of this dissertation. But over and above all, I am grateful for the sacrifice you made and the manner in which you understood it that we would have to forfeit our quality time for the sake of the dissertation. Mwebale nnyo.

ABSTRACT

The study was conducted through a survey on the Setumo and Lotlamoreng dams and in the commercial business districts of Mafikeng and Mmabatho. It set out to evaluate the feasibility of a sustainable community based Integrated Aquaculture Scheme (IAS) in the Mafikeng Local Municipality (MLM).

The study noted the pivotal role on a global scale, played by the fishing industry through provision of food of high nutritional value and creation of employment opportunities for both men and women. It showed the importance of the fishery industry in Sub-Saharan Africa through its contribution of 4% to the sub-region's gross domestic product in 1994. The importance of the fishery industry in South Africa was highlighted by its employment of about 85,000 men and women and its annual contribution of R2.5 billion to the country's economy. The study also showed that the fishing industry in the MLM had become significant through the initiative of about 150 youths that were self-employed fishermen.

The findings of the study were that if an IAS were to be established in the MLM, it would be assured of the patronage of its stakeholders, many of whom were in their youth and were willing and capable of being trained to work on the IAS. Cash

flow projections of the IAS showed that the scheme could financially sustain its operations both in the short and long terms. These findings coupled with evidence adduced that integrated aquaculture was eco-friendly led to the conclusion that a sustainable community based IAS could be developed in the MLM if it received a capital grant to cover infrastructure development and kick-start its operations.

The study recommended that:

- The fishermen in the Molopo basin community should formally constitute themselves into a legal entity through which they could seek funding.
- Community members would have to request the Department of Agriculture, Conservation and Environment to initiate studies on the IAS.
- The provincial government would have to be requested to conduct workshops to educate the Molopo community on; the management of community projects, work ethics, environmental awareness, aims of the IAS, the criteria for selection of participants in the IAS.
- There would have to be strict adherence to high a standard of hygiene practice in the IAS operations.
- IAS operations would have to conform to environmental protection measures.

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ABBREVEATIONS AND ACRONYMS

BRTA	Barolong Bo Ratshidi Tribal Authority.
DACE	Department of Agriculture, Conservation and Environment.
DEDT	Department of Economic Development and Tourism.
DTCA	Department of Traditional and Corporate Affairs.
DWA	Department of Water Affairs.
DWAF	Department of Water Affairs and Forestry.
FAO	Food and Agricultural Organization.
GDP	Gross domestic product.
IAS	Integrated Aquaculture Scheme.
ICLARM	International Centre for Living Aquatic Resources.
MLM	Mafikeng Local Municipality.
NWA	National Water Act.
SSA	Sub Saharan Africa.
USA	United States of America.

CHAPTER ONE

ORIENTATION AND INTRODUCTION

The high demand for food by countries of the industrialized north and their ability to pay competitive prices has triggered a response within the less developed economies of the south to intensively utilize their natural resources in a bid to satisfy the demand. The high demand for food has led to the adoption of scientific means of production and mechanization in the farming and fishing industries. The choice of production system to be adopted, has, in many cases, been made with little regard for the requirements of the local populations and the capacity of the environment to recover from the exploitation.

As a result of this exploitation, the following social and environmental effects are manifested in the populations of the southern economies:

(a) Massive joblessness caused by increased efficiency in production.

(b) High food prices as a result of increased costs of production and high competition.

(c) Environmental degradation due to indiscriminate deforestation and over-exploitation of resources (ICLARM, 1996, Ministry of Agriculture and Land Affairs, 1998).

The North West province in the Republic of South Africa has had more than its share of the above problems. According to the Department of Finance and Economic Affairs (1998), unemployment, estimated at 36.4% in 1996, was the province's core economic development problem and it had been forecasted to increase to 43% by 2001 if no appropriate economic development strategies were implemented.

According to Munslow and Fitzgerald (1994), South Africa's most pressing sustainable development challenge was to improve the livelihoods of the poorest. As such, the North West provincial government realized the need to put the province on a path to sustainable development which, would empower the people by improving their skills, building their self-reliance and raising their dignity (Department of Finance and Economic Affairs, 1998).

Development begins by identifying human needs (Wilber, 1997) and this should be followed by the identification of the natural resource that can be tapped. The Mafikeng Local Municipality (MLM) is endowed with the Molopo River, a natural resource that could be tapped for the development of a sustainable fishery industry with the aim of improving the living conditions of the people.

This study was conceived on the presumption that it would be possible for a community based sustainable Integrated Aquaculture Scheme (IAS) to be developed in the Molopo River basin. The study realized the need for capacity building in areas that aimed at the utilization of the natural resources of the Mafikeng Local Municipality (MLM) in a sustainable manner and at the same time contributing to community development.

This chapter highlights the economic importance of fisheries and the reasons for the fragile state of global fishery. Background information on the factors and variables that affect the development of an IAS are adduced. Other aspects of the study such as the research problem, its objectives, hypothesis, methodology and its significance are also dealt with in this chapter.

1.1 The economic importance of a fishery industry

Fishery resources have played a pivotal role in providing the much-needed animal protein to the impoverished communities in rural Africa and to the African economy as a whole. In Sub Saharan Africa (SSA) marine and inland fisheries contributed about 4% of the region's agricultural Gross Domestic Product (GDP) in 1994 (FAO, 1996). The fishing industry contributes about R2.5 billion a year to the South African economy (Kavita, 2000). The fishery industry also plays an important role by its contribution to the balance of trade for many African nations. According to

FAO (1996), SSA was a net fish exporter since 1984 with fish trade generating a surplus of about US$ 322 million in 1994. Substantial revenues in hard currency also accrued from various types of compensation, royalties and fees from agreements negotiated with non-coastal countries (FAO, 1996).

The fishing industry has also contributed significantly to development in the African continent through creation of employment opportunities. In SSA, the fishing industry provided about 20% of the population's total animal protein intake and employed about 20% of the total agricultural workforce, with women playing an important role in fish processing and marketing (FAO, 1996). According to Kavita (2000), the fishing industry altogether employed about 85000 people in South Africa. In the MLM, fishing, which was mainly an activity for whiling away time by herdboys (Molema, 2001), has increased in levels. By March 2001 there were about 150 fishermen on Setumo Dam (Rouhani, 2001). Rouhani further observes that the number of fishermen was expected to increase further as the demand for fish increased with the changing demographics of the area. There is therefore a need to focus attention on the Molopo River as a natural resource that could be exploited to provide food and employment opportunities and contribute to the development of the MLM.

1.2 Reasons for the fragile state of the global fishery

Evidence of over exploitation abounds in almost all the major commercial fisheries of the world (Friedel, 2000; Falaye and Akinyemi, 1985; Brink, 2001). ICLARM (2001) and Friedel (2000) advance the following reasons for the observed depletion of fish stocks:

(a) About 80 to 90 million people were born yearly mostly to the poor and developing countries of the world. Invariably, population increments of such magnitude increased the demand for fish leading to over exploitation and depletion of natural fish stocks

(b) The fishery resources of the economic north [Europe, United States of America (USA) and Japan] were on the decline with signs of over-fishing. Consequently, the northern countries shifted their focus to the third world waters to try to meet their insatiable demand for fish

(c) Much of the world's fish stocks were depleted by heavy fishing pressure, erosion, industrialization, pollution, reclamation and accidental oil spills (ICLARM, 2001; Edwards, 1999).

In addition the researcher observes that the following reasons have also contributed to the global increase in demand for fish:

(a) As more scientific studies link red meat to poor health conditions such as gout, high blood pressure and other life threatening diseases, the tendency has been for people to substitute fish for red meat in their diets.

(b) The recent outbreaks of Bovine Spongiform Encephalitis (BSE) and Foot and Mouth disease (FMD) in Europe and South Africa led to the decimation of large herds of cattle and ban on importation / exportation of red meat products to Europe. BSE particularly generated a lot of fear in many people causing them to stop eating red meat. This has resulted to an increase in demand for fish not only in the northern economies but in Southern Africa too.

The demand for fish in Mafikeng has increased. According to Rouhani (2001), there were over 150 fishermen operating in the MLM, with total catch exceeding 1250Kg per day, but the fishermen could not cope with the high demand, which they attributed to the large number of expatriates in Mafikeng. It may be possible that it is for this and other reasons that the sales of Mafikeng fish to Botswana and Johannesburg also increased.

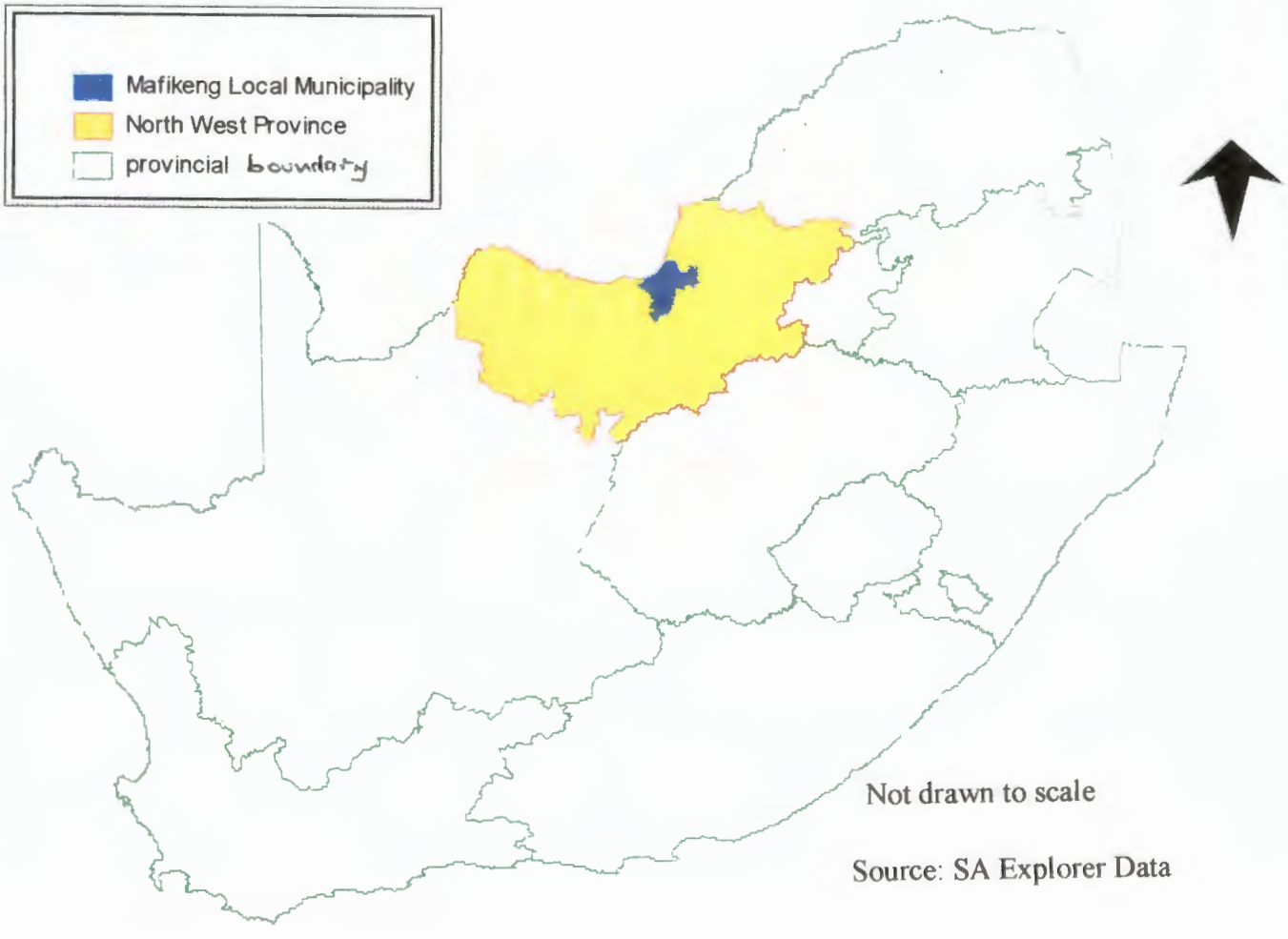
1.3 Background to the study area

The physical and socio-political variables that are of significance to the development of an IAS in the Molopo River basin are reviewed.

1.3.1 Location

The MLM is located on the fringes of the Kalahari Desert and lies in the Southeast quadrant between longitudes 25 - 26° and latitudes 25 - 26°. The position of the MLM in the North West province in relation to the other provinces of the Republic of South Africa is shown in Figure 1.1. The MLM lies at an elevation of 1255m above sea level and covers a total surface area of about 412,264.5 ha. (Wagner, 2001).

Figure 1.1: The position of the MLM in the North West province relative to other provinces of South Africa.



6. Under ideal conditions, how many full time labourers would you employ on your farm?

A. 3-7 B. 8-12 C. 13-17

7. What were the main variables that negatively affected your vegetable growing business? .....

Variable	Does it have a negative impact?	
	A: Yes	B: No
(i.) Land		
(ii) Agricultural inputs		
(iii) Machinery		
(iv) Labour		
(v) Water		
(vi) Transport		
(vii) Storage facilities		
(viii) Market		
(ix) Extension services		

After an explanation of what an integrated aquaculture scheme is and the benefits that accrue, question 7 follows.

8. Would you consider participating in a community based aquaculture scheme?

A. Yes B. No

1.3.2 Climate

The climate of MLM is classified as semi arid (Wagner, 2001). It has a mean annual rainfall of 626.1 mm recorded over a 12-year period. A graphical illustration of the mean rainfall and temperature values in the MLM is presented in Figure 1.2. It shows the rainfall pattern to consist of a short season of heavy rainfall (December to February) followed by a long dry period interspersed with isolated light showers. Hardly any rainfall is recorded in the months of June and July. The average temperatures (minimum and maximum) recorded over a 12-year period in the MLM are 26.4° C and 11.7° C respectively.

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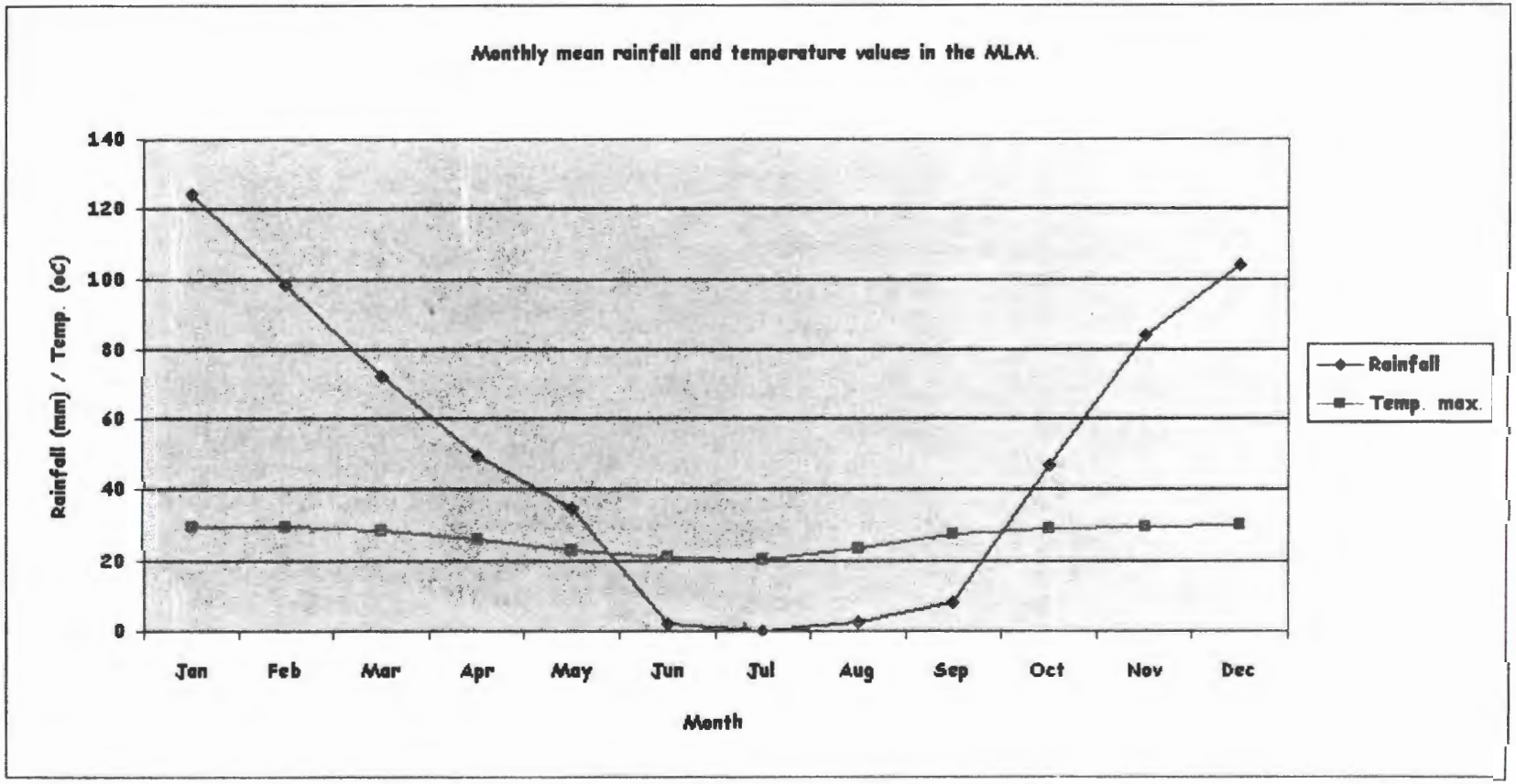
Figure 1.2: 12-Year term mean values for rainfall and temperature in the MLM

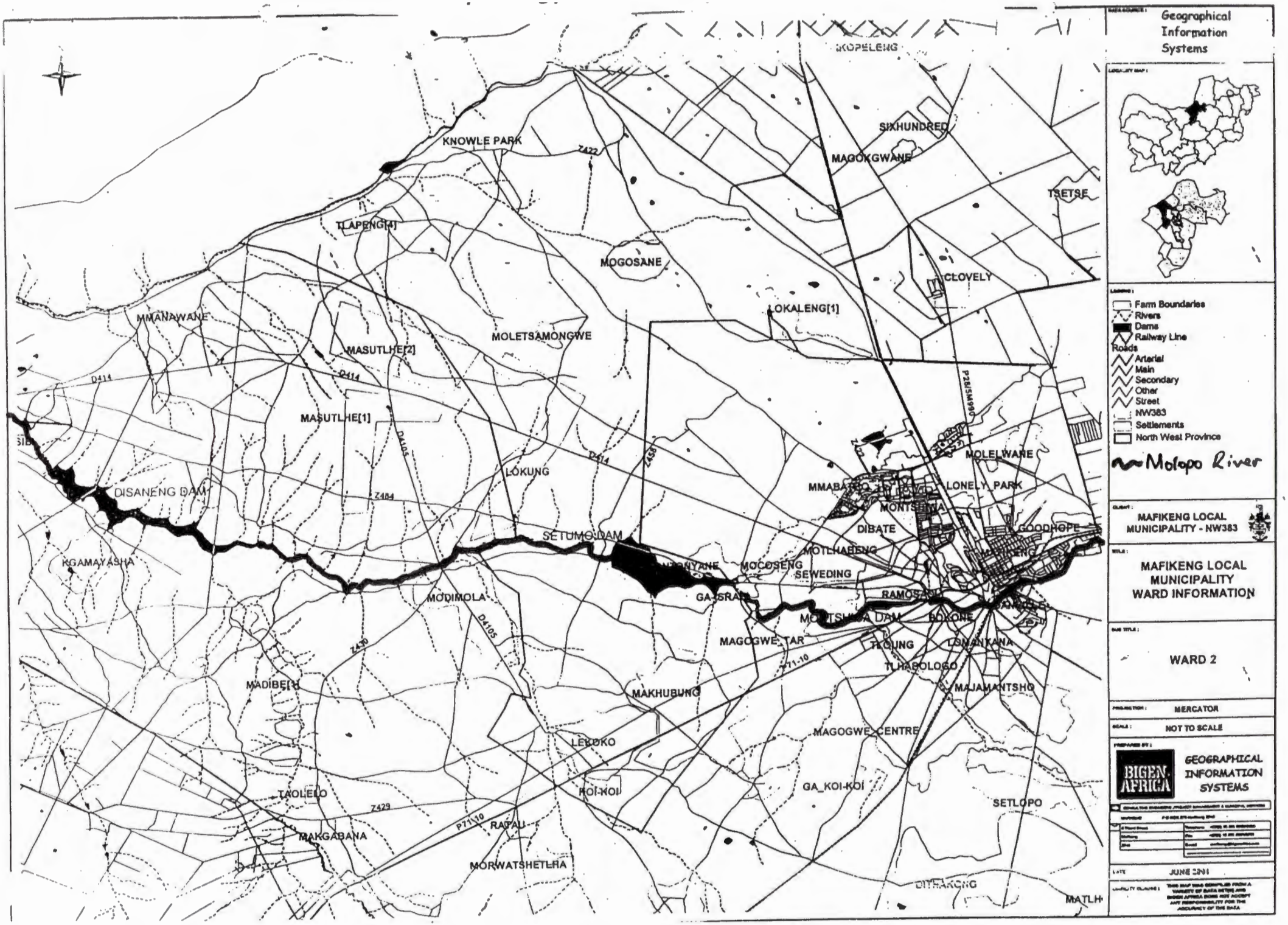
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall	124	98.4	72.1	49.3	34.4	1.8	0.2	2.7	8.3	46.8	84.2	103.9
Temp. max.	29.7	29.7	28.6	26.1	23	20.8	20.4	23.3	27.3	28.8	29.5	30.2
Temp. min.	17.1	17.2	15.7	11.8	7	4	4	6.4	10.9	14.2	15.6	17

Source: School of Agriculture Weather station, Molelwane. Faculty of Agriculture, University of North West



1.3.3 The hydrological system

The availability of water is a fundamental prerequisite for the establishment of any aquaculture scheme. This study deemed it necessary to establish the sources and quantity of water in the Molopo River basin of the MLM. The hydrological system of the MLM, which is comprised of the Molopo River and its intricate network of seasonal tributaries, is shown in Fig 1.3.


Geographical Information Systems
KOPELENG
SIXHUNDRED
MAGOKGWANE
TSETSE
KNOWLE PARK
TLAPENG[4]
MOGOSANE
CLOVELY
LOKALENG[1]
MMANAWANE
MOLETSAMONGWE
MASUTLHE[2]
MASUTLHE[1]
LOKUNG
DISANENG DAM
SETUMO DAM
KGAMAYASHA
MODIMOLA
MADIBE[3]
MAKHUBUNG
LEKOKO
KOI-KOI
TAOLELO
MAKGABANA
RATAU
MORWATSHETLHA
MOLELWANE
LONELY PARK
MONTSHIWA
DIBATE
GOODHOPE
MOTLHABENG
MOCOSENG
SEWEDING
GA-ISRAEL
RAMOSADI
MOTSHWA DAM
BOKONE
MAGOGWE_TAR
TLOUNG
LOMANYANA
TLHABOLOGO
MAJAMANTSHO
MAGOGWE_CENTRE
GA_KOI-KOI
SETLOPO
DITHAKONG
MATLH
Farm Boundaries
Rivers
Dams
Railway Line
Roads
Arterial
Main
Secondary
Other
Street
NW383
Settlements
North West Province
Molopo River
MAFIKENG LOCAL MUNICIPALITY - NW383
MAFIKENG LOCAL MUNICIPALITY WARD INFORMATION
WARD 2
MERCATOR
NOT TO SCALE
BIGEN AFRICA
GEOGRAPHICAL INFORMATION SYSTEMS
JUNE 2011

According to Phillips (2001), the Molopo River starts at the Molopo Eye, as an underground water spring, about 40km east of Mafikeng town. It flows west, through Mafikeng and the villages of Disaneng and Phitsane. In Phitsane, it forms part of the South Africa - Botswana border along which it finally drains into the Kuruman River. For the greater part of its course, the Molopo River is seasonal, with a dry riverbed but with water flowing underground. In the Mafikeng region, between the location of Danville and Disaneng village, it becomes a perennial river due its to rejuvenation by sewage effluent from Mafikeng/Mmabatho towns.

During heavy rains, there is excessive runoff water that drains into the Molopo River. This runoff replenishes dams that lie along the river (Wagner, 2001). These dams, namely Lotlamoreng, Setumo and Disaneng, have been constructed along the course of the Molopo River in the Mafikeng area. Cooke's lake, a water reservoir that serves to regulate the flow of water into Lotlamoreng and Setumo dams, was also constructed on the fringes of Mafikeng town. The capacities of the water reservoirs in the MLM are presented in Table 1.1

TABLE 1.1: The capacities and depths of water reservoirs along the Molopo River.

Reservoir	Capacity (million m^3)	Surface area (ha)	Mean depth (m)
Cooke's Lake	≥2	-	4
Lotlamoreng dam	3	-	4
Setumo dam	11	437	4
Disaneng dam	14	436	4

(Sources: Fernandez, 2001; Rouhani, 2001)

Studies by Caulton and Peddie (1984) and Rouhani (2001) on the water in Lotlamoreng, Setumo and Disaneng dams showed it was of a high quality and supported a vibrant fishing industry in Setumo Dam. The dam also supplied Mafikeng and Mmabatho towns with piped water.

1.4 Statutory requirements for the utilization of impounded water for aquaculture.

The national government has the overall responsibility for and the authority over the management of water resources in the country (Government Gazette, 1998). In Chapter 4 of the National Water Act (NWA) of 1998, the government laid the basis for regulating water use in the country. The Act broadly defines water use to include the following:

- The taking and storing of water in reservoirs.
- Activities that reduce stream flow.
- Altering watercourses.

- Removing water found underground for certain purposes.

According to the NWA (Government Gazette, 1998), water use must be licensed unless the following requirements are met:

- It is listed in schedule I of the NWA.
- It is an existing lawful use.
- It is permissible under a general authorization.
- A responsible authority waives the need for a license.

The use of water for aquaculture requires licensing from the Department of Water Affair and Forestry. However, Section 22 (3) of the NWA provides that a responsible authority may dispense with the requirement for a license for water use if it is satisfied that the purpose of the Act will be met by the granting of a license, permit or other authorization under any other law. Therefore, line departments such as the provincial Department of Agriculture, Conservation and Environment may issue permits for use of water for integrated aquaculture.

Generally aquaculture consumes relatively little water since the water can be returned to the original stream of flow. Growing fish on commercial basis in water bodies that serve to supply drinking water is not permissible, as additives from manure and fertilizers would pollute water. Pollution of water from the use of

manure or fertilizers would not be considered as a problem if provision were made to use the enriched water for irrigation (DWA, 1986).

As such, if fish farming is undertaken as an integrated concept involving the irrigation of agricultural plots, permits for diverting river flow for this purpose would be readily granted provided the water is returned to the stream of origin (DWA, 1986). This would call for a need for an integrated aquaculture system if the water resources of the MLM were to be used in the development of a sustainable fishery industry.

1.5 Some demographics of the MLM.

The MLM has a total population of about 242193 people. About 35% of this population belongs to the economically active group and unemployment stands at 43.9% (Census, 1996). This implies that almost half of the economically active population in the MLM is unemployed. Consequently, the dependency ratio based on population per person employed is high 1:50-100 (Census, 1996). The few people that are employed are financially constrained, as they have to support large numbers of dependants. Development of a fishery industry would help alleviate this situation through the provision of cheap but high quality animal protein and the creation of job opportunities for both men and women in the areas of fishing, marketing and provision of inputs.

1.6 Status of the fisheries industry in the MLM.

There are limited records on the fishery in the MLM save for the survey reports by Caulton and Peddie (1984) and Rouhani (2001). Prior to the construction of the Lotlhamoreng dam in 1947 fishing in the Molopo area was for domestic consumption and was on the main carried out by herd boys using hook and line. The catch almost invariably consisted of *Clarias* species (catfish) and a small type of fish similar to sardines (Molema, 2002).

Caulton and Peddie (1984), in their baseline study, recorded sparse fish stocks with *Cyprinus* (carp) as the most prevalent in Disaneng Dam while in Lotlamoreng Dam, there was evidence of *Clarias* and *Cyprinus*. There was no evidence of *Oreochromis* (Tilapia) recorded in the study. The ecology of Setumo and Lotlamoreng dams is quite similar and, according to the local fishermen, the fish species composition in one is a reflection of what is in the other.

Rouhani (2001), in his survey, reported the presence of *Oreochromis* species in both Disaneng and Setumo dams. According to the report, Oreochromis *mossambicus* constituted 81% and 93% of the total fish caught by gill nets in Disaneng and Setumo dams respectively. The large numbers of juvenile *Oreochromis* caught by seine nets in both dams indicated that successful breeding and population

recruitment of *Oreochromis* was taking place (Rouhani, 2001). Further, Rouhani (2001) reported that the fish in both dams were healthy and that fishery in both dams would be based on *Oreochromis* given its relative abundance and preference by the fishermen.

According to Rouhani (2001), there were about 150 fishermen operating on the Setumo Dam in February 2001 with an approximate total catch of 1125kg per day. The fishermen mostly used 10m stretches of 100mm mesh size gill nets (Rouhani, 2001). Based on his findings, Rouhani (2001) recommended that a small-scale fishery be established in the Setumo Dam. Rouhani (2001) reported that only recreational fishing took place at the Disaneng dam. This was probably due to its distance from the built-up areas of Mafikeng and Mmabatho where most of the consumer markets existed.

However, a commercial fishery in the Molopo basin dams would not be of a sustainable nature as the water from these dams is intended for human consumption. Fishermen would not be granted licenses or permits for commercial fishing let alone be allowed to stock the dams with fry. At the time of the study, no action had been taken to stop fishing in the dams but there was no assurance from the relevant authorities that prohibitive measures would not be enforced. Therefore the continued livelihood for over 150 Molopo fishermen cannot be

planned based on the existing fishery. As such, a need arises to look at the eco-friendly option of Integrated Aquaculture as an approach to developing the fishery industry in the MLM.

Jacobs (2002) observed that the Disaneng had a great potential for recreational fishing by both local (sport) fishermen and tourists. As such, it was anticipated that along with the intensive campaign to attract tourists to the North West province that had been launched, the Disaneng Resort would create job opportunities and increase revenue in the MLM.

1.7 Statement of the problem

Given the potential role that a fisheries industry could play in the economy of the MLM, the following questions need to be answered:

(a) Can a community based sustainable integrated fishery scheme thrive in the MLM?

(b) What contribution can a community based fishery scheme make towards job creation, poverty alleviation, food security and community development in the MLM?

This study evaluated the economic feasibility of a community based sustainable Integrated Fisheries Scheme in the Molopo River basin of the MLM.

1.8 Hypothesis

The hypothesis tested in this study was that:

A community based sustainable Integrated Aquaculture Scheme can thrive in the MLM.

1.9 Objectives of the study

1.9.1 General objective

The general aim of the study was to evaluate whether a community based sustainable IAS could thrive in the MLM.

1.9.2 Specific objectives

(a) To assess the willingness of stakeholders in the Molopo River basin to participate in the development and implementation of an integrated aquaculture scheme.

(b) To determine job opportunities and other benefits that can be directly and indirectly created by an integrated fishery scheme in the MLM.

(d) To assess the existing and potential problems that may hinder development of an IAS.

1.10 Scope of the study

1.10.1 Geographical spread of the study

The study was deliberately limited in terms of area and the population. The greater part of the study was conducted in the Molopo River basin at Lotlamoreng, Setumo and Disaneng dams where representative samples of fishermen, fish traders and vegetable growers were interviewed. Part of the study was also carried out in Mafikeng and Mmabatho towns where selected representatives of government departments, the Barolong Boo Ratshidi Tribal Authority and traders were interviewed.

1.10.2 Content of the study

The study was limited to aspects concerned with the development of a community based IAS in a rural setting. Salient issues for which information was required included the following:

- Availability of land for development.
- Availability of grants for capital development.
- Availability of start up capital for initial current expenditure.
- Willingness of stakeholders to participate in the integrated aquaculture scheme.
- Existing and potential markets for the MLM fish.

1.11 Significance of the study

The study was based on the premise that the residents in the MLM could lead their own change processes by being actors rather than subjects of change. It recognized the need for capacity building with the hope that this would encourage the entrepreneurial spirit and empower the community in the MLM to take primary responsibility in solving their problems by harnessing their natural resources.

Secondly, the study is important as it recognized the importance of commitment of the stakeholders in the utilization and management of natural resources by seeking their views on matters of development of the resources. Decisions so taken would be ethically binding to all stakeholders and would manifest the qualities of good governance namely participation, partnership and facilitation.

Being descriptive in nature, the study was significant as it provided a valuable baseline for further investigations in other areas of aquaculture. This would serve to stimulate the interests of the stakeholders in the other areas of aquaculture such as the rearing of crocodiles, molluscs, prawns and lobsters.

CHAPTER TWO

2 LITERATURE REVIEW

2.1 Introduction

This chapter reviews some aspects of aquaculture that have been studied and explored by other scholars. The chapter identifies gaps in the field of aquaculture. Although most of the existing literature on aquaculture is from studies conducted in countries other than South Africa, it is however, expected that the concepts would be applicable in the MLM situation.

2.2 Background to the review

According to Allen et al (1984), the fishing industry stands as the last significant source of food from non-domesticated or non-cultivated species. However, the rising protein needs of an expanding world population will not be met by harvests that rely on capture fisheries. Globally, a need has arisen to shift from total dependence on sources of fish such as gill nets, trawling, beach seines to mention a few, to partial dependence on domesticated sources. Falaye and Akinyemi (1985) and Sann (1998) argue that aquaculture offers the only alternative means to maintain or increase fish supplies in the face of decreasing fish catches.

2.2.1 Definition of aquaculture

Aquaculture is the controlled commercial cultivation and harvesting of aquatic organisms (DWA, 1986). Aquaculture is subdivided into industrial and rural aquaculture. Industrial aquaculture refers mainly to shrimp and salmon farming while rural aquaculture is defined as the farming of aquatic organisms by small scale households using mainly extensive and semi-intensive husbandry for household consumption and or income generation (Edwards and Demaine, 1999). Integrated aquaculture is defined as concurrent or sequential linkages between two or more human activity systems (at least one being aquaculture), directly on site, or indirectly through off-site needs and opportunities, or both (Edwards, 1999).

Aquaculture may be practised under varying conditions using different production systems. Accordingly, different types of aquaculture may be identified depending on the type of system used in production and the degree of intensity in production. Balarin (1985a), Sann (1998) and Edwards (1999), grouped aquaculture into the following classes:

- Extensive aquaculture; transforms an aquatic ecosystem's primary productivity (organic matter produced by photosynthesis) into products for human consumption. Generally, hardly any external inputs such as fertilizers and supplementary feeding are administered to boost production under this system. Extensive aquaculture is analogous to rangeland management. It is applicable to

dams, ponds and rice paddy stocking. Yields are low, averaging about 1.5t/ha/year.

- Semi-intensive aquaculture; builds on extensive systems. It may require manure, fertilizer or integration with animal husbandry to enhance primary production. Semi-intensive aquaculture is specifically applicable to ponds and yields of 5t/ha/year may be realized.
- Intensive aquaculture; almost exclusively involves high stocking rates, supplementary feeding and fertilization to meet the needs of the species being raised. Aeration is necessary to meet the oxygen needs and system cleaning. The large capital outlay necessary for intensive aquaculture restricts its practice to commercial operations. Yields of up to 2000t/ha/year are possible. It is mainly practised in cages, tanks and raceways.

2.3 The concept of aquaculture in Africa

Studies on aquaculture in Africa show that it is practised at three levels, which Balarin (1985) and Vincke (1985) categorized as:

- Small-scale rural aquaculture.
- Medium-size or artisanal aquaculture.
- Large-scale or industrial aquaculture.

2.3.1 Small-scale rural aquaculture

This is comprised of ventures that are managed by subsistence farmers or small community groups that employed relatively unsophisticated techniques for the purpose of producing additional food. It relies upon the public sector either for funding or support services (Balarin, 1985a).

According to Vincke (1985), small-scale fish farmers owned one or more small fishponds each with an average surface area of 200m^2, which yielded about 20 kg of fish per 100m^2/ year (or 2 tons/ha/year) per pond. The ponds were fertilized using compost and manure while the fish were fed with different locally available ingredients. Vincke further noted that investments in village fish farming were typically self-financed and the owners and their families managed the fishponds. The farmers consumed most of their produce marketing only a small surplus.

2.3.2 Medium-size aquaculture

Vincke (1985) observed that, it was mainly entrepreneurs, with previous experience as small-scale aquaculturalists that were engaged in medium-size aquaculture. At this level, the average size of ponds was 3000m^2 and each yielded over 3 tons of fish per hectare per year (Vincke, 1985). Further, Vincke (1985) also noted that some entrepreneurs farmed using floating cages of about 20 cubic metres that were installed in reservoirs or barrage-ponds.

The entrepreneurs, who in some cases were financed, were able to apply intensive fish rearing techniques such as, fertilization of the ponds, artificial feeding of the fish and integrated aquaculture (Vincke, 1985).

Basing on experience from work in some African countries, Vincke concluded that it was possible that 15 to 20% of small-scale fish farmers could substantially improve their yield after 2 to 3 years of intensive extension work.

2.3.3 Large- scale aquaculture

Large-scale or industrial aquaculture ventures were managed as private sector investments or government corporate activity involving large capital outlay. Nel (2001) reported on an aquaculture project in the North West province of South Africa with a multi-million rand infrastructure that had concluded contracts worth R100 million for the export of more than 700t of fish product to Japan and Taiwan.

Large-scale aquaculture ventures use sophisticated intensive-production systems and pursue the objective of profit rather than a development policy designed to address the global shortfall in fish stocks. This invariably calls for high capital investments, high input costs and a high level of expertise and management (Sann, 1998 and Nel, 2001).

2.4 Aquaculture strategy objectives

Balarin (1985a) briefly classified the objectives of aquaculture as follows:

(a) Production of fish for human consumption for both local and foreign markets.

(b) Improvement of natural stocks.

(c) Introduction of fish into man made reservoirs.

(d) Production of forage fish for rearing of more valuable animal species.

(e) Production of bait for commercial or sport fishing.

(f) Production of ornamental or aquarium fish.

(g) Recycling of organic wastes such as in sewage ponds.

(h) Rearing of select fish for stocking waterways for aquatic weed control as well as control of vectors of diseases such as malaria or bilharzias.

(i) Production of trash fish to be used as a constituent in animal feed.

Balarin (1985a) noted that there was a tendency for the different stakeholders in aquaculture to specialize in certain objectives in the following manner:

- Production at village level was for human consumption.
- Governments concerned themselves with items b, g, h and i.
- The private sector catered for c, d, e, f and to a limited extent a.

2.5 The role of aquaculture in poverty alleviation

Aquaculture may directly or indirectly benefit the lives of poor communities in several ways including improved food supply, creation of employment opportunities and increased income levels. Edward (1999) listed the benefits that accrue from aquaculture as follows:

2.5.1 Direct benefits

- Food of a high nutritional value, especially for vulnerable groups such as pregnant and lactating women, infants and pre-school children.
- Creation of employment through farming, especially for women and children.
- Generation of income through sale of relatively high value products.

2.5.2 Indirect benefits

- Increased availability of low cost fish in local markets.
- Creation of employment on larger farms, seed supply networks and market-chain and manufacture or repair functions.
- Benefit from common property resources, particularly for the landless through cage culture of molluscs and seaweeds, and enhanced fisheries in otherwise underutilized resources.
- Increased farm sustainability through;
  - Construction of ponds, which also serve as reservoirs that provide water for domestic animals and or irrigation.

- Fish as a component of integrated pest management to control vectors of diseases such as malaria and bilharzia and also to control algal bloom.

2.6 Microeconomics of aquaculture production

While biological performance and engineering principles play important roles in aquaculture, its viability also depends on economic principles (Allen et al, 1984). Economic factors that influence aquaculture may be considered at either a macro or micro level. Macroeconomics emphasizes the interactions in the economy as a whole. It includes world trade, national development goals, government policy, cultural attitudes, input supply and international markets. On the other hand, microeconomics is concerned with the smaller elements of the economic system such as consumers, business firms, individual productive resources, commodity prices, and separate industries (Allen et al, 1984; Edwards, 1994; and Begg et al 1994). The scope of this study is limited to micro-economic factors. Much of the literature reviewed in this section relates to manufacturing production. Although aquaculture is an industry based on agro-production, it is however expected that the economic principles that apply in manufacturing are applicable in aquaculture.

In planning a production concern, the objective of profit should constantly remain in focus for it is only profit making concerns that can be self-sustaining i.e. economically viable. Production ventures that do not make profit destroy capital and cannot be self-sustaining. Community based projects should, among other

objectives, aim at making profits. However, such profits have to be reinvested within the project or deployed into other community projects.

A business plan can provide a prospective aquaculture farmer with a pathway to profit. In building a pathway to profit, Allen et al (1984); Beggs et al (1994) and MSB (2001) list the following as important questions that need to be addressed:

- What business am I in?
- What goods do I sell?
- Where is my market?
- Who will buy?
- Who are my competitors?
- What is my sales strategy?
- What merchandising methods will I use?
- How much money is needed to operate my company?
- How will I get the work done?
- What management controls are needed?
- How can they be executed?
- When should I revise my plans?
- Where can I go for help?

An attempt to address the above issues reveals that aquaculture production should aim at the correct product, efficiently produced in required quantities and

distributed to the right place at the right time and the right price. Correct pricing ensures that the producers (investors, workers and the distribution network) are appropriately rewarded. This requires that the prospective farmers should know the costs that will be incurred, the market dynamics of their products and have a concise business plan.

2.6.1 Costs in manufacturing or production

Money is a standard that is used to decide whether or not to go ahead with a business proposition. If the costs are greater than the profit that a business can make, one would have to consider the following options:

- For a type of business that shows profit after an extended period of operation, one would have to make plans for financial reserves to carry through the non-profit making period.
- If the above option were not possible, it would be best to invest elsewhere.

It is therefore important to know one's revenue and cost structure before proceeding with investing in manufacturing. According to Garrison and Noreen (1944), cost is the sacrifice made to obtain goods or services. Cost is measured in a number of ways, which include cash expended, property transferred and service performed.

Business organizations can be grouped under three broad categories namely:

- Manufacturing or Production.

- Service - type activities.
- Merchandizing.

The cost structure in these organizations is in some cases specific to particular organizations but generally overlaps among them. This study was concerned with organizations in the manufacturing or production categories thus emphasis was put on costs in manufacturing firms.

2.6.1.1 Manufacturing costs

Manufacturing involves the conversion of raw materials to finished products through the efforts of workers and the use of production equipment. According to Garrison and Noreen (1994), a finished product has 3 basic elements of cost, namely:

- Direct materials costs.
- Direct labour costs.
- Manufacturing overhead.

(a) Direct Materials Costs

Raw materials, also referred to as direct material, are used in the manufacture of products. According to Garrison and Noreen (1994), direct materials are materials that become an integral part of a company's product and can be conveniently traced into it. Indirect materials are those that may not be easily traced into the product, such as glue in a filing cabinet, and are regarded as part of manufacturing overhead.

(b) Direct Labour Costs

These include labour costs that can be directly traced to the creation of products. Labour costs that cannot be easily traced to the product are called indirect labour costs and are treated as part of manufacturing overhead. These include costs of janitors, supervisors, accounts, security men and drivers.

(c) Manufacturing Overhead

These include all costs of manufacturing with the exception of direct material and direct labour. Manufacturing overhead include such costs as: indirect materials, indirect labour, heat/light, property taxes, insurance, depreciation of factory facilities, repairs and maintenance and all other costs of operating the manufacturing division of a company. Garrison and Noreen (1994) pointed out that the costs for heat/light, property taxes, insurance and so forth, a company incurs in association with its selling and administrative costs are not part of manufacturing overhead. Only those costs associated with operating the production system are included in the manufacturing overhead category. Manufacturing overhead combined with direct labour is known as conversion costs while direct material combined with manufacturing overhead is known as prime cost.

2.6.1.2 Non-manufacturing costs

According to Garrison and Noreen (1994) non-manufacturing costs are sub-classified into 2 categories:

- Marketing or Selling Costs
- Administrative Costs

(a) Marketing costs

Include all costs necessary to secure customer orders and to get the finished product or service into the hands of the customer. Marketing costs include advertising, shipping, travel, sales travel, sales commissions, sales salaries and costs associated with finished goods warehouses (Garrison and Noreen, 1994).

(b) Administrative costs

Include all executive, organizational and clerical costs that may not be included under either production or marketing. Examples of such costs are: executive compensation, general accounting, secretarial, public relations and similar costs having to do with the overall, general administration of the organization (Garrison and Noreen, 1994).

2.6.1.3 Period costs

According to Garrison and Noreen (1994), period costs are those costs that are matched against revenues on a time period basis. Period costs, therefore do not form part of the cost of either purchased or manufactured goods, but are expenses incurred by the company in a given time period. Examples of period costs

include sales commissions, office rent, advertising, executive salaries, public relations and other non-manufacturing costs. Period costs appear on the income statement as expenses in the time period in which they were incurred (Garrison and Noreen, 1994).

2.6.1.4 Product cost:

Product costs are costs that are matched against the products. They include costs that are incurred in the purchase of manufacture or goods (Garrison and Noreen, 1994). In the case of manufactured goods, product costs include direct labour, direct materials, and manufacturing overhead. According to Garrison and Noreen (994), product costs "attach" to units of product as goods are purchased or manufactured and they remain "attached" as goods go into inventory awaiting sale. At the point of sale, the costs are released from inventory as expenses and matched against sales revenue. The "attached" expenses are also referred to as the cost of goods (Garrison and Noreen, 1994). The implication here is that a product cost such as direct labour might be incurred during one period but not regarded as an expense until a following period when sale of the completed product takes place. Garrison and Noreen (1994), summarized the above discussion as follows:

- Manufacturing costs consist of direct materials, direct labour and manufacturing overhead.

- Cost of goods comes from manufacturing costs that have been incurred in the manufacture of goods.

The cost of manufactured goods and the cost of goods sold in a business can be worked out following the schedule presented in Table 2.1:

Table 2.1: Cost of manufactured and sold goods

Cost of Goods Manufactured	**Rands**	
Direct materials:		
Raw materials inventory, April 1.	7,000	
Add: Purchases of raw materials.	60,000	
Total raw materials available.	67,000	
Deduct: Raw material inventory. April 30.	15,000	
Raw materials used in production.	52,000	
Less indirect materials (below).	2,000	50,000
Direct Labour.		60,000
Manufacturing Overhead:		
Indirect materials.	2,000	
Indirect labour.	15,000	
Utilities.	21,000	
Rent.	16,000	
Miscellaneous factory costs.	3,000	
Property taxes.	13,000	
Insurance.	7,000	
Depreciation.	18,000	
Actual overhead costs.	95,000	
Less under-applied overhead.	5,000	
Overhead applied to work in process.		90,000
Total manufacturing costs.		200,000
Add: Beginning work in process inventory.		30,000
		230,000
Deduct: Ending work in process inventory.		72,000
Manufactured.		158,000
Cost of Goods Sold		
Opening finished goods inventory.		10,000
Add: Cost of goods manufactured.		158,000
Goods available for sale.		168,000
Ending finished goods inventory.		49,500
Cost of goods sold.		118,500
Add: Under applied overhead.		5,000
Adjusted cost of goods sold.		123,000

Source: Garrison and Noreen (1994)

2.6.1.5 Opportunity cost

Opportunity cost is the potential benefit lost or sacrificed when the selection of one course of action makes it necessary to give up a competing course of action (Garrison and Noreen, 1994).

2.6.1.6 Sunk cost

A sunk cost is a cost that has already been incurred and that cannot be changed by any decision made now or in the future. Sunk costs are not used in analyzing future courses of action (Garrison and Noreen, 1994).

2.6.2 Determining the economic feasibility of a manufacturing or production business

To determine whether or not a production concern will be economically feasible, a variety of economic measuring tools may be used. These include the following:

(a) Income statement

According to Pelser (2001), an income statement reports the operating results of a business for a stated period of time. The income statement reports whether a profit or loss was made for a given period. It shows the gross income earned from which the trading and operating expenses are deducted to arrive at a net profit or loss.

(b) Cash flow statement

A cash flow statement shows how cash was used in a given period. It comprises of cash flow from operating activities, investing activities and financing activities (Pelser, 2001).

(c) Balance sheet figures

According to Pelser (2001), a balance sheet reports the financial position of a given enterprise at a given date. It depicts the capital employed against employment of capital. Capital employed is the capital provided by investors (both owned and borrowed), while employment of capital shows how funds were utilized that would mainly be in the fixed assets, investments and current assets.

2.6.3 Marketing in aquaculture

Success in aquaculture revolves around its market. Optimum output levels in aquaculture production can be achieved by adopting a marketing concept approach. Marketing is a business philosophy that maintains that the key to achieving organizational goals is to determine the needs and wants of target markets and to deliver the desired merchandize more efficiently than one's competitors (Dalrymple and Parsons, 1995). According to Dalrymple and Parsons (1995) there are three important dimensions to marketing. These are:

- Customer orientation; firms must identify their target customers and attend to their needs and wants in order to fulfill their expectations. In fish farming,

details such as processing, smoking, salting or refrigeration of fish to meet customers wants would have to be considered

- An integrated company effort: sales, finance, production, personnel and marketing all work together to satisfy customer needs. In fish farming this would ensure that correctly priced products would be in the right place at the right time.
- Goal directed behaviour; workers' effort should be directed at achieving the goals of the firm. In fish farming, this would ensure that firms act in a socially responsible manner, meet contractual targets and deadlines. By so doing, a firm would avoid unnecessary penalties and litigation and build a track record for more contracts.

A marketing strategy is a management tool that provides direction for action in marketing of products. Its objective is to maximize the probability of achieving marketing goals. According to Gilbert (1989), success in marketing of aquaculture products required a farmer to have an elaborate marketing strategy. A farmer that developed a sound marketing strategy and considered marketing as important as production would have a definite economic advantage over those who did not. Gilbert (1989) noted that there were three elements that were applicable in developing a marketing strategy. He listed and expounded on them as follows:

- Determination of the present market situation.

- Determining the final marketing goals.
- Developing a logical plan for getting from the present situation to the final goal.

In order to determine the present market situation one needs to assess the market, the financial position of the farm and available marketing alternatives. It is also important for one to understand the importance of demand and supply and also maintain a timely awareness of prevailing market trends.

Farmers would be required to have established market goals failing which; they could drift aimlessly through sales opportunities. Determination of market goals would depend on what had been assessed while determining the present situation. It would be necessary for the farmer to:

- Relate goals to operating costs
- Know what different levels of operation would cost and establish goals that covered costs

The amount by which goals exceeded operating costs would be the farm's economic profit and would be directly proportional to the risk taken.

A logical plan for progressing from the present situation to the final goal requires an evaluation of all alternatives based on operation, labour and financial requirements of each alternative. Other advantages and disadvantages associated

with each alternative have to be taken into consideration. Gilbert (1989) further suggests that the selection of a specific or combination of market alternatives have to be tailored to the market assessments, individual financial circumstances and the size of the operation. Draft market plans need to be tested in several hypothetical situations before the farmer writes down the final plan.

2.6.3.1 Marketing alternatives in aquaculture

In aquaculture, farmers have several options for marketing their products. Gilbert (1989) listed the following options as the marketing alternative in aquaculture:

- Fee fishing or pay lakes.
- Live haulers.
- Direct sales to the public.
- Direct sales to restaurants, grocery stores and other retail outlets.

Fee fishing was an attractive marketing alternative in the Southern United States of America (Gilbert, 1989). Fee fishing is also common in ponds close to the large cities in South Africa. According to Gilbert (1989), this market expanded due to an increase in demand for fishing opportunities and increase in per capita consumption in fisheries products. The major benefit of fee fishing to farmers was that a premium price was paid for fish. The price per pound could even double that paid by large processing plants (Gilbert, 1989).

In planning a fee fishing operation, Gilbert (1989) suggests that the following points would have to be taken into consideration:

- Customers' needs and wants such as; species, size of fish, concessions, bait and tackle, rest rooms, shaded areas and benches.
- Location of ponds; the ponds had to be easily accessible from busy major highways or to be near urban centres with large signs on main and secondary roads to lead customers to the ponds.
- Expected volume sales had to be high enough to justify the labour cost associated with fee fishing especially where revenue collection was by the pound caught.
- Considerable management ability would be required to keep accurate records of stocking densities, time of stocking and catch rates especially for ponds whose revenue was through gate collections.
- Management and staff had to be prepared to work with the public and ready to work long hours often 7 days a week.

Live haulers were another marketing alternative available in aquaculture. Many small-scale farmers sold live fish at pond banks to live haulers who transported and sold it to other outlets such as processing plants, pay lakes, recreational lakes or retail outlets (Gilbert, 1989; Mcveigh, 2001). Most of these farmers lacked

equipment and experience to supply fish to live haulers. According to Gilbert (1989), the following conditions had to be fulfilled for successful live haulage:

- Fish had to be of similar size.
- Fish hauls had to be in the range of 1000 to 10000 pounds per trip.
- There would have to be facilities to grade and weigh fish at the ponds.
- Farmers had to have capacity to expeditiously harvest and load fish.
- At farms where there were no holding tanks, there would have to be facilities to flush haul tanks and fill them with high quality fresh water.

Gilbert (1989) noted that in Southern United States, the species most used in live haulage were catfish, trout and baitfish. According to Mcveigh (2001), live haulage in South Africa involved the koi fish.

The third marketing alternative in aquaculture was that of direct sales to the public. Fish was sold whole or in processed form to the public. According to Allen et al (1984); Gilbert (1989) and Mcveigh (2001), this option required holding facilities. Holding facilities gave farmers the advantage of minimum dealings with the public thus enabling them to ask premium prices (Gilbert, 1989). Gilbert (1989); Dalrymple and Parsons (1995) and McVeigh (2001) note the following as other advantages of holding facilities:

- Farmers could establish specific working hours. This allowed efficient scheduling of time and reduced the time lost waiting for customers.

- Farmers could take orders for fish and specify pick-up time.

Direct sales to the public required strict adherence to public health regulations.

Farmers also had the marketing alternative of direct sales to restaurants, grocery stores, wholesale and supermarket retail chains and export markets (Gilbert, 1989; McVeigh, 2001). This alternative obliged farmers to enter into supply contracts that were strict on product quality, hygiene, consistency in fish size and dependability of supply. According to Gilbert (1989), many small farmers were not able to cope with such stringent requirements because they would only have fish for a short time in the year. Consequently, for reasons of dependability and convenience, wholesale chains and retail outlet managers usually chose large-scale producers even though small-scale farmers could have been able to supply reasonably priced quality products.

Gilbert (1989) observes that regardless of the chosen marketing alternative, a sound marketing program would help to increase sales and profits. This, the author notes, would have to be coupled with an aggressive advertising campaign involving the electronic and print media and the Internet. In addition, sponsoring local events and working with outdoor writers would significantly increase profits.

2.6.3.2 Estimating the market potential

According to Dalrymple and Parsons (1995) and Kotler (1994), market potential represents the maximum sales in monetary units that can be obtained by an industry with a specific marketing effort. Market potential is calculated as follows:

$$MP = N \times P \times Q \qquad [1]$$

Where:

MP = market potential.

N = number of possible buyers.

P = average selling price.

Q = average number purchased by each buyer.

Farmers need to measure the size, growth and potential of various customer groups. Demand estimates are used to make sure that the right number of workers is hired and that the necessary amount of cash is available to pay for inputs and wages. Inaccurate demand predictions can have disastrous effects on profitability. For instance, Dalrymple and Parsons (1995) cited a case in 1992 where Compac underestimated demand for its Prolinear computers. This failure in forecasting meant the company had to scramble to find parts, losing good will with customers and dealers. In this study, market potential was used in estimating demand.

2.6.3.3 The business plan

A business plan is a management tool that can be used to plot the course for starting an aquaculture farm or any other business. It details, in a logical sequence, procedure of establishing a production concern. According to Managing a Small Business [MSB] (2001), to build a business plan the following questions have to be taken into consideration:

- What is to be produced?
- How can it be best made?
- What will it cost to produce it?
- Who will buy the product?
- What profit is to be made?

MSB (2001) outlined a logical progression, which guides one in developing a business plan. The outline adopted from MSB (2001), gives the salient points of a business plan along with tips on how to develop the plan. This outline is as follows:

1. Description of the business

What business are you in?

2. Products

Enumerate your products.

3. Market Area

Describe the market you will serve in terms of geography and customer profile.

4. Competitors

List the principal competitors selling in your market area, estimate their percentage of market penetration and sales in the market, and estimate their potential loss of sales as a result of your entry into the market.

5. How do you rate your competitors?

MSB (2001) goes to advise that one needs to establish the strengths and weaknesses of each competitor. Form opinions on each of the principle competitors, their principal products, facilities, marketing characteristics and new product development or adaptability to changing market conditions. Find out whether any of the competitors recently closed operations or whether they have withdrawn from your market area. (State reasons if you know them)

6. Advantages over competitors

Determine the basis on which you will be able to capture your projected share of the market (MSB, 2001). Below is a list of characteristics that may indicate the advantages your product(s) enjoy over others by placing a check in the proper space. Analyze each characteristic. For example, a higher price may not be a disadvantage if the product is of higher quality than your competitors'. Spell out the specifics of each characteristic and explain where your product is disadvantaged and how this will be overcome.

7. Product(s)

Identify the unique characteristics of your product that can be the basis for advertising and sales promotion using the following criteria price, taste, smell, texture, size or weight, styling or appearance, and any other criterion not listed (MSB, 2001). What, if anything, is unique about your product?

8. Distribution

Establish the most cost effective way of getting your product to the ultimate consumer. Weigh the options of direct sales through your own organization or indirectly sales through agents. Determine what each method will cost you. Consider the various marketing, sales or merchandising techniques and list the benefits they could bring to your business. List your customers by name, the total amount they buy from you, and the amount they spend for each of your products (MSB, 2001).

9. Market Trends

What has been the sales trend in your market area for your principal product(s) over the last five years? What do you expect it to be five years from now? You should indicate the source of your data and the basis of your projection.

List the name and address of trade associations, which serve your industry and indicate whether or not you are a member (MSB, 2001).

List the name and address of other organizations, governmental agencies, and industry and indicate whether or not you are a member.

Share of the market: What percentage of total sales in your market area do you expect to obtain for your products after your facility is in full operation?

Sales Volume: What sales volume do you expect to reach with your products?

10. Production

Production is the work that goes on in a production system that results in a product. In making your business plan, you have to consider all the activities that are involved in turning raw materials into finished products (MSB, 2001).

11. Manufacturing Operation

List the basic operations, for example, stocking, feeding, aeration, cleaning and harvesting which are needed in order to make your product.

12. Raw Materials

According to MSB (2001), determine the raw materials or components you will need, where to get them and how much to stock. Establish whether there are any special considerations concerning the storage requirements of your raw materials? For example, will you use chemicals that can only be stored for a short time before they lose their potency?

13. Equipment

List the equipment needed to perform the manufacturing operations. Indicate whether you will rent or buy the equipment. What will it cost you? Your equipment facilities, and method of operation should comply with the obtaining occupational safety and health regulations.

14. Labour Skills

List the labour skills needed to run the equipment. List the indirect labour, for example: material handlers, stockmen and janitors that are needed to keep the plant operating. If persons with these skills are not already on your payroll, indicate where you will you get them (MSB, 2001).

15. Space

Establish how much space will be needed to make the product, include restrooms, storage for raw material and for finished products and employee parking facilities. The following issues will have to be addressed:

- Local ordinances that have to be complied with.
- Ownership of existing space.
- Whether to own or lease the space.
- The cost and implications of the above alternatives.

16. Overhead

List the overhead items that will be needed in addition to indirect labor and include their cost. Examples are tools, supplies, utilities, office help, telephone, payroll

taxes, holidays, vacations, and salaries for your key people (sales manager, plant manager, and foreman).

17. How much money is needed?

Money is a tool you can use to make your plan work. Money is also a measuring device. You will measure your plan in terms of rands. Outsiders such as bankers and other lenders will do the same. When you determine how much money is needed to start (or expand) your business, you can decide whether or not to move ahead. If the cost is greater than the profit that the business can make, there are two things to consider. Many businesses do not show a profit until the second or third year of operation. If this looks like the case with your business, you will need the plans and financial reserves to carry you through this period. On the other hand, you maybe be better off putting your money into stocks, bonds or other reliable investments rather than taking on the time consuming job of managing a business (MSB, 2001).

Like most businesses, your new business or expansion will require a loan. The burden of proof in borrowing money is upon the borrower. You have to show the banker or other lender how the borrowed money will be spent. Even more important, the lender needs to know how and when you will repay the loan (MSB, 2001).

According to MSB (2001), to determine whether or not your plan is economically feasible, you need to pull together three sets of figures:

(a) Expected sales and expense figures for 12 months.

(b) Cash flow figures for 12 months.

(c) Current balance sheet figures.

18. Expected Sales and Expense Figures

To determine whether or not your business can make its way in the market place, you should estimate your sales and expenses for 12 months.

19. Cash Flow Figures

Cash must flow into the business at proper times if bills are to be paid and a profit realized at the end of the year. To determine whether your projected sales and expense figures are realistic, you should prepare a cash flow forecast for the 12 months covered by your estimates of sales and expenses.

20. Current Balance Sheet Figures

A balance sheet shows the financial conditions of a business as of a certain date. It lists what a business has, what it owes, and the investment of the owner. A

balance sheet enables you to see you at a glance your assets and liabilities (MSB, 2001).

21. Organization

Organization is needed if your plant is to produce what you expect it to produce. According to MSB (2001), organization is essential because you as the owner-manager probably cannot do all the work. You will have to delegate work, responsibility and authority. A helpful tool in getting this done is the organization chart. It shows at a glance who is responsible for the major activities of a business. However, no matter how your operation is organized, keep control of the financial management. In the beginning, the president of the small manufacturing company probably does everything. It is important that you recognize your weaknesses early in the game and plan to get assistance wherever you need it. This may be done using consultants on an as-needed basis, by hiring the needed personnel, or by retaining a lawyer and accountant (MSB, 2001).

22. Making your plan work

To make your plan work you will need feedback. For example, the year-end profit and loss (income) statement shows whether your business made a profit or loss for the past 12 months (MSB, 2001). To keep your plan on target you need readings at frequent intervals. A profit and loss statement at the end of each month or at the

end of each quarter is one type of frequent intervals. However, the profit and loss may be more of a loss than a profit statement if you rely only on it. In addition, your cash flow projection must be continuously updated and revised as necessary (MSB, 2001). One must set up management controls that will help to insure that the right things are being done on a daily basis. The management control system in place should give precise information on inventory, production, quality, sales, collection of accounts receivable and disbursements. The simpler the system, the better. Its purpose is to give the manager and key people current information in time to correct deviations from approved policies, procedures, or practices. The manager should be after facts with emphasis on trouble spots (MSB, 2001).

23. Inventory Control

The purpose of controlling inventory is to provide maximum service to customers. The aim should be to achieve a rapid turnover on inventory. The fewer the rands tied up in raw materials inventory and in finished goods inventory, the better (MSB, 2001). Or, saying it in reverse, the faster you get back your investment in raw materials and finished goods inventory, the faster you can reinvest your capital to meet additional consumer needs. In setting up inventory controls, one should keep in mind that the cost of the inventory is not the only cost. There are inventory costs, such as the cost of purchasing, the cost of keeping inventory records and the cost of receiving and storing raw materials (MSB, 2001).

24. Production

In preparing a business plan, one has to estimate the cost figures for the manufacturing operation (MSB, 2001). These figures serve as the basis for standards against which one measures the day-to-day operations to make sure that the clock does not nibble away at profits. These standards will help to keep machine time, labor man-hours, process time, delay time and down time within projected cost figures. Periodic production reports will allow one to keep their finger on potential drains on profits and also provide feedback on overhead expense (MSB, 2001).

25. Quality Control

Poorly made products cause a company to lose customers. In addition, when a product fails to perform satisfactorily, shipments are held up, inventory is increased, and a severe financial strain can result. Moreover, when quality is poor, it is a good bet that waste and spoilage on the production line are greater than they should be. The details - checkpoints, reports and so on - of one's quality control system will depend on the type of production system (MSB, 2001). In working out these details, keep in mind that their purpose is to answer one question: What needs to be done to see that the work is right the first time? Whether one has to do extensive quality control on raw materials is an added expense to be considered (MSB, 2001).

26. Sales

To keep on top of sales, one needs answers to questions, such as: How many sales were made? What was the rand amount? What products were sold? At what price? What delivery dates were promised? What credit terms were given to customers? It is also important that one sets up an effective collection system for "accounts receivable," so that capital is not tied up in aging accounts (MSB, 2001).

27. Disbursement

Management controls should also give information about the rands a company pays out. In checking on bills, one should not be penny-wise and pound-foolish. It is important to know that major items, such as paying bills on time get the supplier's discount, are handled according to policy (MSB, 2001). Your review system should also give you the opportunity to make judgments on the use of funds. In this manner, you can be on top of emergencies as well as routine situations. Your system should also keep you aware that tax moneys, such as payroll income tax deductions, are set aside and paid out at the proper time (MSB, 2001).

28. Break-even

Break-even analysis is a management control device because the break-event point shows about how much you must sell under given conditions in order to just cover your costs with No profit and No loss. In preparing to start or expand a manufacturing business you should determine at what approximate level of sales a

new product will pay for itself and begin to bring in a profit. Profit depends on sales volume, selling price, and costs. So to figure your break-even point, first separate your fixed costs, such as rent or depreciation allowance, from your variable costs per unit, such as direct labor and materials (MSB, 2001).

According to MSB (2001), the formula for calculating break-even volume is:

$$\text{Break-even volume} = \frac{\text{Total fixed costs}}{\text{Selling price - variable cost per unit}} \qquad [2]$$

29. Keeping your plan Up to Date

The best-made business plan gets out of date because conditions change. The change may be within your company, for example, several of your skilled operators quit their jobs or with customers as their desires and tastes shift. For example, a new idea can sweep the country in 6 months and die overnight (MSB, 2001). Sometimes the change is technological as when new raw materials and components are put on the market. According to MSB (2001), an owner-manager should always be able to adjust a business plan to account for such changes by observing the following points:

(a) Be alert to the changes that come about in the; company, industry, market, and community.

(b) Check plan against these changes.

(c) Determine what revisions, if any are needed in the plan.

According to MSB (2001), one may be able to delegate parts of this work. For example, assign the shop foreman the task of watching for technical changes as reported in trade journals of the industry. Or expect the sales manager to keep management abreast of significant changes that occur in the markets. But one cannot delegate the hardest park of this work. The manager should not delegate the decisions as to what revisions need to be made in the plan. The owner-manager has to make those judgments on an on-going basis (MSB, 2001).

When judgments are wrong, cut your losses as soon as possible and learn from the experience. The mental anguish caused by wrong judgments is part of the price paid for being your own boss. Rewards result from the satisfaction and profits that come from correct judgments made (MSB, 2001).

Sometimes, serious problems can be anticipated and a course of action planned. For example, if sales are 25 percent lower than anticipated, or costs are 10 percent higher? It is important to prepare a reasonable budget based on lower sales, higher costs, or a combination of the two (MSB, 2001).

According to MSB (2001) one should exercise caution if sales are higher than anticipated. The growth in sales may only be temporary. It is therefore important plan expansion following an unexpected increment in sales. New equipment and additional personnel could prove to be crippling if sales return to a previous lower level (MSB, 2001).

2.7 Aquaculture resource zones

Rural aquaculture may be carried out in a range of natural ecosystems and human designed agro-ecosystems, or resource zones, which Edwards (1999), classified into two groups viz. inland and coastal zones. Table 2.2 shows the different resource zones and the applicable aquaculture production systems.

Table 2.2: Resource zones ecosystems and the applicable aquaculture production systems

Resource zone / Ecosystem	Aquaculture production system
Inland zone: Riverine	
Rivers	Retention dams, Pond culture, Cages
Flood plains	Retention dams, Pond culture, Rizipisciculture
Irrigation canal	Pond culture
Inland zone: Locustrine	
Lakes	Cages
Reservoirs	Cages
Ponds	Pond culture
Inland zone: Marshy	
Swamps	Rizipisciculture, Whedos
Rice fields	Rizipisciculture
Coastal zone	
Estuaries	Pond culture
Bays	Cages
Lagoons	Cages
Coral reefs	Barachois
Mangrove	Pond culture
Mudflats	Pond culture
Ponds	Pond culture

(Sources: Edwards, 1999; Balarin, 1985a)

2.8 A logical sequence of aquaculture development

At the onset, the national food budget needs to be examined to determine the nutritional requirements and the scope for crop or livestock production to meet the demand for additional animal protein (Balarin, 1985c, Edwards, 1999). Upon establishment of the existence of a need for aquaculture production, Balarin (1985c) suggests the following sequence of development events:

- Determine existence and size of market.

- Determine existence of potential fish farming sites.
- Examine established aquaculture practices with a view to learning from past mistakes and identify gaps to build on.
- Selection of most suitable species and production system.
- Examine the economic benefits of the project.

2.9 Selection of the culture species

According to Balarin (1985b), fish exist in harmony with their natural environment after natural selection has determined the genetic make-up of the species most likely to be successful. These species, the author states, are tolerant to a range of environmental conditions and can co-exist with a limited burden of pathogens. As such, optimum conditions ought to prevail in an aquaculture system otherwise unfavourable conditions will result in poor growth or high mortality of the fish.

Species selection and stocking density are important factors in choosing an aquaculture production system (Vincke, 1985). The selection of a species for use in aquaculture is mainly based on its biological performance in a given system and its subsequent contribution to profit (Edwards, 1999). Balarin (1985b) and Falaye and Akinyemi (1985) note that success in aquaculture depended on choosing a species that would be capable of performing well under conditions that prevailed in a production system. In order to realize the full potential of a system, management

would have to optimize the culture environment by using such methods as fertilization, artificial feeding and oxygenation of ponds (Balarin, 1985b).

Therefore, the selection of a species for aquaculture depends on its performance under given culture conditions in comparison with alternative species. Evaluation of alternative species would be based on the following criteria:

2.9.1 Biological criteria

The chosen species should be one whose optimum growth requirements closely match with environmental conditions in the production system. Introduction of new species in aquaculture should be considered only where local species are deemed not suitable (Balarin, 1985c).

It is important that the chosen species should be able to reproduce easily in captivity. Vincke (1985) observed that, while other species reproduced with difficulty under conditions in ponds, tilapia species did so with ease. Since many rural farmers lacked access to seed and the means to pay for it, tilapia became the favourite species for aquaculture as it produced fry for restocking.

2.9.2 Biotechnological criteria

There should be sufficient in-house technology on a given species to justify its choice for use in aquaculture (Balarin, 1985c). For instance, Balarin (1985c) noted

that tilapia had long been farmed in Africa and therefore technology for its production was widely known and documented. Poor understanding of the selected species hampers aquaculture development (Balarin, 1985b).

2.9.3 Bio-economic criteria

According to Balarin (1985c), the regard for bio-economic factors not only secured the economic viability of an aquaculture project but was also an important psychology to small-scale farmers as it emphasized maximum benefit for minimum input. Balarin (1985c) cited the following as important bio-economic factors:

- Growth Rate; the best species would be one that was capable of attaining table size in the shortest period under culture conditions. Maximum pond production would be achieved with fast growing species as this could allow for more than one fish crop per year (Balarin, 1985b).
- Food Conversion Rate (FCR); the chosen species should be able to convert low-grade protein into high quality flesh at a high FCR. Efficiency in metabolism translates into a monetary benefit because the cultured species would have a low dependence on costly diets. This would positively contribute to the profit of the project.

- Genetic Capacity; not only must the selected species have the innate capacity to reproduce in captivity, but they must also have genetic characteristics such as colour, shape, taste and texture that are desired by the market.

2.9.4 Pathological criteria

In aquaculture, there exits a need to guard against localized disease infections because wild fish and other organisms in the culture system are potent sources of pathogens that can infect farm fish. In order to achieve the objectives of aquaculture production, Balarin (1985c) advises that the following measures would have to be adhered to:

- Strict observation of farm hygiene to reduce pathogen stress levels in culture systems.
- Stocking of resilient fish such as tilapia for small-scale projects where minimum diagnostic and treatment facilities were available.
- Large-scale projects would have to give attention to site selection in order to guard against localized infection.

2.9.5 Socio-economic criteria

Socio-economic issues also influence the choice of a species to be cultured. According to Balarin (1985b), such issues would include the following:

- Preference of the consumers with regard to taste, smell, texture and appearance of the species.

- The non-fish eating habits of some ethnic groups.
- Respect for the cultural beliefs of the immediate market such as not eating fish without scales.
- Affordability of the fish whole or processed to the traders and consumers

Regard for socio-economic factors in planning an aquaculture project would increase its chances of acceptability by the community.

In Africa, more than 130 fish species have been cultured, but tilapia is by far the most popular (Balarin, 1985a). Several advantages have been attributed to tilapia as a culture species. According to Balarin (1985a), these include:

- A high degree of adaptability that enables them to be cultured in a variety of production systems.
- Tilapias are highly fecund and reproduce easily in captivity.
- Tilapias are efficient plankton feeders that can grow fast on either natural grazing or formulated feeds.
- Are reasonably priced for both poor and rich consumers.

Tilapias have disadvantages too, according to Balarin (1985a), these include:

- A tendency of tilapia to over-reproduce and stunt if reproduction is uncontrolled.

- Restriction to altitudes below 2000m; production of tilapia decreases by a factor of 2.2 for every 1000m increase in altitude.

Balarin (1985b) cautioned that tilapia exhibit a unique trait of innate prolific breeding. This results to high populations in ponds and to stunted fish. Balarin (1985b) advised that if fish from such over populated ponds were to be used for stocking new ponds, one would have to hand sex for male fry or use predator stocking to control the emergent fry. Failing which, Balarin (1985b) warned that the fish would be stunted and the genetically inferior fish would be mistakenly traded for fry.

Overall, the advantages of tilapia by far outweigh the disadvantages. As a result, Balarin (1985b) identified tilapia to be the prime candidate for aquaculture in Africa. Rouhani (2001) observes that tilapia was the predominant species in Setumo Dam and was the choice of many fishermen and as such recommended that any fishery in the MLM should be based on tilapia.

2.10 The physical systems of aquaculture production.

Fish production systems used in Africa fall into two distinct groups namely, traditional systems and conventional systems.

2.10.1 Traditional systems of aquaculture production

These include methods that originated from Africa and have been in use for time immemorial. Some methods are presented in Table 2.3.

Table 2.3: Traditional systems of aquaculture and the countries they where practised.

System	Country where practiced
Howash	Egypt
Acadjas and Whedos	Benin
Barachois	Mauritius

(Source: Balarin, 1985a).

2.10.1.1 Howash

This method was unique to the Nile Delta in Egypt. It consisted of shallow ponds bound by earthen dykes constructed on the flat plain in the Nile Delta (Balarin, 1985a). Balarin (1985a) noted that the use of the howash method was discontinued because it led to reduction in volume of water available for irrigation. It was, however, Balarin's opinion that the howash method could be employed in other low-lying areas of Africa.

2.10.1.2 Acadjas and whedos

According to Balarin (1985a), the acadjas and whedos system consisted of round or rectangular holes filled with water and lined with hard wood on the outer walls. Balarin (1985a) further noted that 12 - 16 logs per sq. m. were used to construct the brush-park system. The density of the logs influenced fish production in these

ponds. The acadja and whedo systems were discontinued because of their contribution to deforestation through excessive use of wood (Balarin, 1985a).

2.10.1.3 Barachois

This method was practised in Mauritius. Shallow lagoons coral reefs would be cut at the narrow opening into the sea. Stonewalls fitted with screen gates were used to seal the lagoons from the sea. However, there would still some exchange of water between the open sea and the lagoon (Balarin, 1985a). The barachois were stocked annually with fingerlings of mullet, *Siganus* and any other fish at rates of about 1000 fingerlings / ha. Although the yield from the barachois was low, it was double the natural productivity of the lagoons (Balarin, 1985a).

According to Balarin (1985a), barachois were capital intensive but had low a labour costs and depreciation rate. However, Balarin (1985a) noted that fish production in barachois was low due to the following reasons:

- Dilution in the production system that resulted from tidal exchanges between lagoon and open sea precluded fertilization to increase yields.
- Predators that came into the lagoons with the rising tide from the open sea together with human poachers reduced the fish stock levels in the barachois and led to poor yields.

Balarin (1985a) was of the opinion that the barachois system of production could be applicable in other coastal areas and fresh-water flood plains of Africa.

2.10.2 Conventional methods of aquaculture

According to Balarin (1985a), the conventional methods of aquaculture that were practiced in Africa had been adopted from developed countries and were modern relative to the traditional methods of Africa. Balarin (1985a) observed the following conventional methods that were used in Africa:

- Retention dams.
- Rizipisciculture.
- Pond culture.
- Cage culture.
- Tanks and raceway culture.

2.10.2.1 Retention dams

These were dams constructed for the purpose of water storage in arid areas. Such dams often lacked a natural complement of fish and artificial stocking was therefore necessary. Ideally, polycultures (mixed species) were preferred in order to create a balanced ecosystem (Balarin, 1985a). According to Vincke (1985), a monoculture (single species) would not use all the nutrient resources of the dam since each species has its own feeding preferences. Thus, by mixing different species, more food resources would be consumed and the total fish biomass production would be increased. Balarin (1985a) noted that the yields from retention dams were low but could be increased to 1.5t/ha. /year by regular restocking and manure application.

2.10.2.2 Rizipisciculture

This involved the production of rice and fish in the same paddy. According to Balarin (1985a), paddies were flooded for over 120 days and stocked with 1 - 3 cm fry a week after the transplantation of rice. Tilapia and carp were the preferred species. The fish was harvested at the same time with the rice. Balarin (1985a) observed that yields of up to 2.25t of fish per hectare per year were possible. The production of rice also increased by 5 - 10%. The integration of this nature provided control against weeds, vectors of bilharzia and malaria and algal bloom. The omnivorous fish would eat snails and mosquito larvae thereby reducing levels of biharzia and malaria. Herbivorous fish would feed on phytoplankton and therefore reduce the occurrence of algal blooms. The integration also provided fertilizer because the nitrogenous waste and faecal matter released by the fish into the water enriched the paddy fields. The burrowing and nesting activity of the fish loosened the pond floor thus allowing root growth in the rice (Balarin, 1985a).

2.10.2.3 Pond culture

This is the most wide spread practice in aquaculture. According to Balarin (1985a), it was introduced in over 40 African countries and had over 321,000 ponds in total. Balarin (1985a) described four basic approaches to pond farming as follows:

2.10.2.3.1 Subsistence pond culture

Ponds were constructed in several ways, which included:

- Excavations of earthen reservoirs in flood plains or below large reservoirs.
- Construction of raised dykes or barrages type across and diversionary streams.

The sizes of pond varied between 100 - 500m^2 and were located around village or irrigation water sources (Balarin, 1985a). The inputs to these ponds consisted of domestic waste and compost. Such poor fertilization could not stimulate sufficient primary production in the ponds that would be required to sustain high biomass output. As such, yields from ponds were relatively low, estimated at about 100 - 500kg of fish /ha/year. Tilapia was the species commonly used in ponds, although the species used, in many cases depended on availability of stock from government seed centres (Balarin, 1985a).

2.10.2.3.2 Semi-intensive pond culture

These ponds were designed with the aim of maximizing fish yield through fertilization and feed supplement without the need for additional energy inputs for aeration (Balarin, 1985a). Ponds would be stoked with fry at rates of 10 - 30,000

per ha. To enhance production, fertilizers or manure were applied as shown in Table 2.4.

Table 2.4: Application of fertilizer to ponds (Kg/ha/week)

Fertilizer / Manure	Kg/ha/week
Lime	40 - 55
Superphosphate	15 - 30
Pig manure	560 - 1630
Poultry manure	110 - 225
Cattle or horse manure	670

(Source: Balarin, 1985a)

Alternatively, integrating animal-cum-fish husbandry could enhance production of ponds. According to Balarin (1985a), animal pens would be either built over the fishponds or on the banks and all liquid and solid wastes would be directed into the ponds. The expected yields from semi-intensive pond culture under integrated animal-cum-fish husbandry are presented in Table2.5.

Table 2.5: Expected fish yield per number of animals stocked.

Type of Animal	Animals Stocked per Hectare	Fish Yield (t/ha/year)
Pigs	70 - 100	5 - 10
Ducks	1000 - 2000	4 - 8
Chickens	1000 - 1200	3.5 - 7
Geese	800	2 - 3

(Source: Balarin, 1985a)

2.10.2.3.3 Intensive pond culture

The ponds had an elaborate design to allow active aeration of the water and also the removal of excreted wastes. Balarin (1985a) further notes that in intensive pond aquaculture, production was almost entirely dependent on a high nutritive

ration of pellet feed. Reproduction controls either through monoculture or hormonal applications were applied to regulate population levels in the production system. Under such systems, yields above 5t of fish per hectare per year were possible (Balarin, 1985).

2.10.2.4 Cage culture

This was practised in deep waters such as lagoons, irrigation reservoirs or lakes. Balarin (1985a) describes cages as floating collars made from empty oil drums supporting large bags of fine mesh nylon netting. With intensive feeding on balanced diet pellets, cages could be stocked up to densities of 250 fish per cubic metre and yield up to 700t/ha/year (Balarin, 1985a). Tilapias build nests on the lake or riverbed where their eggs are laid and fertilized. The cage floor does not allow nesting and therefore tilapias would not be able to breed in cage systems. This would make the cage system was ideal for regulating tilapia population.

2.10.2.5 Tanks and raceways

Tanks were either circular or rectangular and were constructed from concrete or metal. They were used in Kenya, Zimbabwe and Reunion but generally, they were not popular in Africa. It is believed that their unpopularity is due to the large capital outlay associated with tanks and raceways. Tank systems are in use in South Africa. McVeigh (2001) reported that tanks were an innovative way that allowed the mariculture industry to be carried out in tanks on land using pumped water. Mcveigh

further suggested that this system enabled aquaculture production in South Africa to increase from 420t to 4281t of fish per year between 1982 and 1997. Nel (2001) reported on a multi-million rand tank aquaculture project that was under construction in Makokskraal in the North West province. Through intensive feeding of nutritionally balanced pellets, yields exceeding 2000kg/ha/year could be obtained from tanks and raceways (Balarin, 1985a). On completion, Nel (2001) reports, the Makokskraal project would be expected to produce 1500t of fish per year.

According to Balarin (1985a), the following additional benefits can be derived from tank aquaculture:

- Nitrogenous and solid wastes from fish could provide fertilizer that would improve production if tank effluent were used for crop irrigation.
- The solid wastes could be used as manure or in biogas production.
- Fish rejected during grading and fish that died in the culture could be used as feed for crocodiles if the farm was integrated. The crocodiles would also be using the effluent water from the tanks.

Balarin (1985a) further notes that tanks and raceways had the potential to produce the greatest amount of animal protein per unit area than any other known form of livestock industry. Closer attention should therefore be paid to the

development of tank aquaculture in particular, as it may hold the key to alleviating the looming global nutritional crisis.

2.11 Selection of a system for aquaculture production

Having identified the suitable sites for production and the species, it becomes necessary to select the production system to be adopted. The chosen system should be one that would be able to produce efficiently in a manner that is socially acceptable. It should also be able to provide the required economic benefits as well as conserve the environment for future generations. Such a production system would be in line with the concept of sustainable development. Edwards (1999) further notes that the chosen technology would have to fit in the limited resource base of the community and not use resources that could be utilized more productively in other ways.

According to Balarin (1985c) and Edwards (1999), the selection of a production system should be done in a holistic systems framework with due consideration given to the following social, economic, environmental and technical aspects:

2.11.1 Social considerations

Availability of land for development is prerequisite in determining the type of production system to be adopted. According to Balarin (1985c) and Edwards (1999) a number of legal aspects have to be considered when choosing the system of

production. These include; the bureaucratic tape involved in leasing suitable sites, obtaining exploitation and marketing licenses and the rights to use water as well as legal protection and insurance against risk (Balarin, 1985c, Edwards, 1999). The higher the sophistication and productivity of an aquaculture system the more stringent and costly the legal aspects.

Production system ought to be socially acceptable to the people and the animals used should be acceptable to the local community (Edwards, 1999). For instance, in areas where there is a strong Islamic influence among the local communities and markets, it would not be advisable to use pigs in the production system. According to Balarin (1985a), while integration using sewage is a common practice in Asia, it is considered unethical in Africa.

2.11.2 Economic considerations

According to Balarin (1985a, 1985b) the decision on which method of production is to be adopted hinges on a number of economic factors that include affordability of the final product to the consumers and availability of:

- Markets for the products.
- Of funds for; research, capital and recurrent expenditure and infrastructure development.
- Finance for small-scale farmers, entrepreneurs and large-scale investors.
- Production inputs.

According to Kooij (2001), the market sector will determine the degree of sophistication in production. For markets in townships, one would use outdoor earth dams where the fish would be periodically netted and sold whole (Kooij, 2001). Production for markets such as those in townships required a relatively small capital outlay. Also, Kooij maintains, input costs, risk and the level of management expertise required would be low but so would be the efficiency and productivity of the system. The author further states that export markets would require advanced and sophisticated intensive production systems with large capital outlay, efficient production and high turnover.

Availability of funds as loans to farmers or entrepreneurs and grants for research and capital development influences the choice of production. For instance, the selection of a system for production relies on the availability of information about the system and its alternatives. The necessary information is availed through expensive research, which, in Africa, is funded by the state (Balarin, 1985b). The choice of a production system is also influenced by the available infrastructure at the site of development. Availability of electricity at a site would facilitate pumping of water while its absence could make production costs prohibitive (Balarin, 1985c).

In Africa, the greater portion of funds required for aquaculture development originate from government coffers. Funds allocated by government for research,

development finance and extension will depend on national policy towards aquaculture. Therefore, the scope of development for aquaculture and the degree of sophistication of the production units will greatly be influenced by national fishery industry policy.

2.11.3 Technical considerations

There are key technical aspects that influence the choice of an aquaculture production system for a project. According to Balarin (1985a, 1985b) these include the availability of:

- Training facilities for both farmers and extension workers.
- Sufficient numbers of adequately equipped and well motivated extension workers.
- Up to date technical information on aquaculture.
- Back-up services such as hatcheries, disease control centres and places where rural farmers can buy technical supplies and inputs.
- Availability of transport and cold storage facilities.

2.11.4 Environmental considerations

The development of an aquaculture project would have an impact on the environment. An Environmental Impact Assessment (EIA) could determine the extent of the impact. A thorough EIA not only assesses the likely impact but also makes recommendations on the appropriate measures to be taken in order to

conserve the environment. Needless to say, these would have financial implications. According to Balarin (1985c), DWA (1986) and Edwards (1994, 1999), the choice of a system of aquaculture production would be influenced by the following environmental concerns:

- Public health hazards arising from water borne diseases such as bilharzia and malaria.
- Land and water pollution arising from aquaculture effluent.
- Reduction in biodiversity through selective breeding and culturing of species.
- Destruction of wetlands through drainage resulting from removal of papyrus and mangrove vegetation.

The researcher notes that concerns by environmental conservationists on issues such as the extinction of rare plant species as a result of flooding or damming of large areas and the impact of introduced species to the environment may influence the choice of production system to be adopted.

This study was based on the conception that with the right funding, back-up services and compliance to economic principles, community fish farms based on socially accepted species could be developed in the MLM. This would require the coordination of a number of environmental factors and production factors in a market oriented business approach.

CHAPTER 3

3 METHODOLOGY

3.1 Introduction

This chapter presents the methodological aspects of the study. It specifies the area of study and gives the locations of the businesses and offices that were visited in the collection of data. The chapter describes the type of information that was sought, the subjects that were considered as relevant sources of information, sample size and selection, the tools of investigation and how they were applied to gather information. Finally, it outlines the equations and tools that were used to analyze data, make market potential projection and assess the economic viability of the proposed project.

3.2 The study area

The study was conducted in the Mafikeng Local Municipality (MLM), specifically in the commercial business districts of Mafikeng and Mmabatho at the three dams of: Lotlamoreng, Setumo and Disaneng. These areas were purposively selected for the following reasons:

- Major water bodies in the Molopo River basin are situated around these areas.
- The officers, business managers, fishermen and farmers whose activities would bear a direct influence on aquaculture development in the MLM operate in these areas.

- This area had a high population with many fish distribution outlets.
- Many traders and residents of Botswana bought fish and other merchandise from this area.

3.3 Preliminary work

Visits were made to various offices, fishing sites, farms and trading outlets between the dates of 07/01/02 and 11/01/02. The purpose of the visits was to meet the various officials, fishermen and farmers at their respective sites, to elicit their support and cooperation and arrange for interviews at a convenient time. The researcher also sought for addresses of relevant farmers at the Batlharo - Baga Masibi Tribal Authority offices in Disaneng. The various places that were visited are:

1. Barolong Bo Ratshidi Tribal Authority offices in Montshiwa stad.
2. Batlharo - Baga Masibi Tribal offices in Disaneng.
3. The three dams at Lotlhamoreng, Setumo and Disaneng sites.
4. Shoprite Super-market in Mafikeng.
5. Pick and Pay Super-market in Mmabatho.
6. Metro Cash and Carry Wholesalers in Mafikeng.
7. Score Super-market in Mafikeng.

3.4 Design of the study

A survey was used to collect primary data from various participants in the study. Specifically five career groups from the working class in the MLM were used as units of analysis and consisted of:

1. Fishermen.
2. Vegetable growers.
3. Representative of the Barolong - Bo Ratshidi Tribal Authority.
4. Managers in the fish distribution business.
5. Government civil servants from the following departments;
   (a) Corporate and Traditional Affairs.
   (b) Agriculture, Conservation and Environment.
   (c) Water Affairs and Forestry.
   (d) Economic Affairs and Tourism.

Both qualitative and quantitative data was collected in face-to-face interviews with the subjects. The data collected was edited, coded and mean or relative frequency was calculated using equations:

$$\text{Relative frequency} = \frac{F}{N} \times 100 \qquad [3]$$

Where:
F = Frequency of responses
N = Number in sample

$$\text{Mean (raw data)} = \frac{\sum X}{N} \quad [4]$$

Where:

$\sum X$ = sum of observations
N = number in sample

$$\text{Mean (grouped data)} = \frac{\sum FX}{N} \quad [5]$$

Where
x = class mid-point
F = class frequency
N = total frequency

(Source: Maruma, 2000).

3.4.1 Tools of investigation

The tools used included self-administered questionnaires and structured interviews. Close-ended questions were administered in the questionnaire while the interview was composed of both open-ended and close-ended questions. In all cases, the interviewer recorded the data by completing a printed questionnaire as the interview progressed. Recorded data was edited and coded for analysis.

3.5 Selection of subjects

The subjects of the study were selected from five different career groups. The career groups were purposively selected because the researcher believed that their daily activities would have a direct bearing on integrated fishery development

in the MLM. The career groups that the researcher considered relevant are listed in section 3.3 above.

3.6 Sample size and selection

Representative samples were selected from the populations of the different career groups listed in section 3.3 using probability and non-probability sampling techniques. The sample size varied for the different career groups and is indicated, in Table 3.1 for each sampling technique used.

Table 3.1: Summary of sample structure

Career group	Sample size	Questionnaire as Appendix No
Fishermen	10	3
Vegetable growers	2	4
Representative of the Barolong Boo Ratshidi tribe	1	5
Government representatives from the following departments:		5
a) Corporate and Traditional Affairs	1	5
b) Agriculture, Conservation and Environment	1	5
c) Water Affairs and Forestry	1	5
d) Economic Affairs and Tourism	1	5
Fish trade Managers	6	6

Two probability sampling techniques namely simple random and consecutive sampling techniques were employed in the study.

3.6.1 Simple random sample

Simple random sampling was used to select the fishermen interviewed in the study. Sixteen groups of fishermen, with an average number of ten members operated on Setumo Dam. Using the lottery system of drawing yes or no ballots, two members were chosen from each group to form a sub-population of 32 who were further subjected to another lottery draw where ten ballots were for YES and 22 for NO. The ten individuals that picked the yes ballot formed the sample of fishermen. A questionnaire (Appendix 3) was administered to the sample of 10 fishermen. Briefly, the researcher sought to establish the following points:

- The extent to which the local population of the MLM was involved in fishing in the Molopo River Basin.
- The interest of the fishermen in their work and whether they were educated enough to be trained further.
- Whether the fishermen were interested in integrated aquaculture.
- The nature of the problems encountered by MLM fishermen.

3.6.2 Consecutive sample

Because of the small population, the consecutive sampling technique was used to select a sample of two vegetable growers from a population of six farmers. The names of the six farmers were written separately on six ballots. Using the lottery method, one ballot was picked at a time and the name appearing recorded alternately under A or B. The selected ballot would not be returned to the draw

box. This resulted in two groups each of three individuals. The second member from each group was then selected for the study. A questionnaire (Appendix 4) was administered to each one of the selected individuals. The questionnaire, in the main sought to establish the following points:

- The quantity of vegetable produced at the farms.
- The major customers for the vegetable.
- Whether the farmers would be interested in adopting an integrated approach of production.
- The maximum number of labourers they could employ.
- Wages paid to labourers.

3.6.3 Non-probability samples

Purposive non-probability sampling was applied in selecting the respondents from organizations of the following career groups:

1. Barolong - Bo Ratshidi Tribal Authority (BRTA).
2. Metro Cash and Carry Wholesalers in Mafikeng.
3. Captain Dorego's - a fast food franchise in Mafikeng.
4. Score Super-market in Mafikeng.
5. Pick and Pay Supermarket in Mmabatho.
6. Oasis Fresh Vegetable Market in Mmabatho.
7. Botswana Fish Exporters.
8. The following North West Provincial government departments;

(a) Corporate and Traditional Affairs (DCTA).

(b) Agriculture, Conservation and Environment (DACE).

(c) Water Affairs and Forestry (DWAF).

(d) Economic Affairs and Tourism (DEDT).

In each of the organizations, the researcher was shown the relevant officer to interview. Standard questionnaires were administered to each of the subjects in the relevant cases (Appendices 5and 6). In the main, the questionnaires sought to establish the following issues:

- The nature and magnitude of assistance that different stakeholders would accord to a community based integrated fisheries scheme.
- The existing market for fish products in and around the MLM.

Specific individuals were selected for the study because the researcher believed that they were from organizations whose line functions would have a direct bearing on the development of aquaculture in the MLM and were part of the policy implementation structures of their respective organizations.

3.7 Market survey

A market survey was conducted in Mafikeng town to obtain market prices of agricultural products that were to be produced in the proposed integrated aquaculture scheme. Five shops were purposively selected for the survey. These were Spar Supermarket, Top-Taste Butchery, Shoprite Supermarket and Mafikeng Main Market. The reasons for selecting these particular shops were that:

- A large number of MLM residents patronized these shops.
- They sold all the products that were to be produced in the proposed scheme.
- They were strategically spread out in different parts of Mafikeng town.

3.8 Estimating market potential

The market potential of different products was estimated using Equation 1 in Section 2.6.3.2. The approximate number of households in the MLM was given as 51535 (Census, 1996). The number of possible buyers for each product was determined by conservatively estimating the percentage of households in the MLM that would buy the product. The average selling price for each product was the on going market price for the product. The researcher estimated the average number purchased by each buyer after consultation with the respective traders. The values of the variables used in determining the market potential of some agricultural products are given in Table 3.2.

Table 3.2: Values used to calculate market potential of different products

Product	%Number of households	N	P (Rands)	Q (Kg per year)
Fish	40	20614	25.83	60
Spinach	80	41228	7.87	60
Cabbage	85	43805	2.89	108
Chicken	85	43805	14.52	84

3.9 Determining cost of production and expenses for the IAS

Various places were visited with the intention of establishing actual or comparable costs and expenses that could be incurred during production in the proposed IAS. The places visited and the information sought are presented in Table 3.3.

Table 3.3: Places visited and nature of information sought.

Place visited	Location	Information sought
School of Agriculture, University of North West (UNW)	Mmabatho	- Crop production costs - Chicken production costs
Monate Meat Butchery	Mafikeng	Cost of lighting and cold storage
Lerato Butchery	Mafikeng	Cost of lighting and cold storage
Toptaste Butchery	Mafikeng	Cost of lighting and cold storage
Dacosta Farm	Rooigrond	Cost of fry for stocking ponds

The following were contacted at each of the places:

- The Professor in the department of crop production at UNW.
- Managers at each of the businesses and offices.

Except at the university where the researcher was given schedules of expected sales and costs for chicken and vegetable production, all other responses were verbal. Schedules from the university showing crops grown, cost of production and a budget of chicken enterprise are attached as Appendices 1 and 2. Since electricity

charges vary with usage, it was deemed wise to obtain average monthly bills from three butcheries and use their mean as the expected monthly cost of electricity for the project.

In order to determine monthly sales and expenditure, the following assumptions were made:

- Land and a capital grant would be provided to develop a semi-intensive integrated aquaculture scheme consisting of 8 hectares of ponds and 8 hectares of crop fields.
- A starter pack capital grant would be provided to cater for stocking fry and day-old chicks, planting vegetables and recurrent expenditure until sales stabilized.
- Ten thousand broiler birds per cycle would be stocked on the farm, while fry of approximately 25g would be stocked at the rate of 25,000 fingerlings per hectare.
- Capital provided as grants and starter pack would be regarded as sunk cost reviewed in section 2.6.1.6.
- The acreage under crops would be apportioned in the ratio 4 : 4 being cabbage: spinach.
- There would be three cycles of production per year for each crop.

- Due to lack of experience in fish farming on the part of MLM community, it would not be possible to attain the expected yield in the first year of production. Therefore, yield was estimated at 70% and 80% of expected yield per hectare in Year 1 and 2 respectively.
- Due to previous experience in chicken and vegetable production by community members and availability of trained extension service personnel, it was anticipated that there would be minimal losses in yield of about 6% and 10% respectively, arising from unforeseen circumstances during production in the first and subsequent years of production. Using expected yield figures of products from Appendices 5 and 6 and from literature reviewed in section 2.10.2.3.2 and incorporating expected losses of 6 and 10%, expected yields of different products of the proposed scheme were calculated and are presented in Table 3.4.

Table 3.4: Expected yield and actual sales for different products

Product	Expected yield in kg in Year 1	Actual sales (kg)
Fish	39,200	36,848
Cabbage	320,000	270,720
Spinach	140,000	118,440
Chicken	96,000	90,240

- Sales will be as follows;

(a) The first crop of fish will be harvested in June processed and sold throughout the last half of year 1. It is anticipated that the entire catch will be sold in six

months. Ponds will be restocked in July for the second cycle and harvested in December to be sold in the first half of Year 2. This trend will be maintained for the lifetime of the scheme.

(b) Vegetables will be sold as and when they are ready to allow preparations for the next crop.

(c) Chickens will be slaughtered after 64 days and restocked soon after

For purposes of illustration, all sales will be shown to take place on a cycle basis.

Due to an inevitable learning curve, there will be losses in sales resulting from spoilage. Losses due to spoilage are estimated at 6% for all products. The quantities of products estimated for sales are shown in Table 3.4.

- A vigorous advertising campaign would boost sales in fish and chicken. The cost of advertising will be calculated at the rate of 5% of gross profit.
- Personnel composition and salaries would be as shown in Table 3.5.
- Salaries and wages were estimated basing on comparable market rates.
- Salaries and wages are inclusive of all applicable benefit and employer's contributions such as housing allowance, employer's contributions to the National Social Security Fund and medical aid.

Table 3.5: Personnel composition and salaries

Position	Number employed	Monthly salary (Rands)	Annual salary (Rands)
Executive Manager	1	12,500	150,000
Farm Supervisors	2	10,000	120,000
Clerk	1	4,000	48,000
Driver	1	2,000	24,000
Regular labour	10	10,000	120,000
Total	15	38,500	462,000

3.10 Assessment of economic feasibility of the scheme in Year 1 of production

Assumptions made during the feasibility assessment of the IAS were based on the objectives stated in the Department of Agriculture's 1997 Development Strategy. Some of the objectives were that the department would:

- Provide a regulatory and administrative framework, which would facilitate successful and equitable participation in all aspects of the industry by any member of the provincial society willing to do so.
- Promote household food security through a homestead food production and income generation programme.
- Develop and implement social support programmes aimed at improving job provision, quality of life, food security and productivity for all participants in the industry, especially for the disadvantaged masses.
- Promote beneficial cooperative action and organizational capacity to enhance bargaining power to members of cooperatives and to facilitate development.

- Promote processing where production occurs, in order to add value to products, promote food security, create jobs and provide goods and services.
- Promote access to and optimal utilization of agricultural production resources for all, particularly, for those who were previously denied such access, for those with demonstrable potential and for those with viable plans and intentions.
- Develop and implement a programme to encourage young skilled farmers from previously disadvantaged communities to settle on productive farms, in order to establish a new generation of capable farmers who are more reflective of the social composition of the community.
- Ensure the provision of public infrastructure geared at facilitating agricultural development, particularly in those areas and communities where such facilities have historically been lacking.
- Provide grant financing to build an agricultural economic base where this is non-existent.
- Promote agricultural product marketing by broadening access to resources, skills, processing and marketing facilities. Particularly for the small scale and emerging producers.

Based on the assumptions made and on information of comparable costs of production, an income and expenditure schedule for Year 1 of production will be developed which in turn will be used to develop a five year cash flow projection. The cash flow projection is the management tool that will be used to assess the economic feasibility of the IAS both in the short and long term.

CHAPTER FOUR

4 PRESENTATION AND INTERPRETATION OF RESULTS

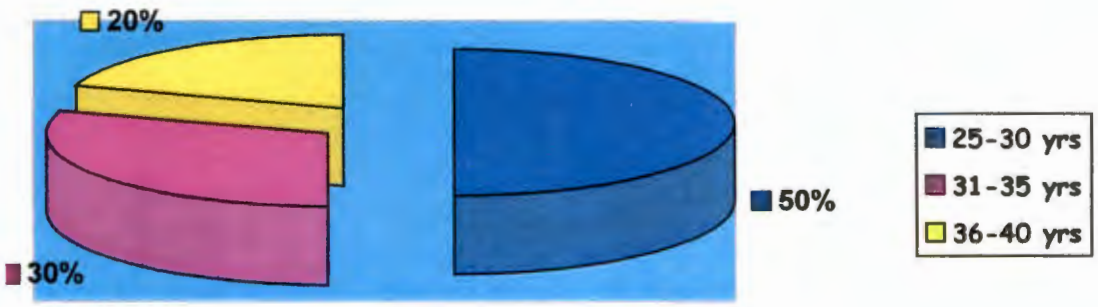
4.1 Introduction

This chapter presents and interprets the results from data that was collected during the study. The results of the findings have been organized into the following sections: demographic, production, socio-political and economic.

4.2 Demographic aspects of the study

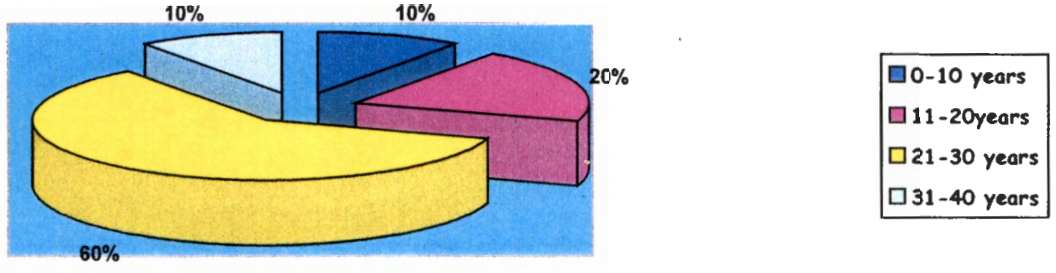
All the people engaged in fishing that were sampled (n = 10) were males of South African origin. The mean age of the fishermen was calculated to be 30.8 years with the majority (50%) of fishermen falling in the age group of 25 - 30 years as shown in Figure 4.1.

Figure 4.1: Frequency distribution of ages of fishermen (n =10)



All the fishermen interviewed were of the Barolong tribe and resided in the MLM where most of them had lived for almost all of their lives. The mean period of stay at their residences was calculated to be 26.5 years. The frequency distribution of the time fishermen had spent at their residences is shown in Figure 4.2.

Figure 4.2: Frequency distribution of respondent fishermen according to period spent residing in the MLM

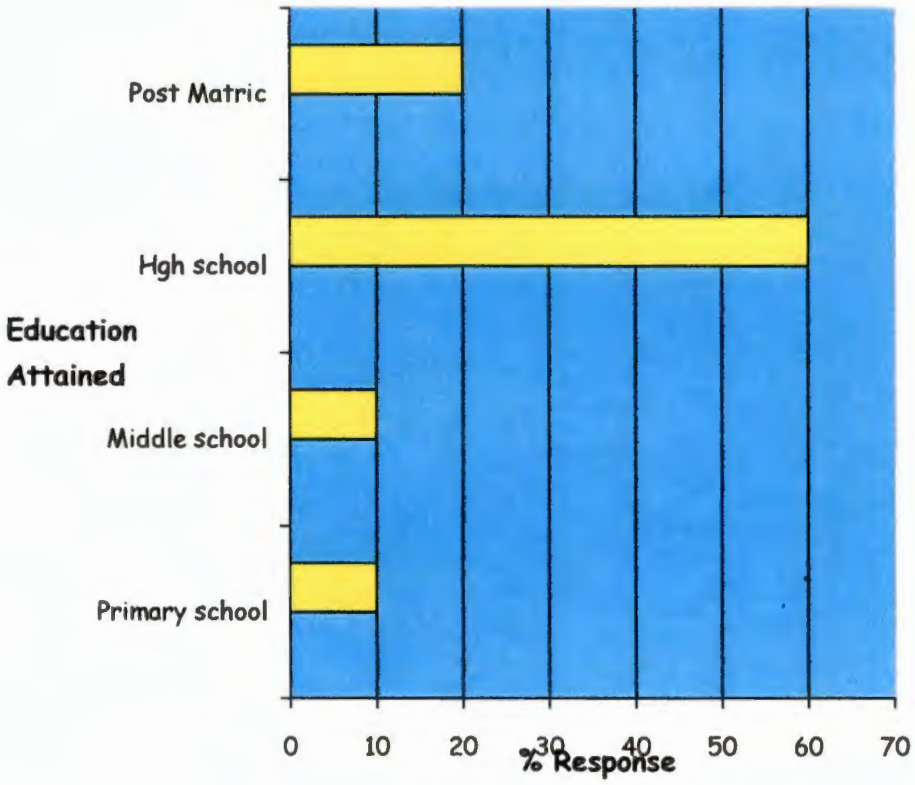


Asked why they were engaged in fishing, all the fishermen answered that they took to fishing as a means of earning a living after having failed to secure alternative employment. Asked why they stuck to fishing for employment, all fishermen answered that the insatiable demand for fish gave them a stable income. This finding suggests that fishing, as an income generating activity, was a recent phenomenon in the MLM, which was started as an initiative of the local youth who had failed to find better employment or placing. The length of time the fishermen

had stayed at their residences suggested that they would be committed to continue living in the MLM for as long as they could earn a reasonable living from fishing. This implies that the IAS could, by recruiting from the community, become a scheme that would be run by the community for their benefit.

The level of education of the fishermen varied from semi literate to post matric with the majority of them having high school education (Standard 8 - 10) as shown in Figure 4.3. This finding shows that the majority of fishermen in the MLM had formal education that would enable them to be trained in the modern techniques of aquaculture and farm management. Given that the fishermen showed an ethical commitment to their work and were not likely to relocate to other places, it would be worth the while to invest in their further training.

Figure 4.3: Frequency distribution of the education level of respondent fishermen



4.3 Production aspects

The survey showed that only 20% of the fishermen could catch fish throughout the year. The majority (80%) of the fishermen were unable to catch fish throughout the year due to lack of appropriate equipment. The study showed that during wintertime, fish was particularly scarce to the extent that, only 20% of the fishermen earned their income from fishing, 20% from casual jobs while 60%, had

no income at all. These results indicate that the fishermen do not lack what to do or the desire to work, but need to be facilitated to be able to work all year round.

The fishermen were asked to mention other factors that affected their production. All the fishermen mentioned licenses, storage facilities and transport as their biggest problems. In the fishing industry cold storage is a major production requirement because without it fish would rot and cause severe losses to the fishermen. These findings imply that the MLM fishermen:

- Lacked bargaining power in sales transactions because they would be ready to accept miserable offers to avoid the consequence of decomposed stock.
- Could supply fish only to a small number of customers.
- Could not be confident of the quality of their product to be able to price in line with the going market price.
- Could lose their days catch through contamination from old stock.

The study showed that none of the fishermen had a license or permit for fishing in the dams. During the selection of the sample, the fishing community showed a lot of apprehension about the survey. All fishermen expressed the fear that the information they volunteered could be used to stop their unathourized activities and pleaded to the authorities to appreciate their situation and legalize their status. The problem of unregulated fishing is that fishermen can catch any

quantity of fish using whatever means they prefer. This practice could significantly damage the Molopo fishery.

The study showed that vegetable farmers (n = 2) in the Molopo basin had acquired one-hectare plots on lease from the Batlharo-Baga Masibi Tribal Authority. At the time of the study, all vegetable farmers were not producing anything on the farms for the same reason. The reason was that the pump, that they all depended on to pump water for irrigation, had broken down and they could not afford to fix it and pay for its operating costs. Asked about other factors that had a negative impact on their activities, all farmers gave the following as being most prominent:

- Lack of necessary equipment and machinery.
- Lack of transport.
- Lack of storage facilities.

Results of the survey on production by farmers indicate that the programme under which the farmers were facilitated to grow vegetables failed for either or both of the following reasons:

- The scheme was not sustainable.
- There was mismanagement of the scheme.

All farmers indicated that they would employ up to five labourers on their plots. The study also showed that neither the vegetable farmers nor the fishermen knew what integrated aquaculture was.

4.4 Socio-political aspects

The study identified five organizations that were considered to hold the key to development of aquaculture in the MLM. These were:

- The Barolong Boo Ratshidi Tribal Authority (BRTA).
- The Department of Traditional and Corporate Affairs (DTCA).
- The Department of Agriculture, Conservation and Environment (DACE).
- The Department of Economic Development and Tourism (DEDT).
- The Department of Water Affairs and Forestry (DWAF).

The study found that only DACE had plans for developing a fishing industry in the MLM. The rest of the organizations namely BRTA, DTCA, DEDT and DWAF had none. Asked why this was the case, all representatives of the four organizations gave the reason that they did not consider fishing as a line activity in their organizations. The implication of this is that some of the officials in key positions may not have been aware of the benefits that could accrue from fisheries as a natural resource. The study also found that two of the five organizations had no plans for any development projects in the Molopo basin while the other three had the following plans:

- BRTA had plans to build a recreation and conference hall.

- DACE intended to develop a fishing industry and an irrigation scheme for citrus fruits.
- DWAF planned to supply free piped water to the villages in the Molopo basin.

None of the representatives interviewed thought that aquaculture would interfere with their organization's development plans for the Molopo basin. All career groups in the survey expressed a willingness to participate or support the intended aquaculture project through:

- Being employed or offering advice as was the case with fishermen and vegetable farmers.
- Purchase products from the scheme, as was the case with the fish traders.
- Provide financial and technical support, as was the case with BRTA and all the government departments.

However, the assistance promised had the following conditions:

- BRTA and DACE required that development should be;
  (a) By community members duly registered as a Non Profit Organization.
  (b) Comprised of members of the community where the development was intended to take place.
  (c) Approved by the tribal council.
  (d) Able to satisfy the needs of the community.
- DWAF required that the developers would have to be licensed to use water resources for aquaculture.

Assistance that the various organizations could offer is given in Table 4.1.

Table 4.1: Assistance offered towards aquaculture development by different organizations.

Organization	Assistance that could be offered
BRTA	- Solicit funds for infrastructure development and personnel training
DACE	- Provide capital grant for infrastructure development - Starter pack for recurrent expenditure - Train personnel - Provide extension services - Assist with licensing procedure
DTCA	- Assist in market development - Solicit funds for infrastructure development
DWAF	- Assist with licensing procedure - Solicit funds for infrastructure development
DEAT	- Assist in market development - Solicit funds for infrastructure development

These findings imply that the North West provincial government has intentions of developing its communities and the funds to do so are available. However, the provincial government does not choose for or impose projects on communities but sets conditions that would have to be fulfilled in order for development projects to be funded. The onus lies on the communities to identify sustainable schemes in order to qualify for non-repayable grants and technical support from the government.

4.5 Economic aspects of the study

The study showed that while fishermen had a good number of customers that bought fish for domestic consumption, all fishermen depended on traders for bulk purchases. Traders telephonically placed their orders and collected fish at a later date. The study showed that none of the fishermen was able to satisfy all the orders they received. The main reason for failing to satisfy all orders was they lacked storage facilities to keep a large stock. This finding implies that the fish stocks in the Molopo dams are under exploited and the MLM fish market is denied of supplies. The result of this is that the market resorts to alternative food in order to satisfy their needs. If there were a steady supply of fish, the demand for it would be higher. Asked about the trend of sales over the past three years, the answer from all fishermen was that sales had been increasing constantly. As such,

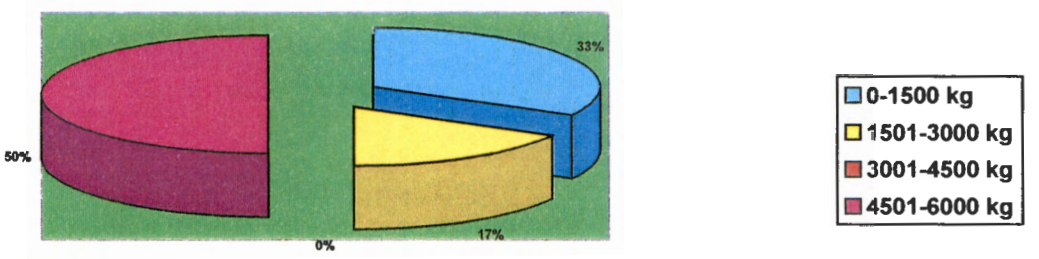
all fishermen were of the view that there was a potential for developing a fishery industry in the MLM.

The study showed that the majority (83%) of fish traders (n = 6) were supplied with fish from outside MLM while 17% bought fish from the Molopo basin. Further, the study revealed that all fish supplied from outside MLM was sold from different shops with one exception of a trader that had a roadside stall, while fish bought from Molopo fishermen was mostly sold in Botswana and Gauteng province. When asked why they did not sell fish from Molopo basin in the shops, traders responded as follows:

- 80% said that they obtained their stock through a central purchasing system organized from their headquarters.
- 10% could not buy because they were franchises with menus that specified sea fish.
- 10% said that there were no suppliers of fish from the Molopo basin.

The quantity of fish sold by traders varied widely and is presented in Figure 4.4.

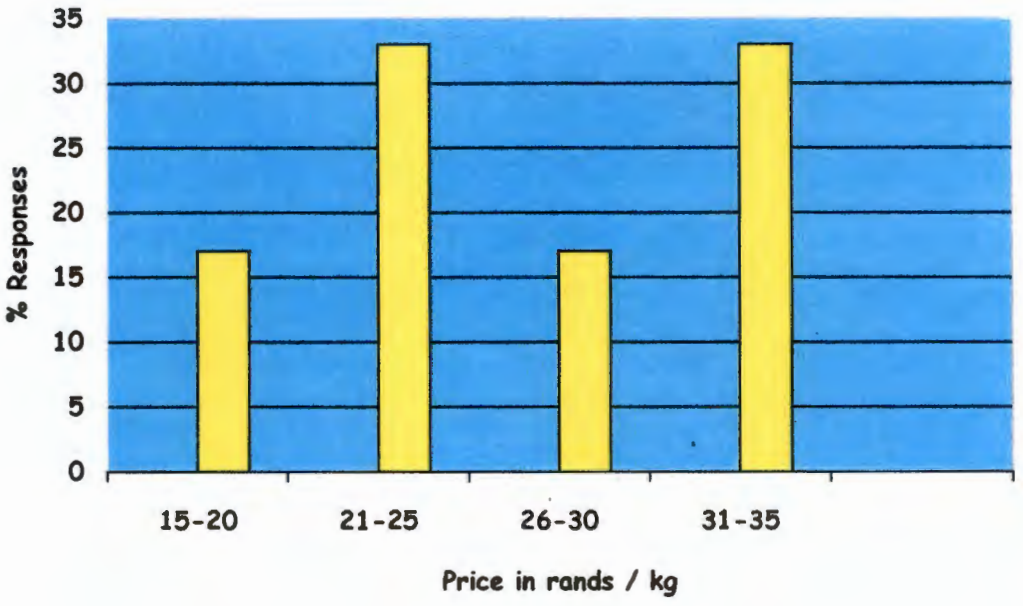
Figure 4.4: Quantity of fish sold per month by traders in the MLM (n = 6)



The study found that most (83%) of the fish sold in the MLM was bought outside the MLM. The study also found that 50% of the fish sold in the MLM was supplied through central purchasing systems of different chain stores. These findings indicate that MLM fish should, among other channels, be marketed through the nation-wide distribution networks of established chain stores. Government departments such as DTCA and DEDT would have to be approached to help secure supply contracts with established distributors.

The price charged for fish products varied widely among the traders and are presented in Figure 4.5.

Figure 4.5: Distribution of price of fish products among traders in the MLM.



The study found that while the mean price of fish in the MLM shops was R25.83 / kg, Molopo fishermen charged only R3.00 / kg.

The study found some of the reasons for the variation in prices to be that:

- Traders bought stock from a wide variety of suppliers.
- The same fish products were packed and priced different to suit the wants of different market segments.

- Value adding increased the price of fish.

From these findings, it can be inferred that Molopo fish can attract higher prices and secure a niche in the MLM market if, among other factors, the following are taken into consideration:

- Adherence to strict hygiene standards during processing and distribution.
- Continuity in supplying of high quality products.
- Value adding.
- Packaging to meet the needs and wants of different market segments.

The study found that a relationship existed between the opinion of traders on the trend of sales of fish and the methods they applied in merchandising fish. This relationship was as follows:

- The 67% of the traders that passively displayed fish in fridges also said their sales did not change in the past three years.
- 33% of the traders actively promoted and or advertised fish were the same that said sales had increased in the last three years.

This implies that the increase in sales observed was direct result of promotions and advertising.

A market survey was conducted in some shops in Mafikeng town. The intention was to obtain prices that would be used to calculate the market potential of farm products that were to be produced on the IAS. The results of the market survey are presented in Table 4.2.

Table 4.2: Market price of some food items in selected shops in Mafikeng town.

Shop	Price (R) per kg		
	Chicken	Cabbage	Spinach
Spar	11.28	4.95	15.80
Shoprite	14.99	2.10	6.00
Top Taste	13.99	2.50	8.00
Madeira Supermarket	16.84	1.30	3.53
Mafikeng Main Market	15.50	3.60	6.00
Mean Price	14.52	2.89	7.87

The mean prices of items obtained in the market survey were used to calculate the monthly market potentials of the different items. The market potentials obtained are presented in Table 4.3.

Table 4.3: Values of market potential for some items in Mafikeng

Item	Annual Market Potential in Rands
Fish	31,947,577
Chicken	53,428,082
Spinach	19,467,862
Cabbage	13,672,417
Total	118,515,938

A market potential survey gives an indication to the producer the size of his possible market but not actual. When jointly considered with the market share enjoyed by competitors, market potential guides the intending producer on the scale at which he should start his production. The findings show that the potential market for the IAS products in the MLM is enormous and yet the fishermen and vegetable growers in the MLM do not have any noticeable claim to this large market. The IAS should therefore aim at securing and maintaining a portion of this market.

4.5.1 Assessing the economic feasibility of the proposed aquaculture scheme

The study found that the items to be produced in the proposed project would be seeded or planted at different times of the year, with each of them having a different growth and harvest period. Table 4.4 shows the timing of seasons for different farm items.

Table 4.4: Time-line showing the growing, harvesting and sales periods of the proposed IAS products

Item / Month	J	F	M	A	M	J	J	A	S	O	N	D	C/yr
Chicken	X	X	X	X	X	X	X	X	X	X	X	X	6
Fish	X	X	X	X	X			X	X	X	X	X	2
Cabbage	X	X	X		X	X	X		X	X	X		3
Spinach		X	X	X		X	X	X	X	X	X		3

Key:

X = time for harvest and sale

C/yr = cycles per year

An Income and Expenditure schedule that was developed based on projected production figures and cost is presented in Table 4.5.

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TABLE 4.5: YEAR-1 INCOME AND EXPENDITURE SCHEDULE

Product	CHICKEN						FISH		SPINACH			CABBAGE			
Cycle	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**1**	**2**	**3**	**1**	**2**	**3**	TOTAL
Sales (kg)	15040	15040	15040	15040	15040	15040	18424	18424	118440	118440	118440	270720	270720	270720	1294568
Price (R)	11	11	11	11	11	11	10	10	0.8	0.8	0.8	0.3	0.3	0.3	
#Total Sales (R)	165440	165440	165440	165440	165440	165440	184240	184240	94752	94752	94752	81216	81216	81216	1889024
***Direct costs**															
Cost of stock	25200	25200	25200	25200	25200	25200	25000	25000	16000	16000	16000	14000	14000	14000	291200
Fertilizer	NA	NA	NA	NA	NA	NA	NA	NA	10800	10800	10800	7200	7200	7200	54000
Cultivation	NA	NA	NA	NA	NA	NA	NA	NA	1200	1200	1200	1200	1200	1200	7200
Pesticide/Med.	1512	1512	1512	1512	1512	1512	NA	NA	800	800	800	2360	2360	2360	18552
Feed	63430	63430	63430	63430	63430	63430	NA	NA	NA	NA	NA	NA	NA	NA	380580
Direct labour	11573	11573	11573	11573	11573	11573	60000	60000	7200	7200	7200	7200	7200	7200	232638
Tot. direct costs	101715	101715	101715	101715	101715	101715	85000	85000	36000	36000	36000	31960	31960	31960	984170
##Indirect costs															
Salaries	24429	24429	24429	24429	24429	24429	24429	24429	24428	24428	24428	24428	24428	24428	342000
Advertising	8268	8268	8268	8268	8268	8268	8268	8268	8268	8268	8268	8268	8268	8268	115752
Transport	4831	4831	4831	4831	4831	4831	4831	4831	4831	4831	4831	4831	4831	4831	67634
Tel. / Post	500	500	500	500	500	500	500	500	500	500	500	500	500	500	7000
Maintenance	483	483	483	483	483	483	483	483	483	483	483	483	483	483	6762
Electricity	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	42000
Total indirect costs	41511	41511	41511	41511	41511	41511	41511	41511	41510	41510	41510	41510	41510	41510	581148
Total cost	143226	143226	143226	143226	143226	143226	126511	126511	77510	77510	77510	73470	73470	73470	1565318
GROSS INCOME	22214	22214	22214	22214	22214	22214	57729	57729	17242	17242	17242	7746	7746	7746	**323706**

Key:

#: Sales as calculated in section 3.9

*: Direct costs obtained from appendices 1 and 2

##: Indirect costs based on market rates in section 3.9.

Table 4.5 shows the different products and the number of times that they will be produced in Year 1 on the proposed farm. The schedule shows the projected sales per cycle at the top followed by direct and indirect costs with the gross income appearing in the bottom line. In developing the schedule, the figures used were estimated or obtained as follows:

- Sales were calculated as shown in section 3.9 based on literature reviewed and Appendices 1 and 2.
- Direct costs were obtained from Appendices 1 and 2
- Indirect costs are based on comparable market rates given in section 3.9.

Since there is no loan repayment and no taxes levied, gross income is either the profit or loss made in each cycle. For ease of illustration, it is assumed that all sales are cash sales and that all products are sold by the end of each cycle. The gross income row shows a positive balance for all cycles of production. This implies that the production costs do not exceed the revenue generated during sales. Given that the sales figures were conservative and the production costs were deliberately inflated, the profitability of the farm will be improved on by minimizing costs and improving on production and sales.

A time-line is used to show the time of sale for each item. Time is given as the month of sale and the amount obtained for each sale is given in rands in Table 4.6.

TABLE 4.6: MONTHLY SALES IN RANDS

TABLE 4.6: MONTHLY SALES IN RANDS

ITEM	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
Chicken	0	165440	0	165440	0	165440	0	165440	0	165440	0	165440	992640
Fish	0	0	0	0	184240	0	0	0	0	0	0	184240	368480
Cabbage	0	0	0	81216	0	0	0	81216	0	0	0	81216	243648
Spinach	0	0	0	94752	0	0	0	94752	0	0	94752	0	284256
Total	0	165440	0	341408	184240	165440	0	341408	0	165440	94752	430896	**1889024**

The time-line is used to develop a monthly cash flow forecast for Year 1 and thereafter, yearly cash flows over a five-year term. These cash flows are presented in Tables 4.7 and 4.8 respectively. The tables show the projected sales revenue on a monthly and yearly basis respectively.

TABLE 4.7: CASH FLOW FORECAST FOR YEAR 1.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
# Total Sales (Rands)	0	1654400		341408	184240	1654400		3414080		165440	94752	430896
***Direct costs**												
Cost of stock	64200	160000	252000		39200	160000	25200	250000	552000		252000	
Fertilizer	7200	1080000		0	7200	1080000		0	1800000		0	0
Cultivation	0	1200	120000		0	1200	120000		0	240000		0
Pesticide/Medicines	1512	2360	23120		1512	2360	2312		1512	3160	1512	
Feed	31715	31715	31715	31715	31715	31715	31715	31715	31715	31715	31715	31715
Direct labour	19386	19386	19386	19386	19386	19386	19387	19387	19387	19387	19387	19387
Total direct costs	124013	81461	79813	51101	99013	81461	79814	76102	125814	56662	77814	51102
##Indirect costs												
Salaries	28500	28500	28500	28500	28500	28500	28500	28500	28500	28500	28500	28500
Advertising	9646	9646	9646	9646	9646	9646	9646	9646	9646	9646	9646	9646
Transport	5636	5636	5636	5636	5636	5636	5636	5636	5636	5636	5637	5637
Tel. / Post	583	583	583	583	583	583	583	583	584	584	584	584
Maintenance	564	564	564	564	564	564	564	564	564	562	562	562
Electricity	3500	3500	3500	3500	3500	3500	3500	3500	3500	3500	3500	3500
Total indirect costs	48429	48429	48429	48429	48429	48429	48429	48429	48430	48428	48429	48429
Total cost	172442	129890	128242	99530	147442	129890	128243	124531	174244	105090	126243	99531
GROSS INCOME	-172442	35550	-128242	241878	36798	35550	-128243	216877	-174244	60350	-31491	331365
Bank begin	530104	357662	393212	264970	506848	543646	579196	450953	667830	493586	553936	522445
Bank end	357662	393212	264970	506848	543646	579196	450953	667830	493586	553936	522445	**853810**

Key:

#: Sales figures calculated in section 3.9.

*: Direct costs obtained from appendices 1 and 2.

##: Indirect costs are based on market rates.

TABLE 4.8: COMPOSITE 5-YEAR CASH FLOW FORECAST FOR THE PROPOSED IAS

	YEAR					
	1	2	3	4	5	TOTAL
Total Sales (Rands)	1889024	2172378	2498234	2872969	3303915	12736520
Direct costs						
Cost of stock	291200	320320	352352	387587	426346	1777805
Fertilizer	54000	59400	65340	71874	79061	329675
Cultivation	7200	7920	8712	9583	10542	43957
Pesticide/Medicines	18552	20407	22448	24693	27162	113262
Feed	380580	418638	460502	506552	557207	2323479
Direct labour	232638	255902	281492	309641	340605	1420278
Total direct costs	984170	1082587	1190846	1309930	1440923	6008456
Indirect costs						
Salaries	342000	376200	413820	455202	500722	2087944
Advertising	115752	127327	140060	154066	169473	706678
Transport	67634	74397	81837	90021	99023	412912
Tel. / Post	7000	7700	8470	9317	10249	42736
Maintenance	6762	7438	8182	9000	9900	41283
Pond maintenance	0	10200	11220	12342	13576	47338
Electricity	42000	46200	50820	55902	61492	256414
Total indirect costs	581148	649463	714409	785850	864435	3595305
Total cost	1565318	1732050	1905255	2095780	2305358	9603761
GROSS INCOME	323706	440328	592979	777189	998556	3132759
Bank begin	530104	853810	1294138	1887117	2664306	
Bank end	853810	1294138	1887117	2664306	3662863	

In developing the cash flow forecasts, it was assumed that all products would be sold off in the month of harvest and that all sales would be for cash. The effect of this has been that in some months, no income is generated. Since costs, especially indirect, are incurred whether sales occur or not, it may be possible to register negative bank balances at the end of some months. The economic viability of the IAS will depend on whether it can generate sufficient reserves to carry it through the periods when no sales occur. If the IAS is given a starter pack grant of R530, 104 in January of Year 1, the projected cash flow for Year 1 of production shows a positive bank balance of R853, 810. This is a good scenario given that there are four months in the year with no sales. Year 1 monthly cash flows show a positive bank balance at the end of each month. This implies that the scheme is able to generate reserves to see it through the lean months where there are no sales. Based on these observations, it is safe to say that the scheme can sustain itself financially in the short term.

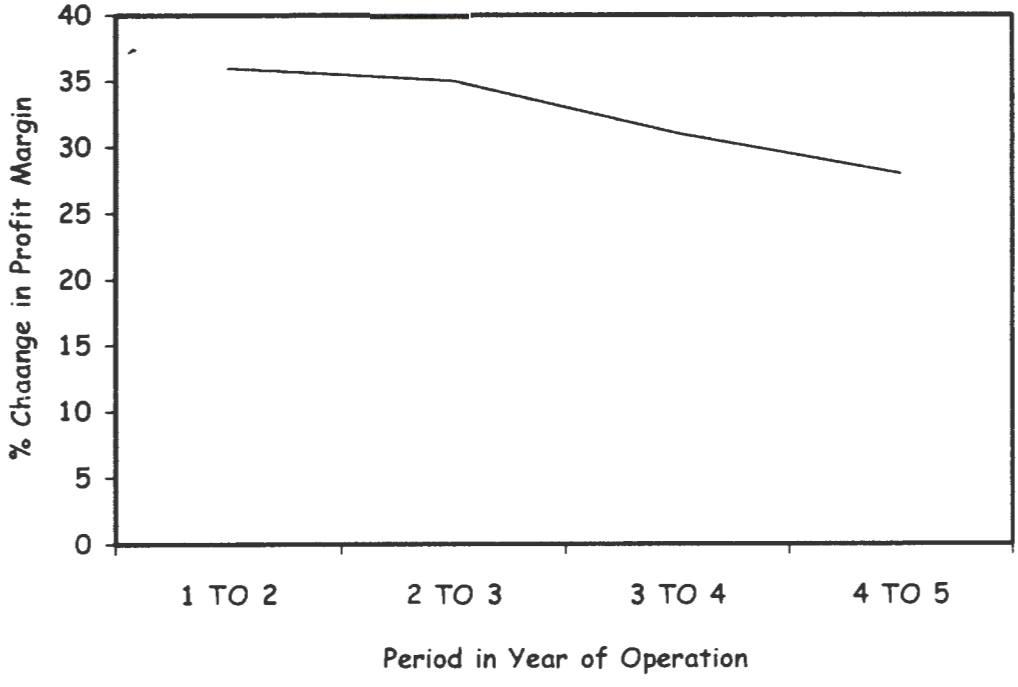
A five-year cash flow projection, reflected in Table 4.8, based on the assumption that cost and sales increase each year at the rate of 10 and 15% respectively shows that:

- The IAS would register an increasing positive gross income at the end of each of the five years. The scheme will be able to meet all its costs in the projected period. The implication is that the scheme can sustain itself financially both in

the short and long term. The cumulative bank balance indicates that the scheme would be able to maintain and replace capital equipment and machinery that would be depreciating with time. Excess funds accumulated can be used to finance other development projects. Clearly the IAS would not require regular cash injections from its benefactors to boost it up as and when it stumbles.

- An analysis of the generated gross income shows that there is a slow gradual decline in the profit margins over the five-year period. Figure 4.6 illustrates the gradual decline of the profit margin over time.

FIGURE 4.6: PERCENTAGE CHANGE IN PROFIT MARGIN OVER TIME



Extrapolation of the graph indicates the IAS will continue making profit for a long time and that it will take long before a 0% profit margin between two subsequent years of production is recorded.

The decline in profit margin levels can be attributed to the following reasons among others:

- There is a yearly increment in costs
- Production levels remain constant from Year 2 onward

The decline in profit margins can therefore be halted and reversed by minimizing production costs and increasing yield out-put levels. Production cost may be minimized through mechanization and the use of modern techniques. Yield may be increased through use of improved seeds and crop management. Management can achieve this objective by carrying out a SWOT analysis. A SWOT analysis identifies an organization's Strengths and Weaknesses, Opportunities and Threats (Thompson and Strickland, 1995). Management then strategically places their organization to operate from a position where it uses all available opportunities to minimize its weaknesses and overcome its threats.

Due to time and financial limitations, it has not been possible to conduct a SWOT analysis where each strategic move would be assessed to quantify the benefits it would bring to the IAS.

Based on the above analysis and on information, which, was adduced earlier in the background to the study that integrated aquaculture has a negligible impact on the environment, the hypothesis of the study is accepted.

CHAPTER FIVE

5 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter gives a summary of the study and looks at its main findings in relation to the specific objectives of the study. The chapter draws conclusions from the study and makes recommendations based on the findings of the study.

5.2 Findings of the study in respect to its objectives

1. In evaluating whether a sustainable community based IAS could be developed in the MLM, the following were established with regard to the community of Molopo fishermen and vegetable farmers and IAS operations:

- They were eligible for allocation of land from the BRTA for the purpose of developing an IAS.
- They were eligible for consideration for allocation of a grant from DACE for the purpose of developing an IAS.
- DEDT and DTCA would assist in securing markets for the IAS products.
- DWAF considered IAS operations as being eco-friendly.
- The MLM community had no objections to the development of an IAS and would give it the necessary support.

- Cash flows projections indicated that the IAS was economically feasible.

2. In assessing the willingness of stakeholders to participate in the development and implementation of an IAS, all stakeholders registered their willingness.
3. In determining the job opportunities and other benefits that would accrue from the IAS, the following were established:

- The IAS would permanently employ 15 people from the community and pay out at least R462 000 in salaries and wages in the first year of operation.
- The IAS would employ a large number of casual labourers during harvest time.
- A considerable number of jobs would be created for community members that would be recruited as artisans, administration clerks, drivers and labourers during the construction phase of the scheme.
- Community members would be sub-contracted during the construction phase of the IAS.
- During the construction phase, participating community would pick up new skills, which they could improve on.
- Numerous jobs would be created in related areas such as marketing of products, weaving bags for packaging cabbages, supplying chicken feed and supplying pesticides and medicines.
- The IAS would provide food of high nutritional value prices especially to the poor members of the community.

- The IAS would be used as a centre to train Molopo youths and other South African youths in the techniques of integrated aquaculture, modern agricultural practice and management skills so that they could start family based integrated aquaculture schemes or other entrepreneurial ventures.

Based on the findings enumerated in Section 5.2 and on the background information that the dependency ratio in MLM is very high (1: 50-100), it is deemed fitting to conclude that:

- The operations of the proposed IAS will be of a sustainable nature.
- As such, a proposal for developing a sustainable community based IAS in the MLM will be favourably considered for funding and implementation by the relevant departments in the North West provincial government and the BRTA.
- The IAS will greatly benefit the MLM community through job creation, poverty alleviation and improved family food security.

5.3 Problems observed and recommendations of the study

In the course of the study, a number of problems that would be a hindrance to the development and operation of an IAS in the MLM were noted. In this section, the problems are discussed and recommendations on how to solve these problems are made:

5.3.1 Lack of organizational structure

During the study, it was realized that all fishing and vegetable farming were self financed and managed by the individuals and their families. The fishermen and farmers in the Molopo basin were not organized under a registered body through which they could seek assistance. It is therefore recommended that the fishermen and farmers in the Molopo basin unite under an organization through which they would seek to be funded.

5.3.2 Lack of knowledge in managing community projects

All the fishermen and farmers in the Molopo basin did not have an idea of how community projects were run. It is recommended that relevant government authorities would have to be approached and requested to teach Molopo community members on how community projects can be operated.

5.3.3 Initiation of preliminary studies

No study had been conducted to determine the capital outlay that would be required to start an IAS in the MLM. It is therefore recommended that the representatives of the Molopo community would have to approach the relevant authorities to initiate such a study.

5.3.4 Work ethics

All the fishermen sampled had never been in formal employment before. All the fishermen were accustomed to being their own bosses who would start and end

work as and when they pleased. It is recommended that all employees of the IAS would have to undergo workshops to orient them on formal working procedures and respect for hierarchy.

5.3.5 Selection of workers to the scheme

The IAS would only be able to employ a limited number of the community members on a full time basis. As such, a lot of problems would arise when it came to selecting the people to work on the IAS. It would strongly be argued that the scheme opens the gates and lets in as many people as possible since it was a community project. However, this action would benefit neither the scheme nor the community as a whole. It would lead to high production cost and management problems arising from lack of control. These problems would negatively affect the profits of the scheme. It is imperative that the IAS should be run with the business motive of profit constantly in focus. The community would benefit more if it used the IAS as a centre for capacity building. As such, the following are recommended for implementation:

- The IAS should be used as a centre to train the youth from the MLM and other parts of South Africa in aspects of: environmental management, modern agriculture and aquaculture practice, marketing, conflict resolution and management skills.
- The IAS should be used as a "cash cow" whose profits would be "milked" and used to fund other community operations.

- The selection of employees and trainees at the scheme should be left to professional recruitment agencies that would be impartial and take issues such as qualification and gender into consideration. The recruitment agencies would work in consultation with the BRTA.

5.3.6 Hygiene standards

The study found that the standard of hygiene among the traders had a proportional relationship with the price they charged for fish. Products of high quality were acceptable in all market segments and fetched high prices. It is therefore recommended that the IAS should adhere to strict hygiene standards with regular inspections and certification from the Public Health Inspectors.

5.3.7 Need for environmental impact assessment

The study showed that environmental issues such as water and land pollution, health hazards like malaria, bilharzia and cholera were associated with integrated aquaculture. It is therefore recommended that measures to monitor, assess and control the impact of the IAS operations on the environment would have to be put in place.

5.3.8 Risk management

The study also showed that the activities of an IAS would expose it to high levels of risk ranging from common business risk like theft to complex risk events such as

pathological risk arising from exotic species and legal liabilities arising from contract infringements and product liabilities. However, due to lack of time and limitation by the scope of the study, it was not possible to analyze the extent to which the IAS would be exposed to risk. It is therefore recommended that a study be conducted to determine the extent to which the IAS would be exposed to risk and to make recommendations on appropriate steps to minimize the scheme's exposure to risk.

BIBLIOGRAPHY

1. **ALLEN, P. P. BOTSFORD, L.W. SCHUUR, A.M. AND JOHNSTON, W.E.** (1984). Bioeconomics of Aquaculture. 1st edition, Elsevier Science Publishers, Amsterdam.

2. **BALARIN, J. D.**(1988 a). Systems in Use and Species Cultivated. Pages 3 - 27. *In* **KING, H. R. AND IBRAHIM, K. H.** (Editors). Village Level Aquaculture Development in Africa. Food Production and Rural Development Division, Commonwealth Secretariat, London.

3. **BALARIN, J. D.**(1988 b). Technical and Socio-Economic Factors inhibiting Development. Pages 28 - 35. *In* **KING, H. R. AND IBRAHIM, K. H.** (Editors). Village Level Aquaculture Development in Africa. Food Production and Rural Development Division, Commonwealth Secretariat, London.

4. **BALARIN, J. D.**(1988 c). The Logistics of Fish Farm Project Appraisal. Pages 92 - 106. *In* **KING, H. R. AND IBRAHIM, K. H.** (Editors). Village Level Aquaculture Development in Africa. Food Production and Rural Development Division, Commonwealth Secretariat, London.

5. **BEGG, D. FISCHER, S. AND DORNBUSCH, R.** (1994). Economics. 4th edition McGraw-Hill Publishing Company, England.

6. **BRINK, D.** (2001). Aquaculture Production in South Africa. Paper presented at AFMA's symposium October 2001. http://www.afma.co.za

7. **CAULTON, M. S. AND PEDDIE, D. A.** (1984). Fisheries in Bophuthatswana: A Preliminary Resource Survey and Recommendations. Natural Resource Management Report No. 2.

8. **CENSUS 1996,** (1996). Demarcation Board Municipal Profile CD: DC38. Statistics South Africa.

9. **DALRYMPLE, D. J. AND PARSONS, L. J.** (1995). Marketing Management: Texts and Cases. 6th edition John Wiley & Sons, Inc. New York, USA

10. **DEPARTMENT OF AGRICULTURE, NORTH WEST PROVINCE, SOUTH AFRICA.** (1997). Development Strategy.

11. **DWA - DEPARTMENT OF WATER AFFAIRS, (1986).** Management of the Water Resources of the Republic of South Africa. DWA Pretoria, South Africa.

12. **FALAYE, A. E. AND AKINYEMI, O.** (1988). Aquaculture in Nigeria. *In* **KING, H. R. AND IBRAHIM, K. H.** (Editors). Village Level Aquaculture Development in Africa. Food Production and Rural Development Division, Commonwealth Secretariat, London.

13. **FERNANDEZ, P.** (2001). Personal communication. Engineer Department of Water Affairs and Forestry, Mmabatho, South Africa.

14. **FRIEDEL, C.** (2000). Post-apartheid fisheries management in South Africa: a local and global perspective.

http://www.saep.org/internProjects/intproj/2000/SAEPprojectsFriedel2000.htm

15. **GARRISON, R. H. AND NOREEN, E. W.** (1994). Managerial Accounting:

Concepts for Planning, Control, Decision Making. 7th edition, Richard D. Irwin, Inc. USA.

16. **GILBERT, R. J.** (1989). Small-scale Marketing of Aquaculture Products. Southern Region Aquaculture Center publication No. 350. Texas Agricultural Extension Service, USA.

17. **ICLARM - INTERNATIONAL CENTRE FOR LIVING AQUATIC RESOURCSE,** (2001). http://www.cgiar.org/iclarm/pubsof.htm

18. **JACOBS, B.** (2002). Personal communication. Manager North West Tourism Board, Mafikeng, South Africa.

19. **KAVITA, P.** (2000). Transformation of the Fishing Industry in the New South Africa: Sustainable Management of Marine Living Resources and Redistribution of Access to them since 1994.

http://www.saep.org/internProjects/intproj/2000/SAEPprojectsKavita2000.htm

20. **KOOI, J.** (2001). Building a business plan. *In* Farmers Weekly, 8 to 12 October 2001, Page 17.

21. **KOTLER, P.** (1994). Marketing Management: Analysis, Planning, Implementation and Control. 8th edition Prentice-Hall International, Inc. New Jersey, USA.

22. **MARUMA, N. N.**(2000). Business Statistics (ADM 103) Lecture Manual, University of North West, South Africa.

23. **McVEIGH, S.** (2001). Big profits on a small-scale. *In* Farmers Weekly, 4

May 2001, Page 51.

24. **MOLEMA, P.** (2002). Personal communication. Public Relations Officer at the Barolong Boo Ratshidi Tribal Authority, Mafikeng, South Africa.

25. **MSB (MANAGING A SMALL BUSINESSS)** (2001). http//www.bizmove.com/starting

26. **MUNSLOW, B.** (1994). Sustainable Development and the Peace Process in Southern Africa: The Experience of Mozambique and Angola. *In* Cole, K. (editor), Sustainable Development for a Democratic South Africa. London, Earthscan.

27. **NEL, C.** (2001). Putting catfish on the SA farming agenda. *In* Farmers Weekly, 12 October 2001, Page 16.

28. **PELSER, F.** (2001). Financial Reporting and Management Accounting (MBA 812) Lecture Manual, University of North West, South Africa.

29. **PETER, E.** (1994). A Systems Approach for the Promotion of Integrated Aquaculture. Paper presented at Integrated Fish Farming International Workshop, Wuxi, People's Republic of China.

30. **PETER, E.** (1999). Towards Increased Impact of Rural Aquaculture. A discussion paper prepared for the first meeting of the APFIC Ad Hoc Working Group of Experts. FAO Regional Office Bangkok, Thailand.

31. **PHILLIPS, G. R.** (2001). Personal communication. Curator Mafikeng Museum, South Africa.

32. **ROUHANI, Q.** (2001). A Report on an Assessment of the Potential for Small-scale Fisheries Development on Disaneng and Setumo dams in the North West Province. Areport submitted to Mr. P. Leteane, Department of Agriculture, Conservation and Environment, North West Province< South Africa.

33. **THOMPSON, A. A. JR. AND STRICKLAND III, A. J.** (1995). Strategic Management Concepts and Cases. 8th edition. Richard D. Irwin. Inc.

34. **VINCKE, M. M. J.** (1988). Developing Productive Systems under Village Conditions. *In* **KING, H. R. AND IBRAHIM, K. H.** (Editors). Village Level Aquaculture Development in Africa. Food Production and Rural Development Division, Commonwealth Secretariat, London.

35. **WAGNER.** (2001). Personal communication. Head of Geography Department, University of North West, South Africa.

APPENDIX 1:

INCOME AND COSTS FOR 1000 BIRDS PER CYCLE (45DAYS).

Item	Quantity	Price per unit	Amount in rands
Income:			
Sale of broilers	948	17.00	16107.84
GROSS INCOME			**16107.84**
Variable costs:			
Day-old-chicks	1008	2.50	2520.00
Transport cost	1008	0.67	675.36
Feed(3.5Kg per birds per cycle)	1008	6.29	6342.64
Heat	1008	0.08	80.64
Medication	1008	0.15	151.20
TOTAL VARIABLE COST			**9769.84**
GROSS MARGIN			**6338.00**
Specified costs			1157.26
Regular labour	1	1157.26	
Repairs and maintenance	1	120.00	120.00
MARGIN ABOVE SPECIFIED COSTS			**5060.74**

FOOT NOTE

1. Mortality rate at 6% (1008*6% = 948)
2. Cycles per annum = 5.7
3. Selling price = 1.6Kg @10.63/Kg = R17 per bird
4. Regular labour - R550/month (64 days per cycle)

Source: School of Agriculture, University of North West.

APPENDIX 2:

COST OF PRODUCTION AND YIELD PER HECTARE PER CYCLE.

Crop	Seedlings	Fertilizer	Labour	Irrigation	Cultivation	Pesticide	Transport	Cont. 5%	Total	Expected average yield (t/ha) per cycle
Cabbage	3500	1800	1800	1200	300	590	2000	560	11750	80 - 120
Carrot	1500	1700	1800	1200	300	200	600	365	7665	20 - 30
Onion	2000	1700	1800	1200	300	200	500	385	8085	25
Spinach	4000	2700	1800	1200	300	200	2000	610	12810	30 - 40
Beetroot	1000	1700	1800	1200	300	250	200	413	8663	14

Foot notes:

1. Irrigation cost at R1.50/mm.
2. Repairs and maintanence costs are included in implement cost.
3. Transport cost per cycle includes collection of seedlings e.t.c.

Source: School of Agriculture, University of North West.

APPENDIX 3.

QUESTIONNAIRE FOR FISHERMEN IN THE MOLOPO RIVER BASIN

Date: .....

Dam: .....

1. Age: .....
2. Sex: [M] [F]
3. Place of birth: .....
4. Residential address: .....

   .....

5. How long have you stayed at this address? .....
6. What is your highest level of education?
7. Why did you start fishing and why have you continued in this career?
8. (.i) Do you catch and sell fish throughout the year? [Yes] [No]

   (ii) If the answer to question 7 (.i) is no, why?
9. What do you do to earn an income during wintertime?
10. What are the factors that negatively affect your productivity in fishing?
11. Who are your main customers (where are they from)?
12. How do you link with your customers?
13. Are you able to satisfy all the orders that you receive?

14. At what price do you sell fish ..... R/Kg.

15. How do you assess the trend of demand for fish over the past three years?

(a) Static (b) declining (c) increasing (d) not applicable

16. Does fishing have a potential for development in the MLM? [Yes] [No]

Explain the reasons for your answer.

17. Do you know what an integrated fish farming system is? [Yes] [No]

After a discussion of what an integrated fish farming system of production is, question 18 follows.

18. Are you willing to adopt an integrated fish farming system of production?

[Yes] [No].

APPENDIX 4.

QUESTIONNAIRE FOR VEGETABLE GROWERS IN THE MOLOPO RIVER BASIN.

Date:

Name: ....

2. How did you acquire your?

A. On lease from the state

B. On lease from the Batlharo - BagaMasibi Tribal Athourity

C. Through inheritance

3. What is the size of your plot in hectares?

A. 0.5 B. 1 C. 1.5 D. 2

4. Are you currently producing vegetables on your plot?

A. Yes B. No

5. (i.) If yes, give the quantities you produce per week

.....

.....

.....

(ii) If no, what is your reason for not producing?

A. No pump to irrigate plots

B. No inputs

C. No market for products

6. Why don't you attend to this problem?

7. Under ideal conditions, how many full time labourers would you employ on your farm?

A. 3-7 B. 8-12 C. 13-17

7. What were the main variables that negatively affected your vegetable growing business? .....

Variable	Does it have a negative impact?	
	A: Yes	B: No
(i.) Land		
(ii) Agricultural inputs		
(iii) Machinery		
(iv) Labour		
(v) Water		
(vi) Transport		
(vii) Storage facilities		
(viii) Market		
(ix) Extension services		

After an explanation of what an integrated aquaculture scheme is and the benefits that accrue, question 7 follows.

8. Would you consider participating in a community based aquaculture scheme?

A. Yes B. No

APPENDIX 5.

INTERVIEW WITH REPRESENTATIVES OF THE BAROLONG BOO RATSHIDI TRIBAL AUTHORITY AND SELECTED GOVERNMENT DEPARTMENTS.

Date :

Name of representative: .....

1. Does your organization have a policy or plans for developing a fishing industry in the Molopo basin ? .....

   A: Yes
   B: No

2. Why is this the position in your organization?

   .....

   .....

   A: Fishing is not a line function of our organization
   B: There is ongoing work fisheries development
   C: A study on fisheries development to commence in current financial year
   D: No proposals tabled

3. What are your organization's plans for development in the Molopo basin?

   .....

   .....

   A: Fisheries development
   B: Building recreation and conference facilities
   C: Irrigation scheme
   D: Domestic water supply
   E: None

4. Would your organization object to the development of an Integrated Aquaculture Scheme in the MLM? [Yes] [No]

A: Yes B: No

5. In what way will the development of an Integrated Aquaculture scheme interfere with your proposed plans?

.....

.....

A: No interference expected
B: By causing pollution of the water
C: By reducing the quantity of water available in the river

6. What conditions do prospective developers in the MLM basin have to fulfill in order get your approval and or assistance?

.....

A: They should be community-based projects
B: Groups should be comprised of members of the community where the development is intended to take place
C: Development plans should be approved by the Tribal Resolution.
D: Intended development should be able to satisfy the needs of the community
E: The project had to be licensed by an appropriate authority
F: None

7. Indicate the assistance your department could provide towards the development of an Integrated Aquaculture Scheme

.....

.....

A: Provide grants for bulk infrastructure and starter packs
B: Seek funding for infrastructure development and training from Non Government Organizations
C: Training
D: Extension services

E: License
F: Market development

APPENDIX 6.

QUESTIONNAIRE FOR MEMBERS OF THE FISH DISSTRIBUTION NETWORK IN MLM.

Date

Name of enterprise .....

Name of representative .....

Position held .....

1. Do you buy fish from local fishermen? A: Yes B: No
2. In which areas do you sell fish?

   A: MLM B: Other areas
3. What are your reasons for not buying from local fishermen?

   A: it is not suitable for our customers

   B: we receive our stock through a central purchasing system

   C: our menu specifies sea fish

   D: there are no suppliers

   E: not applicable
4. What is the approximate quantity of fish (kg) sold through your outlet per month?

A: 0 - 1500

B: 1501 - 3000

C: 3001 - 6000

5. What is the average price of your fish in Rands per kg?

   A: 15 - 20; B: 21 - 25; C: 26 - 30 D: > 31

6. What trend do you observe in the demand for fish from your sales of the past three years?

   A: static; B: increasing; C: decreasing

7. What methods do you use to merchandise fish in your business?

   A: Display processed and packed fish to customers who pick their choice

   B; Take orders from customers and deliver to homes, restaurants, places of work and shops

   C: Advertise and offer promotions

   D: Sell fish from freezers at home

8. If all requirements were met, would you consider stocking locally produced fish in your shop?

   A: Yes B: No