DEPARTMENT OF RESEARCH
AND SPECIALIST SERVICES
Ministry of Agriculture

THE REPUBLIC OF ZIMBABWE

IMPACT ASSESSMENT OF SUNFLOWER RESEARCH AND THE ENABLING ENVIRONMENT IN ZIMBABWE: 1976 - 2000

BY

M. Murata
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D. Martella
E. Mazhangara

November 1997

SOUTHERN AFRICAN
CENTER FOR
COOPERATION IN
AGRICULTURAL AND
NATURAL RESOURCES
RESEARCH & TRAINING

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FOREWORD

Since 1993, SACCAR has been investing substantial resources in developing regional capacity to assess the various impacts of investments in technology development and transfer within the agricultural and natural resource sectors. This is part of a larger initiative to integrate and institutionalize impact assessment as a planning and management tool within the research process.

As a part of this exercise, SACCAR, in collaboration with the University of Zimbabwe, has been organizing and conducting regional training in impact assessment methodologies. Where possible, SACCAR staff have provided technical assistance to national programs to assist scientists trained in impact assessment methodologies to undertake country level studies. So far, SACCAR has prepared two training manuals for social and biological scientists on impact assessment methodologies, and has completed impact assessments of three of its regional research and training projects, and seven national level case studies. This is the seventh country-level study completed by scientists trained in the regional training workshops organized by SACCAR and the fourth of this kind in Zimbabwe.

This study represents yet another milestone for the SACCAR and Department of Research and Specialist Services initiatives in terms of capacity building, and clearly demonstrates that national scientists have the ability and capacity to undertake impact assessment studies on research investment. I am confident that this type of information will strengthen the institutionalization process of impact assessment, and facilitate the mobilization of additional resources for agricultural and natural resources research, nationally and internationally. The information generated during the adoption survey will also enable the research institutes in identifying future research priorities.

Dr. B.J. Ndunguru
Director, SACCAR

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ACRONYMS

ADA	Agricultural Development Authority
AFC	Agricultural Finance Corporation
AGRITEX	Department of Agricultural, Technical and Extension Services
ANR	Agriculture and Natural Resources
ARF	Agricultural Research Fund
ARR	Average Rate of Return
ART	Agricultural Research Trust
CA	Communal Areas
CFU	Commercial Farmers Union
CMED	Central Mechanical and Equipment Department
CONEX	Department of Conservation and Extension
COPA	Commercial Oilseed Producers Association
CPI	Consumer Price Index
CSO	Central Statistics Office
DEVAG	Department of Agricultural Development
DR&SS	Department of Research and Specialist Services
ESAP	Economic Structural Adjustment Program
FSRU	Farming Systems Research Unit
GDP	Gross Domestic Product
GMB	Grain Marketing Board
GOZ	Government of Zimbabwe
ICFU	Indigenous Commercial Farmers Union
ICRISAT	International Crops Research Institute for the Semi-Arid Tropic
IRR	Internal Rate of Return
LSCF	Large-Scale Commercial Farmers
MOA	Ministry of Agriculture
MRR	Marginal Rate of Return
NARS	National Agricultural Research System
NGO	Non-Governmental Organization
NPV	Net Present Value
NR	Natural Region
RA	Resettlement Areas
RF	Resettlement Farmers
ROR	Rate of Return
R&D	Research and Development
SACCAR	Southern African Center for Cooperation in Agricultural and Natural Resources Research and Training
SSCF	Small-Scale Commercial Farms
TDT	Technology Development and Transfer
UDI	Unilateral Declaration of Independence
USAID	United States Agency for International Development
ZFU	Zimbabwe Farmers Union
ZIMACE	Zimbabwe Agricultural Commodity Exchange
ZSC	Zimbabwe Seed Cooperative

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- The Director, and relevant institutes, of the Department of Research and Specialist Services for granting the permission to conduct the study and making information available.

- The Commercial Oilseed Producers Association (COPA) of the Commercial Farmers Union for providing the sampling frame for the large-scale commercial farmers.

- AGRITEX for providing the enumerators who assisted in the survey of smallholder farmers.

- The Southern African Center for Cooperation in Agricultural and Natural Resources Research and Training (SACCAR) for providing technical and financial assistance for conducting the study through a grant from the United States Agency for International Development (USAID).

- Last, but not least, the farmers, both large-scale commercial and small-scale, who devoted a considerable amount of time and patience in completing the questionnaires.

However, the authors are solely responsible for any errors or omissions in this report.

PREFACE

"Impact Assessment of Sunflower Research and the Enabling Environment in Zimbabwe: 1965 - 2000" is the fifth impact study undertaken in Zimbabwe. It comes after the studies on maize, cotton, soybeans, and groundnut research. It is encouraging to those involved in research and development (R&D) to note that the current study once again confirms that investments into agricultural research and development can yield very favorable economic impacts.

The study points out the areas of strength and weaknesses of the R&D process. One of the weaknesses of R&D into sunflower has been the limited release of improved varieties. On the other hand, it showed that the small-scale communal farmers dominated the production of sunflower. However, the average yield levels realized by the small-scale communal farmers are very much lower than the biological potential of the varieties. The need for research to explore the factors constraining the adoption of improved varieties and better management practices of sunflowers by communal area farmers in environments suitable for production of the crop is pointed out in the study.

It is now time for the Department of Research and Specialist Services to put the experience gained in the *ex-post* impact assessments into conducting *ex-ante* impact assessments. By so doing, research projects would be evaluated before they are undertaken, thus ensuring that resources are allocated on the basis of the impact that the project is anticipated to have, among other criteria. Data that would be needed for undertaking *ex-post* assessments would be identified during the *ex-ante* analysis and collection would be initiated while the project is being implemented.

I would like to congratulate the authors for undertaking this important study and urge them to do so for other commodities.

Dr. N.R. Gata
Director, Department of Research and Specialist Services
Harare, Zimbabwe

CHAPTER 1. INTRODUCTION

1.1 BACKGROUND TO THE STUDY

The steady decline in public and donor funding which has been experienced by agricultural and natural resources (ANR) research, since the mid-eighties, has culminated in increased pressure for greater accountability and improved management of ANR research resources. Therefore, in order to maintain or increase current level of funding, there is need to provide evidence that investment in ANR research generates comparable rates of return. Thus, the underlying importance of monitoring and evaluation, including impact assessment as a planning tool to facilitate effective research management, cannot be over-emphasized.

Beginning in 1993, SACCAR initiated a set of activities related to impact assessment after realizing the need for developing appropriate methodologies, capacity as well as means of implementing impact evaluation and agricultural policy assessment both at the national and regional level. The primary objectives of these initiatives were to: (a) develop the regional capacity to undertake impact assessment of ANR research activities, and (b) assist in the institutionalization of impact assessment as a planning tool in the research management process. A three-pronged strategy to achieve this task was devised by SACCAR. As part of this strategy a regional training workshop on "Impact Assessment Methodologies" was organized and conducted by SACCAR in collaboration with the University of Zimbabwe. This regional training was followed by selected in-country case studies to provide trainees with an opportunity to apply the methodologies being taught.

Research programs for case studies were selected in collaboration with the NARS directors. In the case of Zimbabwe, the Director of the Department of Research and Specialist Services (DR&SS) chose the cotton research and the edible oilseed research programs for this purpose. The cotton case study was conducted and reported by Mudhara et al. (1995). The case study on edible oilseeds (groundnut, sunflower and soyabean) was initiated in 1996. This report covers the impact of sunflower research and enabling environment in Zimbabwe. SACCAR provided technical input and some financial assistance (under the United States Agency for International Development [USAID] grant) to conduct this study.

1.2 AGRICULTURE IN THE NATIONAL ECONOMY

While in comparison with most other developing countries, Zimbabwe has a relatively sophisticated and diversified economy, agriculture continues to remain the most important sector. Seventy percent of the country's population resides in the rural areas and the majority of these people depend on agriculture for their livelihood. Depending on the nature of the season, agriculture (including forestry) contributes between 12 and 18 percent towards GDP. In terms of employment, it directly employs about 24 percent of people in formal employment and indirectly, about 70 percent of the population. Agriculture also plays an important role as a foreign currency earner, providing about 40 percent of foreign exchange earnings. Besides, the performance of the economy is highly dependent on agriculture. Effects of the 1991/92 drought which led to a 50 to 75 percent decline in production of the major crops further highlight the importance of agriculture. Because of the virtual collapse of rainfed

agriculture due to that drought, GDP declined by approximately 9 percent in that year (Central Statistics Office, 1996).

For the agricultural sector, the Government aims to ensure food security, increase export earnings and raise the standards of living in rural areas. The government's strategy for satisfying these objectives, among other things, includes provision of credit to smallholders, promotion of research, and development of irrigation facilities. The government also embarked on an economic structural adjustment program aimed at revitalizing the agricultural sector. During the first phase of the program, the domestic marketing of agricultural commodities has largely been deregulated and competition now prevails. The four former agricultural marketing boards have now been restructured with the Government of Zimbabwe (GOZ) having taken over their past debts, leaving them to start operating commercially as 100 percent government owned companies. The creation of a conducive environment for competition in the purchasing of agricultural products will result in farmers receiving realistic prices which could create the necessary incentive for them to increase production. The Grain Marketing Board (GMB) remains a parastatal because of its strategic nature, but has been restructured to operate along commercial lines with the government meeting the cost of any social activities undertaken by the board including maintenance of the strategic grain reserve (Norman, 1996).

The agricultural sector in Zimbabwe is divided into two broad sectors, that is, the large-scale commercial farming sector and the smallholder farming sector. The smallholder farming sector encompasses the communal farmers, the small-scale commercial farmers and the resettlement farmers (Table 1.1). There are about 800,000 farms in the communal areas (CA). Resettlement area (RA) farms hold about 50,000 families settled in formally large-scale commercial farming areas. Small-scale commercial farms (SSCF), where land is held under both freehold and leasehold title, are about 8,500 in number. The large-scale commercial farms (LSCF) are about 4,500 where land is held under free-hold title. Agricultural and Rural Development Authority (ADA), a governmental large commercial estate farming parastatal has 26 farms.

Table 1.1 PERCENTAGE DISTRIBUTION OF LAND AREA BY NATURAL REGION AND LAND USE

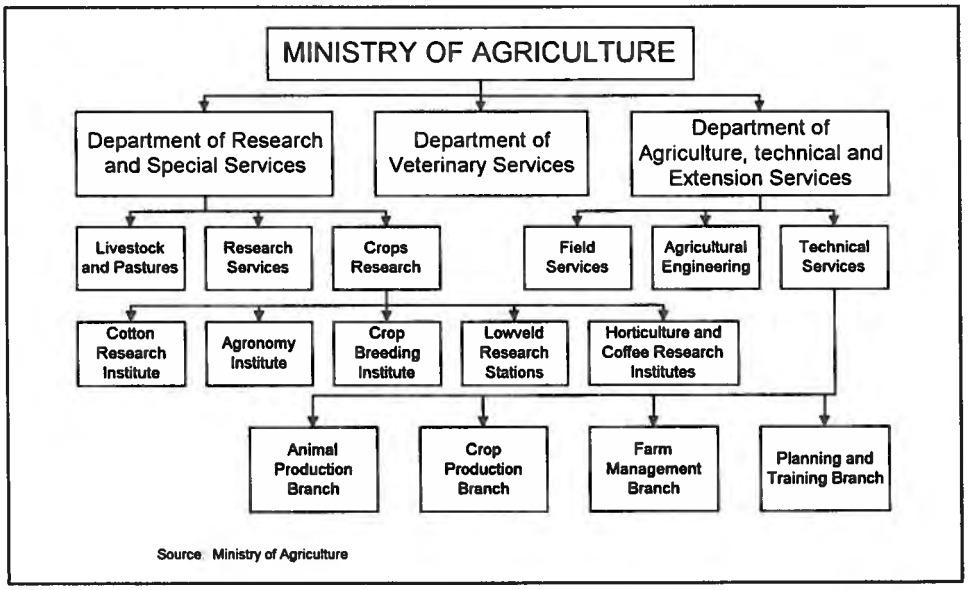
Land Use	Natural Region						
	I	II	III	IV	V	X*	Total
Communal Areas	0.2	3.1	7	18.1	12.8	1.5	42.7
Large-scale Commercial Areas	1.2	9.8	5.6	9.7	5.7	0.5	32.1
Small-scale Commercial Areas	-	0.6	0.7	1.5	0.5	0.2	3.5
Resettlement Areas	0.1	0.4	2.4	0.5	1.1	-	4.5
National Land	0.3	0.9	2.1	6.5	6	1.4	17.2
TOTAL	1.8	14.8	17.8	36.3	26.1	3.2	100

* Natural Region X represents the unclassified areas
Source: Central Statistics Office, 1989.

1.3 THE STRUCTURE OF THE AGRICULTURAL SECTOR

The institutional set up of the agricultural sector in Zimbabwe is given in Figure 1.3. The Ministry of Agriculture (MOA) is divided into three departments namely, Research and Specialist Services (DR&SS), Agricultural, Technical and Extension Services (AGRITEX), and Veterinary Services. The Department of Research and Specialist Services (DR&SS) is the main public funded agricultural research and service institution in Zimbabwe. It is charged with the responsibility to conduct research and generate technologies aimed at sustained improvement of agriculture in all sectors. In addition, DR&SS are tasked with providing specific services and executing certain regulatory functions that ensure agriculture contributes to national development, food security and sustainable land use. The Department has three divisions, that is, Crops Research; Livestock and Pastures; and Research Services. All aspects of germ plasm improvement of sunflower are conducted by the Crop Breeding Institute (CBI) while agronomic research is conducted by Agronomy Institute, both Institutes fall under the Crops Research Division of DR&SS.

Figure 1.1 THE STRUCTURE OF THE AGRICULTURAL SECTOR IN ZIMBABWE



AGRITEX has three main divisions viz. Field, Technical, and Irrigation. While AGRITEX places more effort on the smallholder sector, the large-scale commercial farming sector receives sunflower extension advice from specialists in their Commercial Oilseed Producers Association (COPA).

1.4 SUNFLOWER WITHIN THE AGRICULTURAL SECTOR

Sunflower production in Zimbabwe is directed mainly towards oil extraction. In terms of availability to the oilseed industry, sunflower seed occupies third position after cotton seed and soybeans in that order. Production is dominated by smallholder farmers, with 96 percent of

GMB purchases coming from this sector. The popularity of the crop in smallholder areas is due to its drought tolerance and to the fact that the crop is easier to manage. The crop is more drought tolerant compared to maize, and as a result, more small-scale commercial (SSC) and communal area (CA) farmers have been diversifying into the crop. Sunflower seed production has partly been used to achieve the GOZ policy of equitable income distribution through incentive producer prices, since the crop is mainly grown by smallholder farmers in marginal areas. However, this has been at a cost to the Grain Marketing Board (GMB). The small amounts produced and the geographic dispersion of producers resulted in high handling costs mainly due to pooling the crop and transporting it to expressers located away from producing areas (AMA Economic Review, 1993).

In the commercial sector, due to the poor yielding potential of open pollinated varieties, sunflower was only seriously considered when the hybrids became available in the mid 1980's. For the communal sector, the crop has proved to be a robust friend, giving returns in marginal areas and being used as a late planted crop when early crops had failed. For the bee farmers in the Manicaland and Masvingo Provinces, the crop provides a ready source of nectar and pollen for the bees and an additional income to the farmers. Furthermore, sunflower yields will also increase by this practice (Johnson et al., 1994).

Current national farm average yields of sunflower range between 0.5 metric tons per hectare for smallholder farms and 0.8 metric tons per hectare for large-scale commercial farms. The low sunflower yields could partly be attributed to the following reasons: low input use, low and poor rainfall distribution, poor soils, late arrival of inputs, poor quality seed and poor access to draft power and tillage equipment (Johnson et al., 1994). As such, sunflower is grown as a late insurance crop when it is too late in the season to grow maize. Little fertilizer is applied and sunflower is treated as a "scavenger" crop by smallholders. Since sunflower does not qualify for AFC credit, this reduces further the chances of purchased inputs being applied.

1.4.1 National Trends

Table 1.2 gives the trends in sunflower production from the smallholder and commercial sectors for the period 1979 to 1996. Contrary to the general downward trend in the production of other oilseeds, sunflower production has increased from 9,000 metric tons in 1979 to 50,000 metric tons in 1996. The communal sector area under sunflower has increased by five-fold during the same period (Annex III Table 2).

One of the most important factors affecting sunflower production in the country is the use and availability of high oil content hybrid seed. If meaningful expansion is to be realized on a sustainable basis, producers should move away from using retained seed and open pollinated varieties which are not preferred by expressers as they are low in oil content.

1.4.2 Marketing

Sunflowers are a typical cash crop, with the GMB providing a direct channel to the oil expressers. Since the crop has no alternative value, the crop is strongly market oriented and sensitivity to producer prices is very high. Up until 1993/94 marketed output through the GMB had been increasing phenomenally, averaging about 76 percent per annum. This

accounted for about 85 percent of total production with the remainder probably going through other markets. This might have been possible since sunflower only became a controlled crop in 1983. Prior marketing arrangements between farmers and private traders probably persisted.

Between 1983/84 and 1994/95 season, sunflower was a controlled commodity, meaning that its disposal on the formal market was controlled by the Grain Marketing Board (GMB), with prices paid to the producer determined by a process of negotiation between the farmers organizations, the GMB and the Ministry of Agriculture. The nominal producer price has increased from Z$ 159.00 per metric ton in 1980 to Z$ 1,472.00 per metric ton in 1994. This is an average increase of 55 percent per annum over the same period. The biggest single jump in price (Z$ 472.00) was observed during the 1992/93 season.. The current marketing liberalization has seen expressers awarding contracts to growers. In future such arrangements are expected to increase, thereby lowering the proportion of output going through the GMB (Johnson et al., 1994).

Table 1.2 CONTRIBUTION OF SUNFLOWER TO THE OILSEED INDUSTRY -- 1970 - 1996

	Production (Metric Tons)		
	National	Communal	Large-Scale
Year	Total	Areas	Commercial
1979	9,270	7,000	2,270
1980	10,792	8,000	2,792
1981	12,676	11,000	1,676
1982	8,952	7,500	1,452
1983	3,373	2,424	949
1984	8,770	6,753	2,017
1985	18,106	16,065	2,041
1986	18,360	16,400	1,960
1987	26,026	21,120	4,906
1988	64,713	54,330	10,383
1989	60,814	54,057	6,757
1990	63,990	59,000	4,990
1991	63,963	59,000	4,963
1992	19,503	17,536	1,967
1993	67,650	61,650	6,000
1994	48,620	47,620	1,000
1995	22,160	19,800	2,360
1996	50,550	46,700	3,850

Source: Statistical Year Book.

1.5 PROBLEM STATEMENT

Traditionally, public research into sunflower germplasm improvement (breeding) and crop management improvement has been conducted by DR&SS. Breeding work is done by the Crop Breeding Institute while agronomic research is conducted primarily by the Agronomy Institute in natural regions II to IV and the Lowveld Research Stations in natural region V.

While the Institutes of Agronomy, Crop Breeding, and other support service institutions like the Plant Protection Institute might have done phenomenal work in support of the crop's growth in the agriculture sector, resources for research have been declining. The support for ANR research from treasury has been slashed due to the pressure on the government to reduce the budget deficit under the Economic Structural Adjustment Program (ESAP). Commercial Farmers Organization which benefitted during the pre-independence era and were financially supporting research have now moved to supporting a private research station, Agriculture Research Trust, which attends to their specific needs.

The extension service department, AGRITEX has also received budget cuts from the government though not as severe as those of DR&SS. Extension personnel in general are becoming less experienced and are caught up in other burdening non-agricultural extension related responsibilities to the extent that their effectiveness is reduced.

Arguments have been put forward (Johnson et al., 1994) to develop sunflower which have the greatest immediate benefit for expansion in the communal areas to supply the domestic as well as export markets. This calls for more financial support for sunflower research and the formulation of sound policies to guide these subsectors. This in turn points to the need for an ex-post evaluation to compare how past investments in research development effort in sunflower technology development and transfer (TDT) have been competitive with other attractive investment alternatives. There is, therefore, a need to determine the costs and benefits of the sunflower research which has been conducted so far, to give an indication on whether it is worthwhile to continue funding sunflower research in the future. The institutional and policy environment for sunflower R&D needs to be evaluated since they influence the scientific activities of the research institutions and the economic activities of the producers, respectively.

1.6 OBJECTIVES OF THE STUDY

The overall objective of this study is to assess the impact of sunflower research, extension and the enabling environment in Zimbabwe from 1975 - 1996. The specific objectives are:

1. To describe and understand the existing sunflower production systems in Zimbabwe;
2. To trace the evolution of research and enabling environment with respect to sunflower technology development and transfer;
3. To assess the impacts of sunflower research and enabling environment;
4. To conduct preliminary analysis of the effects of the recent liberalization of the sunflower industry; and
5. To assess policy implications for future investments in research and enabling environment.

1.7 LAYOUT OF THE STUDY

The study on impact assessment of sunflower research and enabling environment is presented in six chapters. The first chapter presents background information on the agricultural sector in general, and describes the problem statement and the study objectives. The second chapter briefly describes the sunflower subsectors in Zimbabwe as well as outlining the evolution of sunflower research, extension and the enabling environment. The third chapter describes the

methodology used for assessing the returns to sunflower TDT investment. The fourth chapter contains the survey results. The impact of past investments in sunflower research and the enabling environment are presented in Chapter 5. The last chapter presents the conclusions, policy implications, as well as the study limitations.

CHAPTER 2. SUNFLOWER PRODUCTION AND THE ENABLING ENVIRONMENT IN ZIMBABWE

2.1 INTRODUCTION

This chapter provides an overview of the oilseed sector in Zimbabwe and gives a brief description of the sunflower subsector. The history of sunflower research and extension in Zimbabwe is also presented. This information is essential for the assessment of the impact of sunflower technology development and transfer.

2.2 THE OILSEED INDUSTRY

Oilseeds in Zimbabwe provide the nation with cooking oil, soaps, margarine as well as fulfilling a nutritional function supplying protein to balance the carbohydrates of the staple grains. The oilseed industry consists of several stakeholders, as shown in Figure 2.1. Prior to UDI in 1965, the oilseed industry was dominated by the groundnut crop. However, after this date the commercial farmers were forced to look to other crops as alternatives to tobacco and maize. The crop diversification program that followed was aimed essentially at achieving self-sufficiency in basic foods. Since independence, the communal farmers were also looking for alternative crops for the late planted maize, especially in the low rainfall areas.

Some of the key issues that the oilseed industry set out to address were:

- Profitability - whether the farmers can produce oilseeds for export at a profit, and if so which crops are likely to be produced;
- Marketing Issues
  - Entrance and viability of small-scale expressers;
  - Storage facilities and marketing of the GMB;
  - Marketing of oil-cake and other bi-products;
  - Linkages between institutions and new products from oilseed;
- Production issues (Johnson et al., 1994).

2.2.1 Oilseed Processing

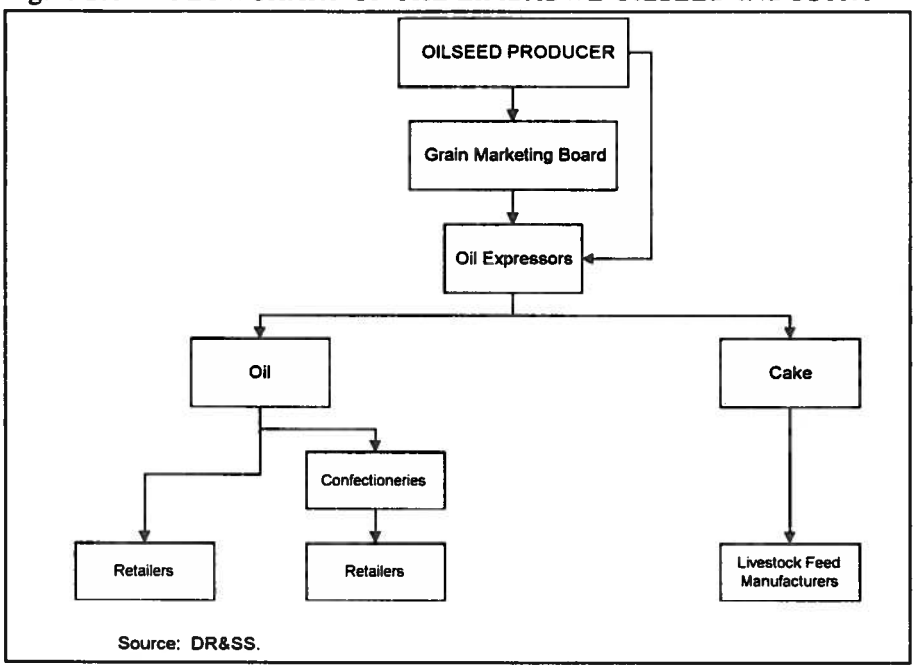
Oilseed processing in Zimbabwe can be divided into large-scale expressers and small-scale rural expressers.

2.2.1.1 Urban Large-Scale Processors

There are four major large scale expressers who are mainly based in Harare and Bulawayo, two major cities in Zimbabwe. The large scale expressers are Olivine Industries, Lever Brothers, United Refineries and National Foods. Olivine Industries, jointly owned by Zimbabwe Government and Heinz Corporation of USA, manufactures soap, candles, vegetable oils, fats and oil cake. Lever Brothers, a private company manufactures, markets and distributes toiletries, edible oils, fats, detergents and canned foods. United Refineries, wholly owned by T.A. Holdings, manufactures vegetable fats, oils and oil cakes. Last is National

Foods, a subsidiary of Astra Corporation and Anglo American, manufactures stock feeds, vegetable oils, fats, maize meal and wheat floor.

Figure 2.1 FLOWCHART OF THE ZIMBABWE OILSEED INDUSTRY



Most of the vegetable oil processed in the large urban processors is coming from soybean, sunflower seed and cotton seed. Table 2.1 shows total oil produced in Zimbabwe. Willards Foods, another company which produces roasted peanuts is the major buyer of long-season groundnut varieties for confectionery.

2.2.1.2 Small-Scale Oil Expressers

Small-scale oilseed expressers have emerged in the rural areas as a result of the pioneering work of 3 NGOs: Appropriate Technology International, Intermediate Technology Development Group (ITDG), and ENDA-Zimbabwe. The Zimbabwe Oil Press Project (ZOPP) initiated by ATI has introduced ram presses in Zimbabwe's communal areas. These projects mainly focus on sunflower.

2.3 THE SUNFLOWER SUBSECTOR IN ZIMBABWE

The major sunflower producing areas in Zimbabwe are Natural Regions II, III, and IV. Production is undertaken by both large-scale commercial and smallholder farmers in these regions.

Sunflower production is largely done by the smallholder farmers, who include communal area farmers (CA), small-scale commercial farmers (SSCF) and resettlement farmers (RF). Large-scale commercial farmers contribute less than 5 percent of total production. Previously, two farmers' unions represented the sunflower producers, i.e., the Commercial Farmers Union

(CFU) through the Commercial Oilseed Producers Association (COPA) represented LSCF, and the Zimbabwe Farmers Union (ZFU) representing the smallholder farmers. In recent years, a third union, Indigenous Commercial Farmers Union (ICFU), was formed and approved by the Government to represent the interests of the emerging black large-scale commercial farmers. The operations of ICFU are still evolving since it is still less than 2 years old.

Table 2.1 VEGETABLE OIL PRODUCTION IN ZIMBABWE 1981-1995

Year	Total Oil Equivalent (Metric Tons)
1980/81	25,000
1981/82	42,000
1982/83	40,000
1983/84	38,000
1984/85	50,000
1985/86	57,000
1986/87	57,000
1987/88	57,000
1988/89	81,000
1989/90	74,000
1990/91	61,000
1991/92	65,000
1992/93	17,000

Source: Central Statistic Office Reports.

2.3.1 Sunflower Production

Sunflower production is undertaken by the smallholder and large-scale commercial farmers. Long-term trends in the production of sunflowers in both the communal and commercial areas shows a decline since the early-1990s. Figure 2.2 shows the total area under sunflower production, and the area cultivated by the commercial and communal farming sectors. The figure clearly illustrates the fact that the area under sunflower in the communal farming sector has increased substantially over the years, especially between 1985 - 1990. The decline in trend since 1990 can be explained to a certain extent by the decrease in the area under sunflower in the large-scale commercial farming sector, and the drought years of the early 1990s. The production pattern, Figure 2.3, to a large extent reflects the trend in the area of production. As one would expect, the average yield obtained by the commercial farmers is much higher than that of the communal farmers, as shown in Figure 2.4.

2.3.2 Support Services

Support services to sunflowers are provided by various organizations. Research is conducted by the Department of Research and Specialist Services in the Ministry of Agriculture. The Agricultural Research Trust (ART) also looks at crop management for its clientele among the large-scale commercial farmers.

Figure 2.2 TRENDS IN SUNFLOWER PRODUCTION AREA — 1979 - 1996

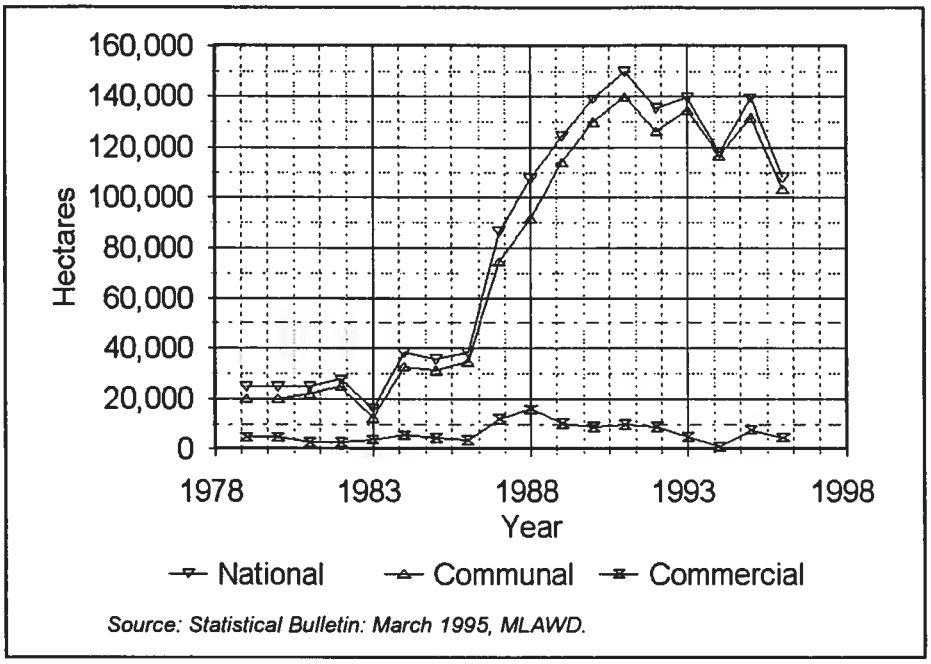


Figure 2.3 TRENDS SUNFLOWER PRODUCTION — 1979 - 1996

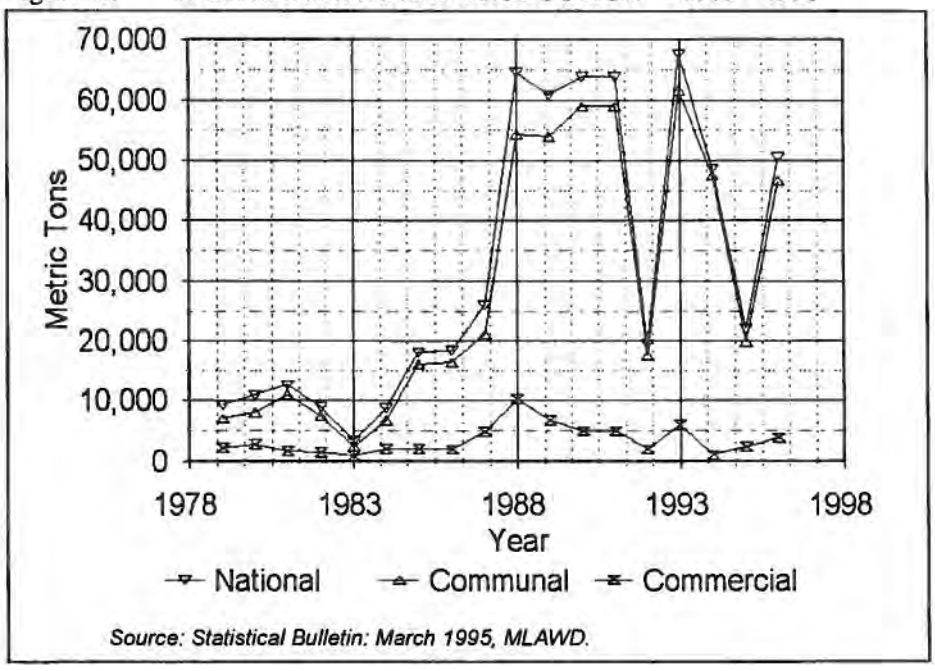
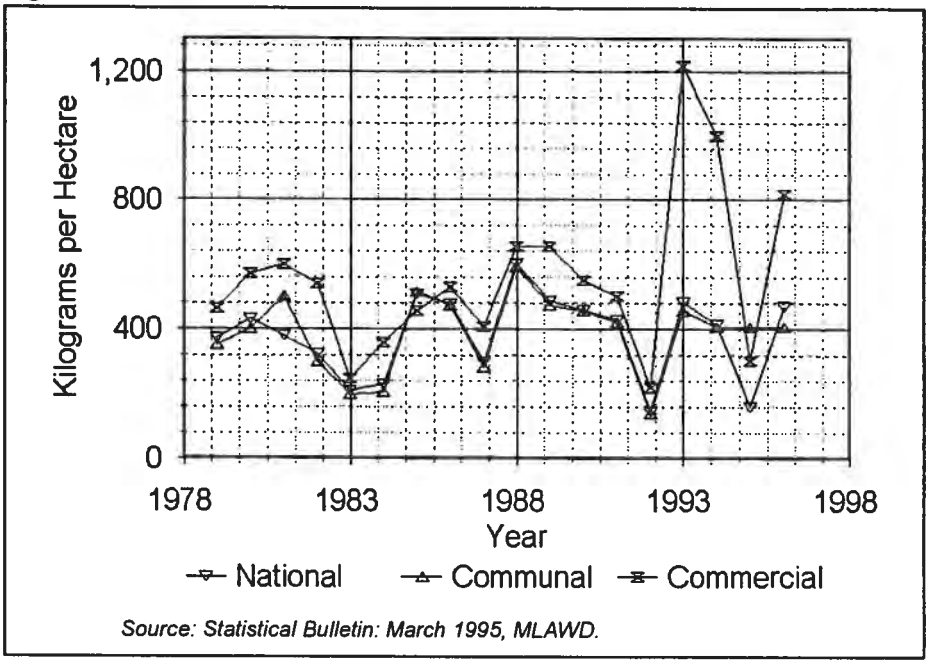


Figure 2.4 TRENDS IN SUNFLOWER YIELD — 1979 - 1996



Source: Statistical Bulletin: March 1995, MLAWD.

Prior to the recent market liberalization, varieties bred by the CBI, once tested and proven, were formally released to the Zimbabwe Seed Cooperative (ZSC) for multiplication and sale to the farmers. In recent years, ZSC started breeding of new sunflower varieties. Various seed firms, including Pannar, Pioneer, and Cargill, have also started operating in Zimbabwe and are doing breeding work.

Smallholder farmers receive extension services from AGRITEX, while LSCF depend more on private organizations, farmer associations, consultants, and to a lesser extent on AGRITEX. Both the smallholder and the LSCF sectors receive advice from seed firms who give recommendations for the varieties they sell.

The LSCF obtain most of their seed from seed firm sales representatives and branches of the Farmers Cooperative, while smallholders mainly use retained seed. Improved sunflower seed is seldom found in rural retail shops, and communal farmers who want to buy improved seed have to go into town to purchase the seed. The wholesalers and retailers claim that the demand for sunflower seed is low, and it is, therefore, not worth the effort to sell sunflower seed. Some of the factors limiting the demand for improved sunflower seed by communal area farmers are:

- The hybrid seed is over four times more expensive than retained seed;
- Hybrids are more demanding in terms of water and management if high yields are to be achieved. Therefore, communal farmers claim that no significant yield improvements are achieved from using hybrid sunflower; and
- There is no grading for oil content at GMB depots, and the communal farmers have no incentive to adopt the improved varieties because of their higher oil content.

Following recent market reforms, any company or individual is free to buy sunflower directly from the producers. GMB however, still has a monopoly for exports. However, the marketing of this crop is rather tricky. In general, communal area farmers grow open pollinated varieties which have a low oil content, and are, therefore, not preferred by both the large-scale and small-scale oil expressers. In addition, different prices are offered for the open pollinated and hybrid varieties, with some buyers not buying any open pollinated varieties. The oil expressers (Olivine Industries, Lever Brothers, United Refineries, National Foods) are the purchasers of almost all the sunflower. Parallel to the large established oil pressers, and processing companies, is the small-scale oilseed expresser industry in the rural areas under various projects supported by NGOs.

2.3.3 History of Sunflower Research in Zimbabwe

The Department of Research and Specialist Services was formed in 1948 when the Department of Agriculture completed the basic infrastructure for agricultural research. Initially, both disciplinary and commodity groups were set up, including animal husbandry, botany, conservation, crop production, dairy, entomology, extension, horticulture, pasture research, plant pathology, poultry, tobacco, and soil chemistry. In 1970, the Agricultural Research Council (ARC) was formed to set the research agenda and allocate funds for research. The ARC reorganized DR&SS into three divisions, i.e., crops research, livestock and pasture research, and research services, in a bid to enhance the efficiency of the organization.

At independence the new government shifted its policies toward increasing the support rendered to communal area farmers in terms of research, extension, and other institutional support services. However, at the same time a number of experienced staff from DR&SS left the organization. This situation was made worse by the slow recruitment and training of replacement staff by government.

Sunflower research is conducted by both public and private sector research organizations. Among the private research organizations are the ART, which work mainly on agronomic aspects, and the various seed firms that mainly do breeding work, and agronomy research is done to some extent by the University of Zimbabwe and Africa University. This section focuses mainly on public research on sunflower in Zimbabwe. Research on sunflower in Zimbabwe is conducted by three institutions, the Agronomy Institute for crop management aspects, the Crop Breeding Institute for breeding, and the Plant Protection Research Institute for plant health aspects.

Sunflower has been grown at the Harare Research Station (currently the location of the Department of Research and Specialist Services) since 1912 (Weimann, 1972). The first results, mainly on cultivar and spacing evaluations, were reported in the Salisbury Agricultural Experiment Station (1920 - 1922) and Gwebi Experimental Farm Annual Reports of 1915 to 1922. Cultivars grown were developed elsewhere and had a variable oil content of between 28 and 35 per cent, by weight. These cultivars, such as Russian Giant, were among the first introductions to be grown in the country. The cultivars introduced at a later stage (in the 1960s) had a higher oil content (up to 40 percent.). Peredovick, an open pollinated cultivar, is by far the longest surviving cultivar that is still grown by the smallholder farmers today.

The sunflower breeding program was officially established at Salisbury Research Station on 1st January 1975, as part of the Oilseeds Breeding Team. The primary objective was to develop cultivars that have the potential of producing high oil yields per unit land area, under varying environmental conditions. To achieve this, a number of objectives were defined. Table 2.2 presents the characteristics that are currently regarded as important to the breeding program.

Table 2.2 OBJECTIVES OF THE SUNFLOWER BREEDING PROGRAM

Characteristic	Current Experimental Level	Target Experimental Level
Seed Yield	2.5 metric tons per hectare	4 metric tons per hectare and stable
Oil Content	45 percent	50 percent and stable
Disease Reaction	Susceptible	Resistant
Uniformity of Maturity	Range 21 days	Homogenous
Stalk Breakage	Prone	Resistant
Head Traits	Variable in size, number, shape inclination, seed set, seed shattering number	< 25 cm, one disc, nodding center filled, good seed retention, > 1000
Seed Traits	Variable in seed mass and seed color	>70 mg, not solid black

* Head traits show variable expressivity and are influenced by competition (i.e. different population densities and weeds).
Source: Adapted from the handover report by the outgoing sunflower breeder, 1996.

From 1984, single cross hybrids were produced, since most of the inbred sunflowers were reasonably vigorous and the resultant hybrids produced reasonably good yields. Due to a recent outcry from the Seed Cooperative about the economics of bulking single cross hybrids, a three-way hybrid production program was embarked on. The first three-way hybrids ever produced by the breeding program were in the Intermediate Variety Trials during the 1995/96 cropping season. However, because of the farming systems adopted by the majority of the sunflower growers, and the persistent dry seasons, there might be need for the program to re-embark on the production of open pollinated varieties.

2.3.4 Cultivars Available on the Local Market

To date, there are only two locally bred hybrid cultivars on the Zimbabwean market. The first product of a breeding effort was the hybrid Msasa which was released in 1985 (Mtindi, 1985), and became available for production by farmers in the 1986/87 season. This was followed by the release of hybrid "Mopane" in 1990 (Mudzana, 1990). In addition, there is a limited range of good sunflower hybrids that have been brought into the country by international seed companies. The cultivars available on the local market are shown in Table 2.3.

Table 2.3 SUNFLOWER VARIETIES AVAILABLE IN ZIMBABWE

Variety	Days to Maturity	Percent Oil Content
Msasa	83 - 100	41
Mopane	90 - 110	44
PAN 7369	135 - 140	43
PAN 7392	135 - 140	43
G100	90 - 110	44
G101	90 - 110	44
SNK 37	90 - 110	43
Peredovick	115 - 125	36

Source: DR&SS.

2.3.5 Sunflower Production Recommendations

The sunflower production recommendations cover the various cultural aspects, such as plant spacing, suitable soils, irrigation requirements, fertilizer types and levels of application, based on Natural Region where the sunflowers are grown, Table 2.4. Agronomic recommendations resulting from the work of the Agronomy Institute, the Plant Protection Research Institute, and other research institutions are discussed in the following sections.

Table 2.4 CURRENT AGRONOMIC RECOMMENDATIONS FOR SUNFLOWER

Natural Region	Variety	Agronomic Practice
II, III, and IV	Msasa Mopane G101 SNK 37 PNR 7225 PNR 7369	- Rotate with maize, cotton, and beans - Planting Times: Lowveld - December Middleveld - mid to late December Highveld - mid December - Plant Population = 55,000 plants per hectare - Planting Depth: Heavy soils = 40 to 50 millimeters Sandy soils = 50 to 75 millimeters - Seeding Rates: Hybrids = 5 kilograms per hectare Open Pollinated = 7 kilograms per hectare - Fertilization Basal = 250 kilograms per hectare of Compound L Top-dressing = 150 kilograms per hectare of Ammonium Nitrate Lime if pH is below 5.3 - Weed control during first six weeks is essential other wise the potential yield reduction is 50 percent

Source: DR&SS Agronomy Division.

2.3.5.1 Climate and Soil Requirements

Sunflowers can be grown in most parts of Zimbabwe, although giving better yields in the cooler areas. They grow well on well-drained sands and heavier-textured soils.

2.3.5.2 Rotation

Root-knot nematodes can greatly reduce sunflower yields, especially on sandy soils. It is, therefore, not advisable to grow sunflower on the same piece of land more than once in three years. Rather, sunflower should be rotated with maize, cotton and beans.

2.3.5.3 Lime and Fertilizer Requirements

Guidelines on N, P and K requirements of sunflower were suggested in the Oilseeds Handbook (1981). On the assumption that all crop residues are returned to the soil at the end of a growing season, the fertilizer requirements suggested for sunflower are presented in Table 2.5.

For nitrogen, a good soil was classified as one on which a leguminous green manure crop had been planted and ploughed under at the correct stage of maturity. A medium fertility soil was an early-ploughed virgin, or reverted land, or grass ley, or land already cultivated. A poor fertility status was considered a late-ploughed virgin, or reverted land, or grass ley.

Table 2.5 SUNFLOWER FERTILIZER REQUIREMENTS (KILOGRAMS PER HECTARE)

Nutrient	Nutrient Status of Soil		
	Good	Medium	Poor
Nitrogen	Up to 40	40 - 60	60 - 80
Phosphate (P_2O_5)	20 - 30	30 - 50	50 - 70
Potassium (K_2O)	20 - 30	30 - 40	40 - 50

Source: DR&SS.

For phosphorous, good soil was classified as cultivated land on which large amounts of P have been applied in the past by regular, uninterrupted annual dressings. A medium soil was cultivated land to which moderate P fertilizer had been applied in the past, while a poor soil was virgin, or reverted land on which little or no P had been applied in the past.

For potassium, a good soil pertained mostly to newly opened land of "normal" fertility, and to cultivated land that had received regular applications of K, and where crop residues had also been incorporated into the soil after harvest. Medium fertility was considered to be land of normal fertility that had been cultivated for some time with regular dressings of K in combination with residue incorporation into the soil. Poor land was where soil analysis had shown the K status to be low.

Sunflower is also sensitive to soil acidity. In Zimbabwe, a pH value above 5.3 (on 0.1 metric $CaCl_2$ scale) has been recommended for optimum seed yield of sunflower (Fenner, 1979). In order to maintain the soil pH in the desired range, as a general rule where manure is not used,

it was recommended to apply one bag of lime for every bag of Ammonium Nitrate used in the previous season (ZFC Farmers Handbook, 1994).

2.3.5.4 Land Preparation

The final land preparation should be done by cultivator just before planting. Sunflowers require a fine seedbed in order to achieve good germination.

2.3.5.5 Time of Planting

Planting should be delayed until mid-December to ensure that the crop matures at the end of the rains. Recommended approximate planting times are as follows:

- Lowveld - late December;
- Middleveld - mid to late December; and
- Highveld - mid-December.

2.3.5.6 Weed Control

The recommendation to the farmers is to keep the land weed-free using a hoe or cultivator. Herbicides can also be used. Trifluralin, Lasso, Dual, and Gesagard are examples of herbicides that can be used to control weeds in sunflowers.

2.3.5.7 Pest Control

Cutworms and leaf-eating pests can be controlled in sunflowers by applying Karate.

2.4 CONSTRAINTS TO OILSEED RESEARCH

Like the many commodity areas in DR&SS, the overall resource constraints affect the sunflower research programs through decreased resource allocation. The constraints affecting oilseed research are discussed below.

2.4.1 Finance

The lack of adequate operating funds has forced the oilseed research programs to cut some of its activities and curtail implementation of new ones. Almost all of the on-farm research has come to a stand still. The number of breeding and testing sites for new varieties has also been reduced considerably. Consequently, interpretation of research findings becomes less reliable. In a bid to alleviate the inadequate research funds, the researchers have sourced for additional funding from donors. For example, the sunflower agronomy program has some of its work on soil fertility management funded by the Rockefeller Foundation. This has enabled the program to continue on-farm work in several communal areas.

2.4.2 Transport

The transport fleet obtained through Government's Central Mechanical Equipment Department (CMED) is fast disappearing, because repairs and maintenance are not being effectively done.

Furthermore, the vehicles which are not operable are not being replaced. As a result, the staff of the oilseed research programs cannot carry out most of their research activities, which in turn is causing a great deal of loss of morale. The few vehicles within DR&SS that are reliable are usually called up whenever national duty demands, thereby disrupting the research program. The situation is even more difficult for on-farm research work in rural areas of Zimbabwe.

2.4.3 Staffing

Staff turnover in DR&SS continues to rise. The sunflower breeder left the Department in January 1996, but because of the freezing of vacant posts and the lengthy process to have them unfrozen, no replacement has been made to date. Data on support staff also shows a declining trend in number as vacant posts are being frozen or abolished in line with streamlining of the civil service as part of ESAP. This situation is creating a gap in technology generation which will be very difficult to fill.

2.4.4 Institutional Linkages

Poor linkages between research and extension have led to different research and extension strategies by the two institutions. The research-extension-farmer linkage is also very weak. The interaction between researchers and processors is not adequate, and as a result, researchers are not well informed about the quality of seed required by the processors.

2.5 EVOLUTION OF THE ENABLING ENVIRONMENT

2.5.1 Extension

Prior to Independence in 1980, agricultural extension was divided into two departments, namely DEVAG and CONEX. DEVAG provided extension services to black farmers, while CONEX provided extension to white farmers. DEVAG was created for conservation practices, and most of the extension messages were borrowed from CONEX. At independence, these departments were merged into AGRITEX. AGRITEX has two divisions, namely field and technical, that are responsible for extension. Crop specialists in the technical division, located at national and provincial levels, have the responsibility of acquiring the latest extension messages as well as training extension workers. The field division is the lowest strata which is in constant contact with farmers.

2.5.2 Credit

There is little doubt of the real need for capital in the communal areas. This need has grown over the last decade, most probably due to the increased use of purchased inputs in agriculture. In general, all farmers in Zimbabwe are eligible to apply for credit from the Agricultural Finance Corporation (AFC), a government parastatal instituted by an Act of Parliament. However, lack of collateral by smallholders is a serious impediment to their accessing this credit. Large-scale commercial farmers have a comparative advantage in accessing loans because they have collateral in the form of land and other assets.

2.5.3 Marketing and Pricing Policy

In 1994, the government liberalized the marketing of sunflower, and other commodities, in line with the policy of the economic and structural adjustment program. With market liberalization, oilseed processors are now able to purchase their raw material direct from farmers at prices agreed between the two parties. The GMB, however, still controls the foreign export market.

If producer prices were higher, sunflower would be an excellent commercial alternative to maize for large-scale farmers. The current producer price does not compete commercially with other main season crops, such as cotton. Communal farmers have, however, been more responsive to increases in producer prices.

2.5.4 Land Reform

Historically, most of the high potential agricultural land was owned by large-scale commercial farmers. After independence in 1980, the government embarked on a resettlement program in which land was bought from LSCF in order to resettle people from the communal areas. The pressure is still on GOZ to redistribute land because of the political expectations, the low potential of the communal areas, and the natural resource degradation as a result of overcrowding in the communal areas.

CHAPTER 3. METHODOLOGY FOR ASSESSING THE IMPACT OF THE SUNFLOWER TECHNOLOGY DEVELOPMENT AND TRANSFER PROGRAMS

3.1 INTRODUCTION

Different interpretations are given to the term impact. In this chapter, the term impact is defined and a conceptual framework to analyze the socio-economic impact of a technology development and transfer activity is outlined. The method used in assessing the rates of return on sunflower R&D is also presented. Finally, the data collected and the estimation procedures used are discussed.

3.2 MEANING OF IMPACT

This study attempts to assess the socio-economic impact of sunflower R&D in a comprehensive manner. The term impact in the context of R&D activities includes both the direct product of research as well as the so called people level impact (Anderson and Herdt, 1990). People level impact refers to the effect of the technology on the ultimate users or target group for which the technology was developed. Impact begins to occur when there is a behavioral change among the potential users. The people level impact deals with the actual adoption of the research output and subsequent effects on production, income, environment and/or whatever the development objective may be.

3.3 CONCEPTUAL FRAMEWORK TO ASSESS THE IMPACT OF SUNFLOWER R&D PROGRAMS

The people level impact of any R&D program cannot be achieved without accomplishing the intended direct product of research. Therefore, in any comprehensive impact assessment, there is a need to differentiate between the research results and the contribution of the research results to development, and both aspects should be addressed simultaneously. In any impact assessment study, it is also important to demonstrate that the changes observed are functions of the intervention/technology and cannot be accounted for in any other way. Causality, attribution, and incrementality are the key concepts that require careful consideration in any study.

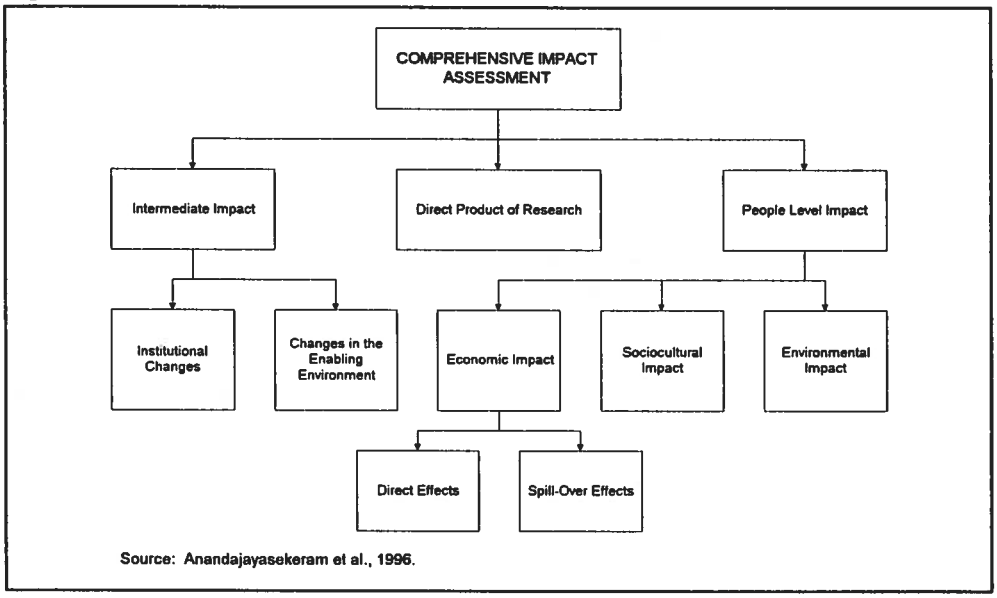
The various effects considered in a comprehensive impact assessment of any R&D activities are summarized in Figure 3.1, and the different techniques/methods available for measuring these effects are summarized in Table 3.1. These aspects are briefly described in the following sections.

3.3.1 Direct Product of Research/Effectiveness Analysis

The direct product of research may be an improved technology (on-farm or off-farm; embodied or disembodied; product or process innovation), specialized information, or a combination of these two. The performance of a research program in relation to its intended direct product is assessed using what is known as effectiveness analysis. Effectiveness analysis measures the degree to which the project or activity has achieved its desired objectives. As

mentioned earlier, the results evaluated here are directly derived from the research activity. The assessment of the direct product of research requires a set of operationally defined goals and objectives, criteria for success to measure the performance (often called measurable indicators), and some standard (quantified) for measurement of success. The most useful starting point for effectiveness analysis is the logical framework.

Figure 3.1 COMPREHENSIVE IMPACT ASSESSMENT



Source: Anandajayasekeram et al., 1996.

Table 3.1 IMPACT TYPES, TECHNIQUES, AND METHODS USED IN A COMPREHENSIVE ASSESSMENT

IMPACT TYPE	TECHNIQUE	METHOD
INTERMEDIATE IMPACT • Institutional Changes • Changes in the Enabling Environment	Simple Comparison/Trend Analysis	Survey, Secondary Data
DIRECT PRODUCT OF RESEARCH	Simple Comparison - Target vs. Actual	Effectiveness Analysis Using Logical Framework
ECONOMIC IMPACT	Various	ROR Estimates
SOCIO-CULTURAL IMPACT	Comparison Over Time	Socio-economic Survey/Adoption Survey
ENVIRONMENTAL IMPACT	Various - Need Bio-physical Information Qualitative and Quantitative	Environmental Impact Assessment

Source: Anandajayasekeram et al., 1996.

3.3.2 Economic Impact

Economic impact measures the combined production and income effects associated with a set of R&D activities. The economic impact can be assessed through what is known as an "efficiency analysis" which compares the cost (including the transfer and adoption costs) and the benefits of the project in a systematic manner. In assessing the economic impacts, research is treated as an investment and rates of return (ROR) are then estimated for this investment. ROR summarizes the benefits and costs, and income from the activity in a single number which can be easily compared with the cost of obtaining funds or rates of return obtained from alternative investments.

There are two broad approaches to estimate ROR. The econometric approach which often uses a production function (regression approach), or the total factor productivity approach to estimate the marginal rates of return (MRR). The MRR calculates the returns to the last dollar invested in each component through econometric estimation. The estimation of MRR requires good quality time series data which in most developing countries are difficult to obtain.

The other approach is the surplus approach which uses a benefit - cost framework to estimate the average rate of return (ARR). The ARR takes the whole expenditure as given and calculates the rate of return to the global set of expenditures. The ARR indicates whether or not the entire investment package was successful, but not whether the allocation of resources between investment components was optimal (Oehmke, 1992).

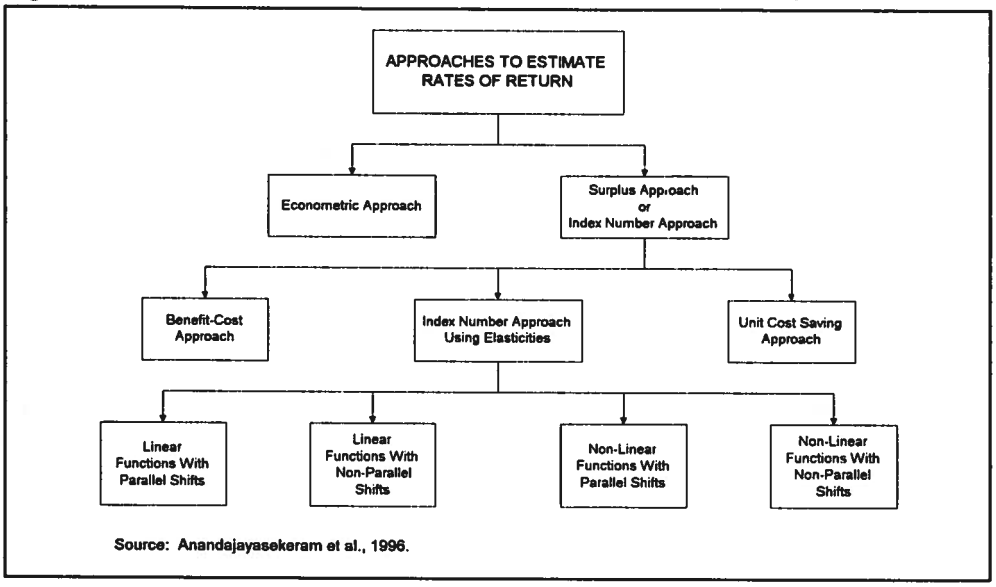
The various techniques used for ROR estimates are summarized in Figure 3.2. Due to lack of consistent time series data, in this study it was decided to use the surplus approach to estimate the ARR for the R&D investments in the sunflower research program. The specific techniques (derivatives of the surplus approach) used in this study, the benefit - cost approach, is discussed in detail elsewhere in this chapter.

3.3.3 Intermediate Impacts/Institutional Impacts

Horton (1990) classified technology under two categories: production technology and R&D technology. R&D technology refers to organizational strategies and methods used by research and extension programs in conducting their work. The R&D impact of research and extension programs may include scientific procedures, organizational models, institutional strategies (for program planning, evaluation, training, networking, etc.), as well as interdisciplinary team work. The intermediate/institutional impact includes the institutional changes that have occurred as a result of a research program within the research organization, as well as the changes that have occurred in the enabling environment outside the institution which facilitate technology transfer and adoption.

The method often used to assess the intermediate impact is simple comparison or trend analysis over the period under consideration. A logical framework is, once again, a useful tool to systematically incorporate the institutional impacts in the analysis.

Figure 3.2 APPROACHES FOR ESTIMATING RATES OF RETURN



Source: Anandajayasekeram et al., 1996.

3.3.4 Socio-Cultural Impacts

Socio-cultural impacts include the ultimate effect of research findings on the attitudes, beliefs, resource use pattern, status of women, income distribution, nutritional status, institutional implications, etc. Very often socio-economic surveys are used as instruments to assess the socio-cultural impact of technology development and transfer (TDT). A baseline survey and continuous monitoring of identified indicators will facilitate this assessment.

3.3.5 Environmental Impact

The adoption of modern agricultural technologies has often resulted in external benefits and costs largely through their effects on the environment. The environmental impacts of technologies can be positive or negative. For example, the use of chemicals (pesticides, insecticides, etc.) may affect the bio-diversity negatively and may result in the contamination of ground water. On the other hand, integrated pest control measure may reduce the amount of chemicals used, thus affecting the environment positively.

The full assessment of the environmental impact often requires complex analysis of physical, biological, social, and economic processes. This also requires bio-physical information and involves valuation problems. Because of these difficulties, very often qualitative assessments of environmental impacts are used in empirical analysis.

3.3.6 Spill-Over Effects

The wide applicability of research results over a range of agricultural production conditions or environments, often cutting across geographical and national boundaries, and across commodities, are generally referred to as "spill-over effects." These spill-over effects can be inter country, inter commodity, and/or inter sectoral. The applicability of techniques and

procedures developed by the sunflower R&D groups across national boundaries and commodities will lead to spill-over effects.

3.4 RATE OF RETURN ESTIMATES

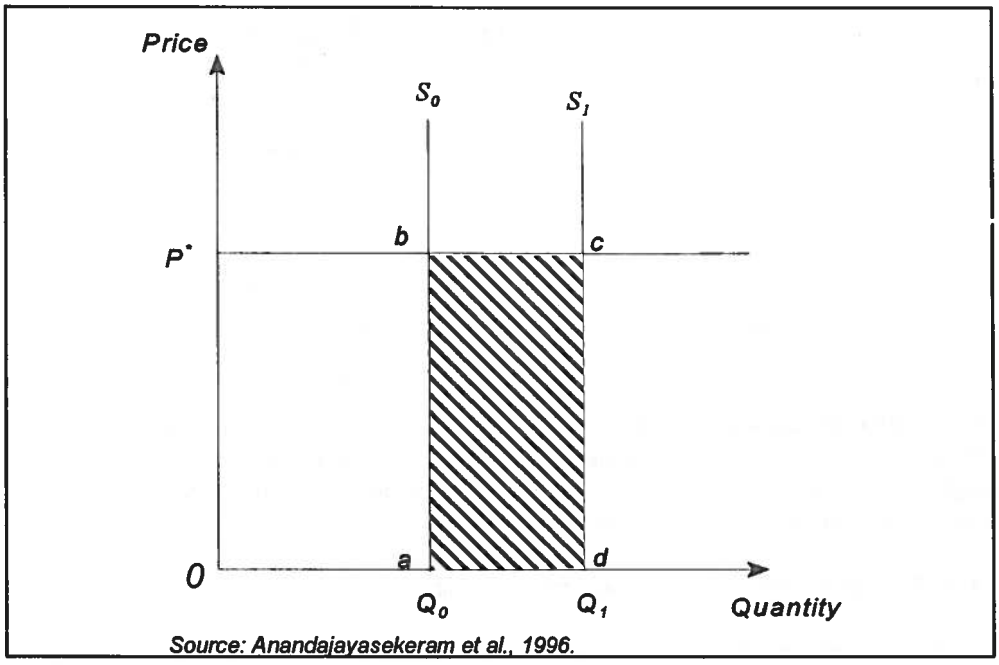
One of the objectives of this study is to estimate the economic impact of the sunflower R&D initiatives. This is measured in terms of rate of return (ROR) to investment, which considers research as an investment activity and estimates the returns to the society.

3.4.1 Social Benefit - Cost Analysis

As mentioned earlier, one of the objectives of this study is to estimate the benefits and costs of the sunflower R&D activities to the society. In this analysis, any cost or benefit accrued to individuals or societies outside Zimbabwe are not included. The prices and costs used in the analysis are opportunity costs and prices. An extreme case of the surplus approach, the benefit - cost framework is used in the analysis.

A typical simple benefit-cost analysis is a special case of the surplus approach where the demand curve is perfectly elastic and the supply curve is perfectly inelastic as shown in Figure 3.3. The shaded area ("abcd" in Figure 3.3) is easily measured by multiplying the differences in output (Q_1-Q_0) caused by R&D investments, by the constant price P^*. The advantage of this method is that it does not require any elasticity measures.

Figure 3.3 BENEFIT-COST ANALYSIS MODEL FOR MEASURING RETURNS TO R&D INVESTMENTS

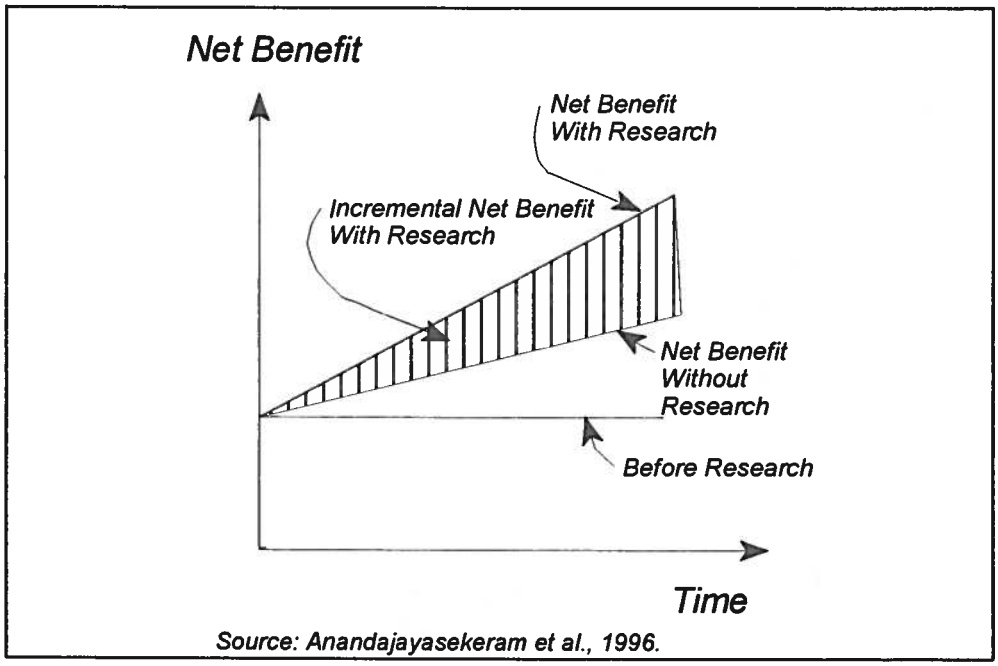


Source: Anandajayasekeram et al., 1996.

3.4.2 Calculating the Gross Benefits

The main features of a benefit - cost analysis framework is the specification of the "with' and "without" scenarios. A typical "with" and "without" scenario for agricultural R&D activities is represented in Figure 3.4. The "with"-R&D case corresponds to what has been observed over the years. The "without"-R&D case is difficult to define. In this study, a "trend" analysis of the yield data is used to define the "without" scenario. Using the before research situation would grossly overestimate the benefits as shown in Figure 3.4. In order to assess the economic impact of research, the technology that was made available to the farmers during the period of analysis should be clearly defined. In this particular case, several varieties and agronomic recommendations have been generated and disseminated to the farmers during the period. What is being measured is the combined effect of these technologies.

Figure 3.4 NET BENEFITS TO TECHNOLOGY DEVELOPMENT AND TRANSFER



Source: Anandajayasekeram et al., 1996.

The adoption of agronomic practices is more difficult to obtain because of the stepwise adoption followed by the small-scale producers. The farm level survey data and the trend analysis of the crucial parameters prior to the release of the technologies, provided the essential information required for the analysis.

3.4.3 Calculating the Research and Transfer Costs

The second component in the analysis is the estimation of the technology development and transfer costs. These costs can be broken down into three categories: research costs, adoption costs, and transfer costs.

The cost of conducting research includes staff salaries and benefits, recurrent expenditures, administration and overhead expenditures, and provision for the depreciation of capital assets.

Adoption costs are those costs that are associated with the uptake of the new technology by farmers over time. Changes in the production practices involve changes in input use (including varietal change), such as fertilizers, herbicides, insecticides, equipment/implements, etc. Thus, all extra costs involved in using the technology should be considered in calculating adoption costs. The important consideration is that all costs are included, and to ensure that such costs are not underestimated.

The technology transfer costs are mainly the extension costs including the on-farm research costs. If the chemical companies, seed companies, and NGOs are involved in technology transfer, their costs should be included.

3.4.4 Calculating the Internal Rate of Return

The incremental net benefit flow is calculated by subtracting the total cost flow from the incremental gross benefits. The incremental net benefit flow over the years is converted into values that can be compared by discounting and/or compounding. This takes into account the time value of money. The discounted incremental net benefits can be represented as follows:

$$DINB_t = \left(NB_t - \sum_{j=1}^{M} RD_{j,t} - \sum_{i=1}^{K} AC_{i,t} - \sum_{n=1}^{L} TC_{n,t} \right) r_t$$

Where:

$r_t = \dfrac{1}{(1+v)^t}$ = *The Discount Factor*

v = *Discount Rate;*

$DINB_t$ = *Discounted Incremental Net Benefit in Year t;*

NB_t = *Undiscounted Additional Benefit in Year t;*

$RD_{j,t}$ = *The jth Undiscounted R&D Expenditure in Year t;*

$AC_{i,t}$ = *The ith Undiscounted Adoption Cost in Year t;*

$TC_{n,t}$ = *The nth Undiscounted Transfer Cost in Year t*

There are "M" types of R&D expenditures. In this case "M" is equal to 2, representing research and extension expenditures, i.e., R&D includes both research and transfer costs. The research expenditures are lagged by a period long enough for the sunflower R&D program to produce an impact at the farm level. In this study, the lag length was 5 years.

The discount rate used in this study is an approximation of the social time preference rate. This is normally taken as the rate of interest (real) on long-term government bonds. During the period 1983 to 1996, the lending rate, which was used to approximate the social time preference rate, averaged around 10 percent (World Development Report, 1994). Rates of 5 and 15 percent are used as part of sensitivity analysis.

The summation of the discounted incremental net benefits yields the net present value (NPV) of sunflower R&D, which indicates positive impact when it is greater than zero. Of interest is the discount rate that reduces the sum of discounted incremental net benefits to zero. This discount rate is the average internal rate of return (IRR) of sunflower R&D. When this rate is greater than the social time preference rate, then past investments in sunflower R&D have been socially profitable.

3.5 DATA COLLECTION METHOD

Both primary and secondary data were used in the analysis.

3.5.1 Primary Data

Primary data on the current management practices and the adoption of various technological components over time were collected using a standard questionnaire. See Annexes I and II for the questionnaires used in this study. Personal interviews were conducted to collect the information from communal farmers and a mail survey was used to collect data from the commercial farmers. Information on household characteristics, farm characteristics, details on sunflower cultivation practices over time, and various aspects of marketing and support services were collected. These aspects are summarized and discussed in Chapters 4 and 5. In addition, various individuals involved in the sunflower R&D activities were also interviewed to obtain specific information.

3.5.2 Secondary Data

Cost information, evolution of the sunflower R&D program, and information on various technologies were collected from various published and unpublished reports. Information regarding the consumer price index (CPI), prices, production, acreage, yields, were obtained from the Quarterly Digest of Statistics and the Central Statistical Office. Various Annual Reports of the Agronomy Institute were used to estimated the proportion of sunflower trials to the total number of trials.

3.6 SAMPLING

Different procedures were used to select the sample farmers for the survey for the two sectors.

3.6.1 Communal Areas

A multi-stage sample technique was used for drawing up the sample of groundnut growers in the communal areas. The district level production statistics, with figures provided by the Early Warning Unit of AGRITEX, were used in identifying districts producing groundnuts. Ten districts were selected from the list of districts that produced at least five percent of the total

communal area production. The average production figure from two production seasons, i.e., 1994/95 and 1995/96, was used for this purpose. In each selected district, two wards were randomly selected from the list of wards in that district. Randomly, ten groundnut growers were interviewed in each ward. Another 24 households were selected from Hurungwe district. The final sample was composed of 62, 62, and 100 farmers in NR II, NR III, and NR IV, respectively.

3.6.2 Large-Scale Commercial Farmers

A sampling frame of all registered large-scale commercial sunflower growers (640) was provided by the Commercial Oilseed Producers Association (COPA). Using a systematic sampling procedure, a total of 150 farmers were selected for the mail survey. Questionnaires were sent to the 150 farmers selected. Forty-seven farmers returned the completed questionnaires. This is around 7.3 percent of the population, and 31.3 percent of the sample selected for sending mail questionnaires.

The information collected from these two surveys is summarized in Chapters 4 and 5.

CHAPTER 4. SUNFLOWER PRODUCTION SYSTEMS ON COMMUNAL FARMS

4.1 INTRODUCTION

This chapter describes the major socioeconomic characteristics of farmers growing sunflower and management practices of sunflower production in the smallholder farming sector of Zimbabwe. The description is based on results of a survey conducted across Natural Regions (NR) II, III and IV covering a total of ten districts. A multistage sampling method was used in selecting a total of 224 farmers who were interviewed in the smallholder sector. This chapter discusses the communal area sunflower production systems.

4.2 COMMUNAL AREA SOCIOECONOMIC CHARACTERISTICS

4.2.1 Household Characteristics

The average age of the decision makers at household level was 49 years, Table 4.1. In more than 50 percent of the households surveyed, decisions were made by females, while in about one-third of the households decisions were made by males. The remaining households reported that decisions were being made by both males and females. The results are not unusual for the communal farming sector, since most men work in urban areas, while their wives and children remain in the rural areas. The wives make most of the day-to-day decisions on farm operations. Men enter the decision making process mainly in the disposition of assets, such as livestock or farm equipment.

Table 4.1 AGE AND GENDER OF DECISION MAKERS BY NATURAL REGIONS - SAMPLE FARMERS 1996

	Household Decision Makers			
		Percent Decision Makers of Households		
Natural Regions	Average Age	Female	Male	Both Genders
NR II	48.0	68.0	29.0	3.0
NR III	49.8	50.8	37.7	11.5
NR IV	50.0	59.2	34.7	6.1

Source: Zimbabwe Farm Survey, 1996.

The education level of decision makers did not vary very much between the Natural Regions as shown in Table 4.2. Up to 13 percent of the decision makers had never been to school, while about three-quarters of the decision makers had seven years of primary education (i.e., up to the seventh grade). Between 10 and 17 percent of those surveyed had formal high school training. Farmers with specialized college training, that is, holders of certificate, diploma or degree in agriculture, occurred only in Natural Region II. These were mainly retired extension workers and farm managers.

4.2.2 Farm Sizes and Distribution

In general, communal areas are characterized by high population densities and small farm sizes. The size of the farm and its location determines the land use in the smallholder sector. Farms surveyed ranged in size from 0.2 hectares to 9.6 hectares, with at least 70 percent of the sample owning 3 hectares and below. Table 4.3 shows the frequency distribution of farm sizes by natural region and size categories.

Table 4.2 EDUCATION LEVEL OF DECISION MAKERS BY NATURAL REGION - SAMPLE FARMERS 1996

Natural Regions	Percent of Decision Makers			
	No Formal Education	Primary Education	High School Education	College Training
NR II	13.0	72.5	10.0	4.5
NR III	6.8	76.3	17.0	0.0
NR IV	13.2	71.5	15.3	0.0

Source: Zimbabwe Farm Survey, 1996.

Table 4.3 DISTRIBUTION OF FARM SIZE BY NATURAL REGION - 1996

Farm Size (Hectares)	Percentage of Farms		
	Natural Region II	Natural Region III	Natural Region IV
Up to 1	17.6	3.2	13.0
>1 to 2.0	19.3	43.5	25.0
>2.1 - 30	14.5	22.6	24.0
>3.1 - 40	21.0	17.6	25.0
>4.0 - 5.0	6.4	11.3	7.0
>5.0	20.9	3.2	6.0
Average	3.2	2.6	2.7

Source: Zimbabwe Farm Survey, 1996.

In NR III and IV, only 3.2 and 6 percent of the farms, respectively, had more than 5 hectares, whereas in NR II, 21 percent of the farms had more than 5 hectares.

4.2.3 Livestock Ownership

Livestock plays a key role in providing draft power to the smallholder agricultural sector. It also provides organic fertilizer in the form of manure which is extensively used as a substitute to the highly priced inorganic fertilizers. Livestock also plays the role of a "bank" in the smallholder sector, since it is an asset that can be liquidated to get cash for farm family investments. Table 4.4 shows the distribution of cattle and donkey ownership by natural regions for the sample surveyed.

Cattle ownership in the surveyed area ranged from 0 to 32 units. A third of the households in all three natural regions had between 1 and 5 head of cattle. The percentage of households with no cattle ranged between 18 percent and 43 percent, increasing from the higher potential

NR II to the more marginal NR IV. Average cattle ownership in NR II was 7.76 units, of which 2.58 units were draft animals, while in NR III and IV the figures were 4.94 and 2.13 and 3.36 and 1.46, respectively. Twenty-one percent of the households in NR II had no draft cattle, while 29 and 43 percent had no draft power in NR II and NR IV, respectively. Natural region IV had been hit hard by the 1991/92 drought. The majority of farmers in this region are rebuilding their draft animal herds. Households without draft power and those with inadequate draft animal power resort to hiring, borrowing, and sharing with neighbors. The most popular means of alleviating draft power shortages was through borrowing, followed by zero tillage. Twenty-seven percent in NR II practiced zero tillage, while in NRs III and IV, 31 and 16 percent, respectively, practice zero tillage.

Table 4.4 DISTRIBUTION OF CATTLE AND DONKEY OWNERSHIP BY NATURAL REGIONS - SAMPLE FARMERS 1996

Livestock Owned	Percentage Distribution					
	Natural Region II		Natural Region III		Natural Region IV	
	Cattle	Donkey	Cattle	Donkey	Cattle	Donkey
0	17.7	98.4	29.0	82.3	43.0	69.0
1-5	32.3	1.6	38.8	17.7	30.0	28.0
6-10	22.6	0.0	22.6	0.0	19.0	3.0
> 10	27.3	0.0	9.6	0.0	8.0	0.0

Source: Zimbabwe Farm Survey, 1996.

Donkey ownership was highest in NR 4. There is, however, an inverse relationship between cattle ownership and donkey ownership. Only 3.2 percent of the sample farmers in NR II own donkeys, and the proportion of donkey owners increased to 17.7 percent and 35 percent in NR III and IV, respectively.

4.2.4 Implement Ownership

Table 4.5 shows the distribution of implement ownership by natural regions for the sample farmers in the surveyed areas. Ploughs were the most common implements owned by communal area farmers across the three NRs. There were more owners of cultivators and harrows in NR II than in NR III and IV. Ridgers and planters were the least owned implements, implying that if the communal area farmers have to construct ridges they need to use ploughs or cultivators. Hiring or borrowing was reported on a few essential implements in particular the plough and scotch cart. The plough was hired by 19.4 percent, 21 percent and 7 percent of the sample in NR II, III and IV, respectively. The same implements were borrowed by 21 percent, 32 percent and 31 percent of the respondents in NRs II, III and IV, respectively. The scotch cart followed the same trend, but the percentages were less than 10 percent.

4.2.5 Sources of Income

Maize was the most common main income source across all three natural regions, as reported by 61.7 percent in NR II, 54.8 percent in NR III, and 51.1 percent of the sample farmers in NR IV (Table 4.6). Cotton ranked second as the main income source in NR II, while in NR III and IV groundnuts ranked second followed by sunflower. As secondary income sources,

sunflowers emerged as important in NRs II and IV. Remittances, livestock, poultry, and horticulture were also reported as important sources of income in NR II.

Table 4.5 DISTRIBUTION OF IMPLEMENT OWNERSHIP BY NATURAL REGION - SAMPLE FARMERS 1996

Implement	Average Number Owned		
	NR II	NR III	NR IV
Plough	1.2	0.8	0.9
Cultivator	0.7	0.3	0.3
Ridger	0.1	0.0	0.0
Harrow	0.5	0.2	0.2
Scotch cart	0.2	0.1	0.4

Source: Zimbabwe Farm Survey, 1996.

Table 4.6 SOURCES OF MAIN AND SECONDARY INCOME BY NATURAL REGION - SAMPLE FARMERS 1996

Crop	Percentage of Farmers					
	Main Source			Secondary Source of Income		
	NR II	NR III	NR IV	NR II	NR III	NR IV
Maize	61.7	54.8	51.1	0.0	0.0	0.0
Groundnuts	3.3	16.1	13.0	30.6	32.3	34.0
Sunflower	3.3	12.9	7.6	32.3	11.3	25.0
Other Field Crops	6.7	6.4	26.6	22.5	11.3	20.0
Cotton	23.3	0.0	10.9	11.3	3.2	1.0
Horticulture	1.7	0.0	0.0	9.7	17.7	29.0
Livestock	0.0	1.6	7.6	6.4	30.7	18.0
Non-Farm Income	0.0	0.0	3.3	13.0	30.7	21.0

Source: Zimbabwe Farm Survey, 1996.

The main use of income generated from the sale of sunflowers in NR II, as indicated in Table 4.7, was meeting daily household needs, which include groceries. In NR III, the respondents indicated purchase of agricultural inputs, while in NR IV income from sunflowers was mainly spent on household groceries and school fees.

4.2.6 Crops Grown During the 1995/96 Season

A total of nine different crops were grown by the sample smallholders during the 1995/96 season, Table 4.8. Maize occupied the largest area and was grown by all sample farmers in the three agro-ecological regions. Its popularity, or dominance, is due to the fact that maize is the staple food crop in Zimbabwe's communal areas, and is also easily marketed through a variety of channels. The average area planted by smallholders was more than one hectare in the sampled natural regions. Groundnuts were the second important crop grown by 85, 97, and 93 percent of the farmers in NRs II, III, and IV, respectively. The average area allocated to groundnuts was highest in NR IV and lowest in NR II. Groundnuts are grown on a more extensive scale in low rainfall areas, hence, larger land allocations.

Table 4.7 MAIN USES OF INCOME FROM OILSEED CROPS - SAMPLE FARMERS 1996

Crop/Use	Percentage of Farmers		
	NR II	NR III	NR IV
Sunflowers			
Household Daily Requirements	35.5	9.7	34.0
Agricultural Inputs	18.0	20.9	12.0
School Fees	22.6	4.8	27.0
Clothes	17.7	8.1	16.0
Groundnuts			
Household Daily Needs	50.0	54.8	52.0
Agricultural Inputs	12.9	16.1	12.0
School Fees	24.2	22.6	30.0
Clothes	22.6	27.4	22.0
Soybeans			
Household Daily Needs	37.5		
Agricultural Inputs	70.8		
School Fees	37.5		
Clothes	45.8		

Source: Zimbabwe Farm Survey, 1996.

Table 4.8 DISTRIBUTION OF AREA ALLOCATED TO CROPS BY NATURAL REGION - SAMPLE FARMERS -- 1995/96

Crop	Natural Region II			Natural Region III			Natural Region IV		
	Percent Growing	Hectares		Percent Growing	Hectares		Percent Growing	Hectares	
		Area	Range		Area	Range		Area	Range
Maize	100.0	1.75	0.2-9.2	100.0	1.18	0.2-4.0	100.0	1.26	0.2-6.0
Cotton	35.5	0.40	0-9.2	na	na	na	10.0	0.11	0-2.0
Sorghum	9.7	0.05	0-1.2	9.7	0.04	0-1.0	37.0	0.22	0-1.6
Pearl Millet	4.8	0.01	0-0.2	17.7	0.09	0-1.6	19.0	0.08	0-1.2
Rapoko	4.8	0.01	0-0.5	27.4	0.10	0-0.8	28.0	0.12	0-1.2
Groundnut	85.0	0.29	0-1.2	96.7	0.35	0-0.8	92.9	0.38	0-1.0
Soybean	25.8	0.13	0-1.2	na	na	na	na	na	na
Sunflower	50.0	0.25	0-1.6	24.2	0.10	0-0.8	34.0	0.18	0-2.0
Beans	na	na	na	24.2	0.05	0-0.4	42.0	0.09	0-0.4

Source: Zimbabwe Farm Survey, 1996.

Sunflower ranked as the third most commonly grown crop by half the sample in NR II, a quarter in NR II, and a third in NR IV. Cotton, an important cash crop in the smallholder sector, was grown by 36 percent of the farmers in NR II and 10 percent in NR IV. The average area planted was 4 times higher in NR II than in NR IV. No farmers in NR III grew cotton in 1995/96. Soybean is a relatively new crop in the communal areas, and are mainly concentrated in Hurungwe Communal Area (NR II) where extensive promotional activities have been undertaken by the research and extension departments. It is worth noting that despite the vigorous promotions during the mid-1980s, the production of soybeans is very

small in the communal farming sector. Only 26 percent of the sample farmers grew soybeans during the 1995/96 season on an average area of 0.4 hectares.

Three small-grain crops, sorghum, pearl millet, and finger millet, were grown in all three natural regions in the 1995/96 season. Small-grains are by nature more drought tolerant, and hence, more suitable for growing in marginal rainfall areas. The percentage of farmers growing these crops, and the average area allocated to them, bear testimony to this phenomena (Table 4.8). More farmers in NR IV grow small-grains compared to the other NRs. The last crop, field beans, are grown on residual moisture in NR II, and as a conventional crop in NR III and IV. Field beans are an important dual purpose (food and cash) crop grown by smallholder farmers on very small portions of land of up to 0.4 of a hectare. The average area allocated to this crop by sample farmers was 0.05 and 0.09 hectares in NR III and IV, respectively. No field beans were grown in NR II during the 1995/96 season.

4.2.7 Adequacy of Food Production

Farmers were asked whether they produced adequate food in normal years. While their responses to this question might have been influenced by the recent droughts which the country experienced, the results show that the majority of the sampled farmers produced adequate food to meet their household requirements. In NR II, 91.9 percent of the sample farmers indicated that they produced adequate food to meet their requirements. In NR III and IV, slightly fewer households indicated producing adequate food, i.e., 81 and 83 percent, respectively.

4.2.8 Access to Support Services

Ninety-eight percent of the farmers stated that they were not using credit for producing sunflowers across all three regions. AGRITEX was reported to be the source of extension advice by 97.7 percent of the sample in NR II and IV for both sunflower and groundnut. The remainder was attributed to farmer-to-farmer extension. Farmer to farmer extension was also reported by 32.3 percent in NR III, and the remainder stated AGRITEX as their source. Over ninety percent of the farmers reported that they were satisfied with the advice they received from the AGRITEX staff. Membership in ZFU was reported by 50, 31, and 37 percent of the sample in NRs II, III, and IV, respectively. ZFU activities seemed to be more pronounced in high potential NRs than the low potential ones.

4.3 SUNFLOWER CROP MANAGEMENT PRACTICES IN COMMUNAL AREAS

4.3.1 Land Preparation

Sunflowers require a fine seedbed in order to achieve good germination, therefore, final land preparation should be done by a cultivator just before planting. The majority of the sample farmers in all the three natural regions prepared their fields using ploughs, and the ploughing was done either in winter or spring, Table 4.9. Zero tillage as well as the use of hoes (digging) for land preparation were practiced in NR IV by less than 5 percent of the sample farmers. Absence of tools and equipment may constrain these farmers from adopting improved practices. Land preparation was done mostly by men in NR II and III, and by men, women and children in Natural Region IV.

Table 4.9 SUNFLOWER PRODUCTION PRACTICES IN COMMUNAL AREAS - SAMPLE FARMERS — 1985 - 1995

Practice	Percentage of Farmers								
	1985			1990			1995		
	NR II	NR III	NR IV	NR II	NR III	NR IV	NR II	NR III	NR IV
Land Preparation									
Winter Plow Only	50.0		63.6	43.5	55.6	62.5	40.5	45.5	33.3
Spring Plow Only	50.0	80.0	27.3	56.5	33.3	20.8	59.5	50.0	33.3
Discing		20.0	9.1		11.1	8.3		4.5	21.4
Winter and Spring Plow					4.2				
Digging									2.4
Zero Tillage									2.4
Disc and Plough									4.8
Ripping						4.2			
Planting Method									
Broadcast/Random		20.0	10.0	4.3	22.2	4.2	8.3	9.1	9.3
In Rows	100.0	80.0	90.0	95.7	77.8	95.8	91.7	90.9	90.7

Source: Zimbabwe Farm Survey, 1996.

4.3.2 Planting Method

It is recommended that sunflower should be planted in rows. The survey results revealed that more than 80 percent of the farmers in the NRs II, III and IV planted in rows, with the remainder broadcasting their seed, Table 4.9. Across all three natural regions, the task of planting was executed mainly by women. Men also assisted in the planting, while children took little participation in this task.

4.3.3 Varieties Grown

The list of sunflower varieties available in Zimbabwe has been given in Chapter 2. Although in recent years AGRITEX has undertaken a deliberate promotion campaign to grow hybrid sunflower seed in communal areas, the farmers continue to use low-quality, outdated varieties because of the prohibitive cost of hybrid seed. What came out clearly from the survey results was that in all natural regions, more than 70 percent of the farmers interviewed did not know the name of the cultivar that they were growing. The most commonly grown traditional variety is Peredovick (Table 4.10). Of the improved varieties, the hybrid Msasa was grown by most farmers across the regions, followed by the Pannar varieties. Again, the majority of the farmers did not know the name of the improved variety that they were growing. For the 1995 period, this could be explained by the fact that most of these farmers claimed that they obtained their seed through the seed-pack drought relief program, thus, they did not know what the variety was distributed.

Table 4.10 SUNFLOWER PRODUCTION PRACTICES IN COMMUNAL AREAS — SAMPLE FARMERS — 1985 - 1995

Practice	Percentage of Farmers (Total Sample)								
	1985			1990			1995		
	NR II	NR III	NR IV	NR II	NR III	NR IV	NR II	NR III	NR IV
Sunflower Varieties Grown									
Improved									
Msasa	6.5	3.2	7.0	11.3	3.2	9.0	6.4	6.5	11.0
Pannar				3.2			12.9	1.6	2.0
Mixed	1.6	1.6		1.6	4.8		4.6	4.8	1.0
Traditional									
Peredovick	17.7	1.6	3.0	22.6	4.8	14.0	30.6	17.7	26.0
Mixed		1.6	1.0		1.6	1.0	3.2	4.8	2.0
Seeding Rate									
Mean	17.0	14.0	14.1	14.6	18.4	17.3	17.6	17.7	19.4
Range	2.5-32.0	5.0-25.0	6.3-25.0	4.0-33.0	5.0-25.0	5.0-37.5	5.0-50.0	5.0-50.0	2.5-50.0

Source: Zimbabwe Farm Survey, 1996.

4.3.4 Seed Rate

For hybrid sunflower, a seed rate of 5 kilograms per hectare is recommended, whereas for open pollinated varieties the seed rate should be 7 kilograms per hectare. The survey results revealed that the farmers were either over estimating the seed rates or were not aware of the recommended rates, Table 4.10. One would understand the desire to increase the seed rate, taking into consideration the fact that sunflower germination on sandy soils is difficult and tricky.

4.3.5 Fertility Management

The recommendation is to apply 250 kilograms per hectare of compound L as basal dressing and 150 kilograms per hectare of ammonium nitrate as a top-dressing. However, there exists a strong belief among farmers that sunflower will perform well even in fields with nutrient-poor soils. As a result, farmers hardly make any effort to manage soil fertility in fields where sunflower is grown. This is confirmed by the survey results which showed that across the three regions, 83 to 100 percent of the farmers interviewed did not apply any basal fertilizer, Table 4.11. Of the remaining few that applied fertilizer, the type most commonly used was compound D, followed by compound L. The fertilizer was either applied before planting or at planting. Very few (less than two percent) of the farmers applied basal fertilizers, between one and three weeks after emergence, Table 4.11.

Basal fertilizer application rates ranged from 20 kilogram per hectare to 298 kilograms per hectare, Table 4.11. Overall, the improved varieties got more fertilizer than the traditional ones, since hybrids are more demanding in terms of fertility management if higher yields are to be achieved. Most of the basal fertilizer was either banded or dolloped, and only a few farmers broadcast fertilizer, Table 4.11.

Table 4.11 BASAL FERTILIZER PRACTICES FOR SUNFLOWER PRODUCTION IN COMMUNAL AREAS - SAMPLE FARMERS -- 1985 - 1995

Variety/Type	Percent of Farmers								
	1985			1990			1995		
	NR II	NR III	NR IV	NR II	NR III	NR IV	NR II	NR III	NR IV
Fertilizer Usage									
Improved Varieties									
Comp D		3.2		4.8	3.2	1.0	9.7	4.8	
Comp L				4.8		1.0	6.5		1.0
Manure				1.6					2.0
None	100.0	96.8	100.0	88.7	96.8	98.0	83.9	95.2	97.0
Traditional Varieties									
Comp D				4.8	3.2		4.8	6.5	
SSP							1.6		
Comp L									1.0
Manure						1.0			
AN								1.6	
Timing of Fertilizer Application									
Before Planting	12.9			1.6		1.0		1.6	1.0
At Planting		1.6		12.9	6.5	2.0	19.4	9.7	2.0
One Week After Planting	1.6						1.6		
Three Weeks After Emergence				1.6			3.2		
Quantity of Fertilizer applied									
Improved Varieties									
Comp D	150.0			291.7	87.5	125.0	281.3	100.0	50.0
Comp L				250.0		50.0	193.8		
Manure	125.0			5,000.0					
Traditional Varieties									
Comp D	298.3	50.0		125.0	125.0		116.7	250.0	
Comp L							20.0	250.0	
AN					125.0				
Manure	5,000.0								42.0
Method of Applying Fertilizer									
Broadcast/Random	1.6			1.6	1.6			1.6	
Banding		1.6		11.3	1.6		14.5	4.8	
Dollop	12.9			3.2	3.2		8.1	4.8	
None	85.5	98.4	100.0	83.9	93.5	100.0	77.4	88.7	100.0

Source: Zimbabwe Farm Survey, 1996.

The majority of the sample farmers did not apply a second application of fertilizer. For those who apply fertilizer, the improved varieties received higher rates than the traditional ones, Table 4.12. Ammonium nitrate was the most commonly used fertilizer for top-dressing. The top-dressing was done at four weeks after emergence or at the first flowering, which is also

the recommended time for top-dressing. Dolloping and broadcasting were the two methods used for top-dressing by the interviewed farmers.

Fertilizer application is a task executed mainly by men in NR III, by men and women in NR IV, and by men, women, and children in NR II.

Table 4.12 TOP-DRESSING FERTILIZER MANAGEMENT PRACTICES FOR SUNFLOWER PRODUCTION IN COMMUNAL AREAS - SAMPLE FARMERS

Practice	Percent of Farmers								
	1985			1990			1995		
	NR II	NR III	NR IV	NR II	NR III	NR IV	NR II	NR III	NR IV
Ammonium Nitrate Usage									
Improved Varieties	3.2	1.6		8.1	3.2	2.0	11.3	4.8	1.0
Traditional Varieties	6.5			3.2	1.6	1.0	1.6	1.6	1.0
Quantity of Fertilizer Applied (Kilograms per Hectare)									
Improved Varieties	218.8	16.0		187.6	101.8	93.8	151.8	130.3	
Traditional Varieties	72.1			87.5	125.0	100.0	150.0	62.5	
Timing of Fertilizer Application									
3 - 4 Weeks After Emergence	3.2			6.5	1.6		6.4	4.8	2.0
5 - 6 Weeks After Emergence					1.6				1.0
At First Flowering	6.5			4.8	1.6		6.5	1.6	
Fertilizer Application Method									
Broadcast/Random		1.6			3.2			1.6	
Dollop	9.7			11.3	1.6	3.0	12.9	3.2	2.0

Source: Zimbabwe Farm Survey, 1996.

4.3.6 Weeding

Sunflower crops should be kept weed-free especially during the first few weeks, otherwise substantial yield loss from weed competition will occur. The majority of the sample farmers interviewed performed their first weeding between two and four weeks after emergence, Table 4.13. There were variations in number of subsequent weedings across regions and between seasons. In NRs II and IV, the majority of respondents carried out two subsequent weedings, whereas in natural region III, they weeded once more.

4.3.7 Pest and Disease Control

Eighty percent of the sunflower growers in NR II did not practice any pest and disease control measures. For the remaining 20 percent, the activity was mainly done by men and children. In NR III, about five-percent of the sample farmers controlled pests and diseases, while in NR IV there was none. The limited pest and disease control practiced in NR IV was done by all labor categories.

Table 4.13 WEED MANAGEMENT PRACTICES FOR SUNFLOWER PRODUCTION IN COMMUNAL AREAS - SAMPLE FARMERS — 1985 - 1995

Practice	Percentage of Farmers																	
	1985						1990						1995					
	NR II		NR III		NR IV		NR II		NR III		NR IV		NR II		NR III		NR IV	
	Imp	Trad	Imp	Trad	Imp	Trad	Imp	Trad	Imp	Trad	Imp	Trad	Imp	Trad	Imp	Trad	Imp	Trad
Timing of First Weeding																		
1 - 2 Weeks After Emergence	40.0	18.2	33.3		16.7	40.0	20.0	15.4	20.0	33.3	22.2	6.7	7.1	15.5	25.0	28.5	13.4	75.0
3 Weeks After Emergence	20.0	27.3	33.3		33.3	40.0	10.0	30.8	40.0	33.3	33.3	53.3	35.7	29.8	25.0		33.3	25.0
4 Weeks After Emergence	40.0	45.1	33.3	100	33.3	20.0	70.0	46.2	40.0	33.3	33.3	26.7	42.9	39.2	50.0	64.3	33.3	
5 - 6 Weeks After Emergence		9.0			16.7			7.7			11.1	13.4	14.3	15.5		7.1	20.0	
Number of Subsequent Weedings																		
One	25.0	40.0	100	100	33.0	25.0	25.0	30.8	100	100	33.3	53.3	42.9	25.0	50.0	77.8	66.7	76.2
Two	75.0	60.0			67.0	75.0	75.0	69.2			55.6	30.8	42.9	75.0	50.0	22.2	26.7	23.8
Three											11.1	15.4	14.3				6.7	

Source: Zimbabwe Farm Survey, 1996.

4.3.8 Harvesting and Yields

The mean sunflower yields for the three natural regions are given in Table 4.14. Seed yields of traditional varieties were comparable to those of the improved varieties, and were even superior in some regions. The explanation for this could be that since hybrids are more sensitive to poor management as compared to open pollinated varieties, the non-application of fertilizers by the majority of the farmers could have resulted in poor yields. Yields were also generally higher in NR II, followed by NR IV. Yields were surprisingly low in NR III, and yet according to the CSO sunflower production statistics, this region is supposed to be the best sunflower producing area. Harvesting of sunflower was done by men, women, and children in all the natural regions studied.

Table 4.14 SUNFLOWER PRODUCTION IN COMMUNAL AREAS - SAMPLE FARMERS — 1985 - 1995

Variety/Yield	Mean Kernel Yield (Kilograms per Hectare)								
	1985			1990			1995		
	NR II	NR III	NR IV	NR II	NR III	NR IV	NR II	NR III	NR IV
Improved									
Mean	825.0		711.6	941.7	493.3	1,093.0	897.0	481.3	547.2
Range	275-1,375		165-1,856	75-1,650	100-1,375	275-2,062	125-2,063	137-825	547.2
Traditional									
Mean	983.1	412.5	632.5	1,164.0	379.2	684.5	598.6	514.6	682.6
Range	688-1,375	412.5	110-1,100	25-4,402	50-963	220-1,375	100-1,615	25-2,063	682.6

Source: Zimbabwe Farm Survey, 1996.

4.3.9 Labor Shortages

The majority of the farmers surveyed (76 percent in NR II, 74 percent in NR III, and 80 percent in NR IV) experienced some general labor shortage for sunflower production, but did not give any specifics.

4.3.10 Sunflower Marketing

4.3.10.1 Natural Region II

Sunflowers grown in this region can be marketed through the GMB, traders, locals, and companies. Farmers may be contracted by some companies to produce a crop or sell to those companies without entering into any agreement. Before 1995, most sunflowers were marketed through the GMB followed by traders, while local buyers took the smallest share (about 3.4 percent). In 1995, an increased proportion was sold to companies and traders, while a reduced proportion went to the GMB, i.e., from 79.3 percent to 70.8 percent. Companies entered the market around 1995. The proportion of sunflower sold to the GMB further dropped to 53.8 percent, but still remained as the largest market outlet. The percentage sold to traders, on the other hand, increased from 20.8 percent in 1993 to 34.6 percent in 1996.

4.3.10.2 Natural Region III

Sunflowers can be sold to the GMB, traders, and locals in this region. Like NR IV, in 1996 most of the sunflowers were sold to the GMB, but proportionally more were sold to the GMB from NR III than from NR IV. In 1995, unlike NR IV, most of the sunflowers went to the GMB (57.1 percent) which was the same as in previous years. Proportionally more sunflowers were sold to the GMB in 1995 than in previous years.

4.3.10.3 Natural Region IV

Sunflowers in NR IV can be marketed through the GMB, local merchants, traders, and companies. In 1996, sunflowers grown in this region were mainly marketed through the GMB (about 40.7 percent), and locals (about 29.6 percent). A different situation prevailed in 1995 when most of the sunflowers went to local buyers (about 44 percent), followed by the GMB (36 percent), and the remainder went to traders. Previously, the GMB took the largest share, followed by locals.

Overall, there has been a significant drop in the proportion of farmers marketing their sunflowers through the GMB, contrasted to the rise in sales to traders, a result of market liberalization.

4.3.11 Transport

There was a notable decline (from 68.6 percent to 48.9 percent) in the use of motorized transport between NRs II and IV. Besides the motorized transport, scotch carts were the next most common mode of transport. Less than 5 percent of the total sample farmers encountered transportation problems across NRs II and III, while in NR IV transportation problems were

mentioned by one in every four farmers. Twenty-two percent of the farmers in NR IV stated that transport was too expensive.

4.3.12 Market Regulation Changes

Less than 10 percent of the farmers surveyed were aware of the changes in the rules and regulations of oilseed marketing as a result of the market liberalization. The remainder were unaware of such changes.

4.3.13 Credit

Ninety-eight percent of the farmers surveyed in the three natural regions stated that they were not using credit for sunflower production. This could be explained by the fact that the AFC has not been pushing sunflower seed, and that very few seasonal loans have been given for crops other than maize and cotton.

4.3.14 Farmer Training, Organization and Quality of Service

Sixty-seven percent, 63 percent, and 64 percent of the farmers surveyed in NRs II, III, and IV, respectively, belong to a farmer extension group. In NRs II and IV, 100 percent of the farmers said that they sought advice on sunflower production from extension, whereas in NR III, only 27.4 percent sought advice on sunflower production from extension. It was also apparent that most of the farmers who receive extension advice actually waited for it to be brought to them by AGRITEX personnel, while less than 25 percent of the farmers actually made any effort to seek advice. Over ninety-five percent of the farmers reported that they were satisfied with the advice they received from the extension staff. As for membership in ZFU, 31 to 37 percent of the surveyed farmers in the drier regions were members, compared to the high potential NR II where 50 percent of the farmers surveyed said they were ZFU members.

4.4 SUMMARY OF THE COMMUNAL SUNFLOWER GROWER MANAGEMENT PRACTICES

Sunflower appears to be a universally adopted crop in the communal areas across all three natural regions. While the land preparation and planting methods used by the most farmers are in accordance with recommendations, the other recommended sunflower production practices are not being followed. For example, the farmers were not buying improved seed, rather they used seed carried over form the previous sunflower crop. Farmers are not even sure of the variety that they are growing. The seed rates used by farmers were almost 4 times the recommended rate, suggesting either ignorance on the recommended rate or a deliberate attempt to improve sunflower plant stands on the sandy soils where there is a problem with germination.

The survey results showed that the majority (more than 80 percent) of the farmers did not apply fertilizer to the crop. The farmers have a strong belief that sunflower is a "scavenger crop" which can perform well even on poor soils. Average kernel yield, observed in the survey, were higher than the CSO national average. This could be a result of an over estimation of yield by some farmers.

The survey results also indicated that there is potential for improving sunflower yield in communal areas, particularly if farmers are encouraged to grow improved varieties and apply fertilizer. The area under sunflower has increased substantially over the years in the communal farming sector. The production potential of the available varieties are much higher than the average yields obtained by the sample farmers. Therefore, adoption of improved varieties and better management practices can substantially improve productivity and overall production of sunflower in the communal farming sector.

CHAPTER 5. SUNFLOWER PRODUCTION SYSTEMS ON LARGE-SCALE COMMERCIAL FARMS

5.1 INTRODUCTION

This chapter describes the major socioeconomic characteristics of sunflower growers and management practices followed in the large-scale commercial farming sector of Zimbabwe. The description is based on results of a survey conducted across the various production regions. Questionnaires were mailed to large-scale farmers, using the Commercial Oilseed Producers Association membership list as the sampling frame. This chapter discusses the sunflower management practices in the commercial sector in detail.

5.2 LARGE-SCALE COMMERCIAL AREA SOCIOECONOMIC CHARACTERISTICS

5.2.1 Farm Characteristics and Resource Endowment

Land holdings for the sampled large-scale commercial farmers range from 76 hectares to more than 3,500 hectares, Table 5.1. Seventy-five percent of the sample sunflower farmers had up to 2,000 hectares.

Table 5.1 SIZE AND FREQUENCY LARGE-SCALE COMMERCIAL FARMS - SAMPLE FARMERS 1996

Farm Size (Hectares)	Sunflower Producers Percent
501 - 1000	33.3
1001 - 1500	16.6
1501 - 2000	24.9
2001 - 2500	8.3
2501 - 3000	8.3
> 3000	8.3

Source: Zimbabwe Farm Survey, 1996.

Table 5.2 shows the allocation of area to various crops by the large-scale commercial sunflower growers.

For the large-scale sunflower growers surveyed, the area under maize ranged from 5 - 629 hectares, with an average of 172.4 hectares. Only two farmers grew groundnut, one on 1.3. hectares and the other on 4 hectares. The area under sunflower ranged from 2 - 130 hectares, with an average of 33.7 hectares. Nearly 50 percent of the surveyed farmers had less than or equal to 20 hectares of sunflower. Forty-six percent of the respondents produce soybeans on areas ranging from 20 - 466 hectares, with a mean area of 220.2 hectares. Less than 50 percent of the respondents grew sorghum on areas ranging from 2 to 240 hectares, with a mean of 96.3 hectares. Three farmers surveyed grew cotton on areas of 63, 118, and 319 hectares

each, while two farmers grew seed maize on 25 hectares and 80 hectares. Wheat was also grown by two farmers on 300 hectares and 560 hectares, respectively.

Table 5.2 AREAS OF CROPS GROWN IN 1996 BY LARGE-SCALE SUNFLOWER GROWERS - SAMPLE FARMERS 1996

Crop	Mean	Range
Maize	172.4	5 - 629
Groundnuts	2.2	1.3 - 4.0
Soybeans	220.2	20 - 466
Sunflower	33.7	2 - 130
Sorghum	96.3	2 - 240
Tobacco	13.0	13
Wheat	430.0	300 - 560
Cotton	166.7	63 - 319

Source: Zimbabwe Farm Survey, 1996.

5.2.2 Equipment Ownership

Compared to the communal sector, the large-scale commercial farming sector has a larger range of equipment for farm operations. This is because many of the operations are mechanized. The various types of equipment owned by the large-scale commercial farmers included tractors, ploughs, cultivators, ridgers, harrows, planters, combine harvesters, discs, rippers, and mist blowers. Other farmers who do not have machinery can usually hire the equipment economically.

5.2.3 Sources of Income

Maize (38.5 percent) and livestock (38.5 percent) featured as the main income sources of the sampled large-scale commercial sunflower growers. Groundnuts, wheat, soybeans, and cotton were also reported to be the main sources of income by the commercial farmers. Horticulture, sunflower, remittances, as well as poultry, were reported as supplementary income sources.

5.2.4 Oilseed Farming

In 1975, only 10 percent of the sample farmers were growing sunflower, while 26 percent were producing soybeans, Table 5.3. The adoption of sunflowers started two decades ago. It started gradually from 1975 and grew at a constant pace. Approximately 67 percent of the sample farmers have between 0 and 12 years experience in growing sunflowers.

5.2.5 Labor Force

The size of both permanent and casual labor did not correlate with size of farms. Fifty percent of the large-scale commercial sunflower farms surveyed had up to twenty employees who worked on a permanent basis and the same proportion also worked on a casual basis. Approximately 50 percent of the large-scale commercial farmers surveyed experienced labor shortage for groundnuts, maize, tobacco, sunflower, horticultural crops, and cotton.

Table 5.3 YEARS OF EXPERIENCE OF LARGE-SCALE FARMERS IN GROWING SUNFLOWERS - SAMPLE FARMERS 1996

Years Experience	Percentage of Farmers
0 - 4	33
5 - 8	22
9 - 12	11
13 - 16	22
> 16	11

Source: Zimbabwe Farm Survey, 1996.

5.2.6 Marketing of Sunflowers

Table 5.4 depicts the effect of market liberalization. A greater proportion of the sample sunflower growers market their sunflower in compounds. This trend has been maintained over the years. Other market outlets are the GMB, traders, local and harvesters. Nearly 39 percent of the sample are aware of the changes in marketing arrangements. Of these, 66.7 percent noted that they are now free to export their production, while the remainder noted that they are free to market anywhere they want in Zimbabwe. Fifty percent of the respondents stated that the market liberalization was not going to affect their area planted to groundnuts or sunflowers.

Table 5.4 LARGE-SCALE COMMERCIAL SUNFLOWER GROWERS MARKET OUTLETS - SAMPLE FARMERS — 1990 - 1996

Outlet	1990	1995	1996
GMB	29	22	13
Trader	-	22	13
Compound	57	33	50
Local	14	22	12
Harvesters	-	-	12

Source: Zimbabwe Farm Survey, 1996.

5.2.7 Credit Use

Thirty-six percent of the sampled sunflower farmers indicated that they use credit for sunflower production. Eighty percent of those farmers using credit have done so in the past 3-4 years. The majority (80 percent) source credit from the banks, while the remainder gets loans from AFC. Fifty-six percent were currently satisfied with the credit they receive., while 87.5 percent of the respondents think that the market liberalization will affect availability of credit.

5.2.8 Extension

Less than 8 percent of the large-scale commercial sunflower producers obtained advice from AGRITEX and DR&SS, while 42 percent of the sunflower producers obtained extension

advice from chemical companies. Most of the sample farmers (58 percent of the sunflower producers) obtained extension advice from other farmers, and none of the sample farmers obtained advice from NGOs.

5.3 SUNFLOWER PRODUCTION PRACTICES IN THE LARGE-SCALE COMMERCIAL FARMS

5.3.1 Land Preparation and Planting

Ripping was the land preparation method mostly used by the surveyed farmers for preparing land for planting sunflower, Table 5.5. Ploughing was also used by many farmers either on its own or in combination with discing or ripping. The recommendations are that final land preparation should be done by a cultivator just before planting since sunflowers require a fine seedbed in order to achieve good seed germination.

Table 5.5 METHOD OF LAND PREPARATION BY LARGE-SCALE COMMERCIAL FARMERS - SAMPLE FARMERS — 1985-1995

Method	Percent of Farmers		
	1985	1990	1995
Ploughing	25.0	22.2	10.0
Discing	0.0	0.0	10.0
Ripping	25.0	33.3	40.0
Zero Tillage	0.0	11.1	10.0
Harrowing	25.0	11.1	0.0
Disc and Plough	0.0	11.1	10.0
Ripping and Discing	0.0	0.0	10.0
Ploughing and Harrowing	25.0	11.1	10.0

Source: Zimbabwe Farm Survey, 1996.

Hand planting or the use of planters were the methods used by sample farmers, as shown in Table 5.6.

Table 5.6 PLANTING METHOD USED BY LARGE-SCALE COMMERCIAL FARMERS - SAMPLE FARMERS — 1985 - 1995

Method	Percent of Farmers		
	1985	1990	1995
Planter	50.0	66.7	54.5
Hand/Manually	50.0	33.3	45.4

Source: Zimbabwe Farm Survey

5.3.2 Varieties Grown

The improved varieties used by the large-scale commercial farmers are PNR 7369, Hysum 33, Mopane, and Msasa. A good number of farmers could not indicate the variety that they are growing. While farmers reported the use of PNR 7369 in 1985, the variety had not been

officially released at that time, Table 5.7. It should also be noted that variety Hysum 33 which some farmers claimed to be growing is not among the sunflower varieties ever availed in Zimbabwe.

Table 5.7 VARIETIES OF SUNFLOWER GROWN BY LARGE-SCALE COMMERCIAL FARMERS - SAMPLE FARMERS — 1985 - 1995

Varieties	Percent of Farmers		
	1985	1990	1995
Peredovick	20.0	20.0	0.0
Msasa	20.0	0.0	8.3
PNR 7225	0.0	20.0	0.0
PNR 7369	20.0	20.0	33.3
Hysum 33	0.0	10.0	8.3
Mopane	0.0	0.0	8.3
Unknown	40.0	30.0	41.7

Source: Zimbabwe Farm Survey, 1996.

5.3.3 Seed Rate

The seed rate ranged from 3 - 9 kilograms per hectare, Table 5.8. The rate seems to have been reduced over time from a mean of 8 kilograms per hectare in 1985 to 5.5 kilograms per hectare in 1995. The recommended seed rate is 5 kilograms per hectare for hybrids and 7 kilograms per hectare for open pollinated varieties. The reduction in seed rate over time might be an indication that farmers were moving from growing open pollinated to hybrids, as evidenced by the absence of open pollinated variety Peredovick among varieties grown in 1995.

Table 5.8 SEED RATE USED BY LARGE-SCALE COMMERCIAL FARMERS - SAMPLE FARMERS — 1985 - 1995

Seed Rate (Kg/Ha)	Percent of Farmers		
	1985	1990	1995
3	0.0	0.0	11.1
5	0.0	0.0	22.2
6	33.0	22.2	33.3
7	0.0	11.1	0.0
8	33.0	11.1	11.1
9	33.0	11.0	0.0
Mean (Kg/Ha)	8.0	6.0	5.5

Source: Zimbabwe Farm Survey, 1996.

5.3.4 Fertility Management

Compound L at 200 - 250 kilograms per hectare is recommended for basal application, since soils in Zimbabwe have been found to be generally deficient in the nutrient. Sunflowers are sensitive to boron deficiency which causes stunting of plants and malformation of the heads. Compounds D and L were the most frequently used basal fertilizer types, Table 5.9. Fertilizer

rates ranged from 175 kilograms per hectare to 350 kilograms per hectare. Over the period 1985 to 1995, the basal fertilizer application rates have increased from 266 to 322 kilograms per hectare. Although some of the farmers are applying too much fertilizer, the majority are applying the recommended rate.

Table 5.9 BASAL FERTILIZER MANAGEMENT PRACTICES FOR SUNFLOWER PRODUCTION BY LARGE-SCALE COMMERCIAL FARMERS - SAMPLE FARMERS

Practice	Percentage of Farmers		
	1985	1990	1995
Fertilizer Types			
Compound D	50.0	50.0	30.0
Compound L	25.0	37.5	60.0
Compound M	25.0	0.0	0.0
Compound Z	0.0	12.5	0.0
Compound K	0.0	0.0	10.0
Fertilizer Rates (Kilograms per Hectare)			
175	0.0	25.0	10.0
200	33.3	12.5	10.0
250	33.3	25.0	30.0
300	0.0	12.5	10.0
350	33.3	12.5	20.0
>350	0.0	12.5	0.0
Timing of Fertilizer Application			
At Planting	75.0	50.0	70.0
At Land Preparation	25.0	50.0	30.0
Method of Fertilizer Application			
Vicon	25.0	12.5	10.0
Banding	0.0	0.0	10.0
Planter	75.0	75.0	60.0
Broadcasting	0.0	15.5	10.0

Source: Zimbabwe Farm Survey, 1996.

Basal fertilizer was applied at or before planting by the sample farmers, as is recommended, Table 5.9. In 1985, 1990, and 1995, 75 percent, 50 percent, and 70 percent of the farmers, respectively, applied the basal fertilizers at planting. The rest applied during land preparation.

The planter was the most commonly used method for applying basal fertilizer, Table 5.9. In 1985, all farmers used the planter. In 1990 and 1995, 87.5 percent and 70 percent, respectively, used the planter. In 1990, 15.5 percent of the farmers broadcasted the fertilizer, while in 1995, 10 percent broadcasted. The rest of the sample farmers banded in 1995.

All the sample farmers who used top-dressing applied ammonium nitrate, which is the recommended fertilizer for top-dressing. All the sample farmers applied top-dressing fertilizer at the time of flowering or soon after, which is the recommended time of applying top-dressing. The application rates used are also within the recommended rates, Table 5.10.

Table 5.10 TOP-DRESSING MANAGEMENT PRACTICES FOR SUNFLOWER PRODUCTION BY LARGE-SCALE COMMERCIAL FARMERS - SAMPLE FARMERS — 1985 - 1995

Practice	Percentage of Farmers		
	1985	1990	1995
Fertilizer Rates (Kilograms per Hectare)			
50	0.0	16.7	12.5
100	50.0	0.0	0.0
125	50.0	16.7	12.5
150	0.0	16.7	0.0
200	0.0	33.3	12.5
250	0.0	16.7	25.0
>300	0.0	0.0	37.5
Method of Fertilizer Application			
Vicon	50.0	28.6	22.2
Manually	50.0	57.2	66.7

Source: Zimbabwe Farm Survey, 1996.

The majority of the sample farmers either used the Vicon or manually applied the top-dressing fertilizer, Table 5.10. The number of farmers using the Vicon is falling over years. It fell from 50 percent in 1985 to 22 percent in 1995. By contrast, the Percentage of farmers using manual applications increased from 50 percent in 1985 to 67 percent during the same period.

5.3.5 Weeding

Weeding of sunflower should be done within the first four weeks after emergence. Weed control during the first six weeks is essential, otherwise the potential yield reduction is about 50 percent. All the farmers seemed to be following the recommendations, Table 5.11. Hand weeding still remains the most widely used method of weed control on sunflowers.

Table 5.11 WEEDING MANAGEMENT PRACTICES FOR SUNFLOWERS BY LARGE-SCALE COMMERCIAL FARMERS - SAMPLE FARMERS — 1985 - 1990

Practice	Percentage of Farmers		
	1985	1990	1995
Time of First Weeding			
1 Week After Emergence	0.0	0.0	9.1
2 Weeks After Emergence	25.0	33.3	27.3
3 Weeks After Emergence	50.0	33.3	18.2
4 Weeks After Emergence	25.0	22.2	27.3
Before Emergence (Herbicide)	0.0	11.1	9.1
Number of Subsequent Weedings			
1	33.3	42.9	30.0
2	66.7	42.9	50.0
3	0.0	14.2	20.0

Source: Zimbabwe Farm Survey, 1996.

In most cases (80 percent), two further weeding operations are undertaken after the first one. Twenty percent of the sample farmers also weeded the crop a third time in 1995, Table 5.11.

In 1985, no chemicals were reportedly used to control pests and diseases in sunflower. In 1990, Bravo and Karate were used. In 1995, four chemicals were used, i.e., Carbaryl, Bravo, Karate, and Pyrethroid. In general, very few farmers surveyed used chemicals. Only sprayers were used for applying the chemicals.

5.3.6 Sunflower Yields

Yields realized by the sample farmers were above the national average in all the years, but below the potential of some of the hybrids, such as the Pannar varieties, Table 5.12. There seemed to be a decline in yield in 1995, and this could be attributed to poor rainfall distribution during the 1994/95 season for those farmers growing sunflower without irrigation.

Table 5.12 YIELDS OF SUNFLOWER ATTAINED BY LARGE-SCALE COMMERCIAL FARMERS - SAMPLE FARMERS — 1985 - 1995

Yield (Kg/Ha)	Percent of Farmers		
	1985	1990	1995
< 1000	25.0	22.2	18.1
1000 - 1500	0.0	11.1	36.4
1501 - 2000	50.0	22.2	0.0
2001 - 2500	25.0	11.0	27.3
> 2500	0.0	33.3	9.1
Mean (Kg/Ha)	1,737.0	1,972.0	1,423.0

Source: Zimbabwe Farm Survey, 1996.

5.4 SUMMARY OF THE LARGE-SCALE COMMERCIAL SUNFLOWER GROWER MANAGEMENT PRACTICES

The average farm size for the sample farmers ranged between 76 - 2,500 hectares. The average area under sunflower was 33.7 hectares.

The survey results revealed that the respondents had grown sunflower for up to 12 seasons, suggesting that a considerable percentage had found the crop viable enough to warrant continued growing over the years.

About 60 percent of the sample farmers used improved varieties. Although the others also used improved varieties, they could not specify the exact variety. Ripping was the most commonly used land preparation method for sunflower. The seed rate used was within the recommended range. All respondents applied fertilizer to their sunflower crop. Although a few herbicides have been recommended, they were hardly used for weed control. Overall, sunflower management practices on large-scale commercial farms were in accordance with the recommendations.

The information obtained from the large-scale commercial farmers and the communal farming sector are used in assessing the socioeconomic impacts of sunflower R&D.

CHAPTER 6. IMPACT OF PAST SUNFLOWER RESEARCH, EXTENSION AND ENABLING ENVIRONMENT — 1966 - 2000

6.1 INTRODUCTION

Past investments in research and development programs of agricultural commodities have several impacts on society. These include changes in the enabling environment, sociocultural impacts, environmental impact as well as production and income effect on the target beneficiaries. The people level impact includes in addition to economic effects such things as changes in food security at all levels, gender relations and environmental implications that may not be easily captured in the calculation of the rate of return. This chapter analyzes the impacts associated with sunflower R&D activities in Zimbabwe.

6.2 PEOPLE LEVEL IMPACT - ECONOMIC IMPACT

The main focus of this section is on the calculation of the rate of return using a simple benefit - cost analysis which uses no elasticities. This involves estimation of benefits, and research and transfer costs.

6.2.1 Benefits

6.2.1.1 Deriving the "Without" Technology Scenario for Sunflowers

The first improved sunflower variety was released in 1985. Therefore, the first benefits from research would have been experienced in 1900. This accommodates for the four year period when the breeders lines are bulked. Some of these early varieties are still being grown. The mean of the average yields obtained during the period 1978/79 to 1985/86 were taken as the yields of the "without" the technology period. It was also assumed that the yields would have continued at this level in the without technology phase.

The difference between the average base yield and the actual yield at time t gave the incremental yield. In other words:

$$Yield_{It} = Y_{At} - Y_{Wt}$$

Where:

Y_{It} = *Incremental Yield at Time t*
Y_{At} = *Actual Yield in Time t*
Y_{Wt} = *Base Yield "Without" R&D Yield at Time t*

To get the incremental production, the incremental yield was multiplied by the area in time t. This was multiplied by the price to give the incremental value of production. Benefits for the communal and commercial sector farmers were estimated separately.

6.2.1.2 Calculating Research and Transfer Costs

Research and transfer costs can be broken into three classes i.e., research development costs, adoption costs and transfer costs. Research development costs include salaries and benefits, recurrent costs, overhead and administration, and depreciation.

For sunflower, research costs were incurred by the Department of Research and Specialist Services through the Agronomy Institute, Crop Breeding Institute and the Plant Protection Research Institute. Each of these institutes conducted research on a number of commodities including sunflowers. Their budgets for running experiments are not split between the constituent commodities they were responsible for. On the basis of advice from the researchers in these institutes the sunflower component for each institute was determined.

Salaries and allowances for each institute are not given separately but are included in the DR&SS allocation. To get each institute's component of salaries and allowances, the DR&SS allocation was multiplied by the proportion of the particular institutes' number of professional staff to the total number of professional staff in DR&SS. To get the institute's component going into sunflower, the above figure was multiplied as for running expenses in Table 6.1. The running expenses attributable to sunflower research for each institute was estimated using the procedure described in Table 6.1.

Table 6.1 METHODS USED FOR CALCULATING RUNNING EXPENSES FOR SUNFLOWERS IN DIFFERENT INSTITUTES

Institute	Method
Agronomy Institute	Proportion of the sunflower trials to the total number of trials conducted by the institute each year multiplied by total annual expenses for the institute
Crop Breeding Institute	Proportion of the number of technical and professional staff working on sunflowers to the total number of staff in the institute multiplied by total annual expenses for the institute.
Plant Protection Research Institute	Ten percent of the total annual expenses of the institute.

Source: Zimbabwe Impact Assessment Team.

6.2.1.3 Extension Costs

AGRITEX is the organization mainly involved in transferring technologies on sunflowers to farmers. As in the case of research costs, the extension costs are not broken down by commodity. The following steps were taken in estimating the annual extension budgets for sunflower during the period 1976 - 2000.

- The total AGRITEX budget was divided into livestock and crops budget using the ratio of value of crop production or livestock production to total value of agricultural production; and
- The crop budget was then multiplied by the ratio of the area under sunflowers to the total area under crop. This gave an estimate of the sunflower extension budget.

6.2.1.4 Adoption Costs

The adoption Percentage was multiplied by the estimate of the additional expenditure that had to be incurred when using the new technology and the total area under sunflowers. In addition it was assumed that small holder farmers would retain some of their crop for use as seed. Therefore, 10 percent of the area under improved technology was taken as having been planted to fresh seed.

6.2.1.5 Estimating Sunflowers Area and Yield Beyond 1996

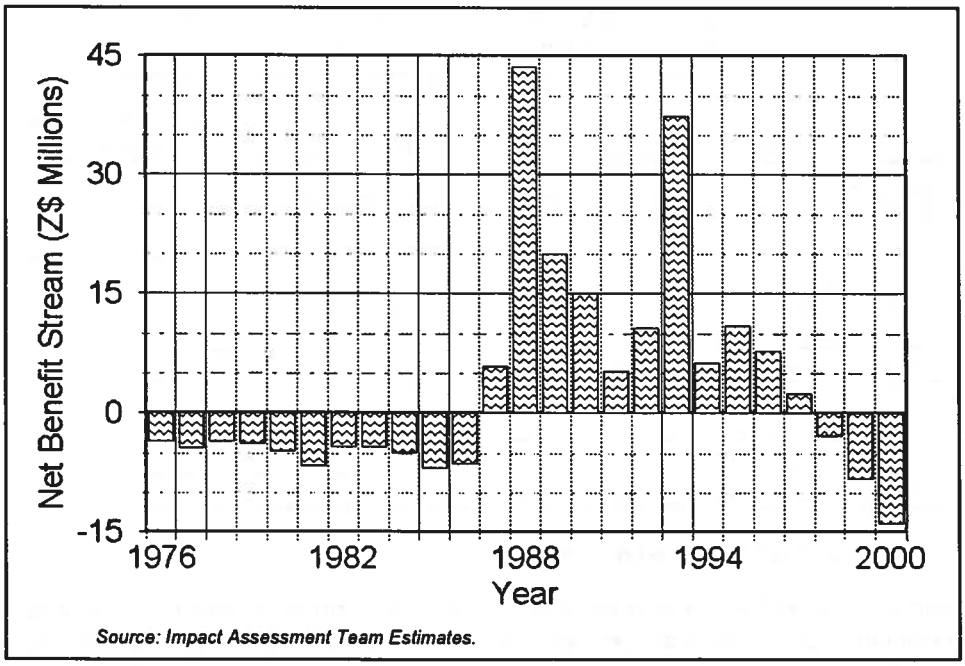
The area planted to sunflowers beyond 1996 was assumed to continue at the same level as 1996. This may underestimate the potential benefits of the R&D.

Yields beyond 1996 were computed using the average yield over the previous 5 years. This may be a conservative estimate, given the fact that farmers may increase the area under the improved varieties, thereby, raising the average yield.

6.2.1.6 Payoff to Investments in Sunflower Research and Development

Subtracting the research, extension, and adoption costs from the gross benefits gives the net benefits for the investment over the period, as shown in Figure 6.1 and Annex IV.

Figure 6.1 NET BENEFIT STREAM FROM SUNFLOWER R&D — 1976 - 2000



Source: Impact Assessment Team Estimates.

The best way to determine whether there was a payoff to the investments in sunflower R&D is to estimate the rate of return (ROR) and the net present value (NPV) of the net benefit stream. In this study, the social time preference rate of 10 percent was used to estimate the NPV of the income stream.

The estimated NPV for the investment at the 10 percent interest rate (real) was Z$ 5.33 million, as shown in Table 6.2. The associated IRR (ROR) for this investment is 12 percent. The result clearly indicates that the investments in sunflower R&D is profitable, although the rate of return is relatively low compared to the other crops (maize, cotton, soybean, and groundnuts) investigated in Zimbabwe. This is partly because of the fact that the breeding programs focused on developing varieties with higher oil content, but the pricing policy dit not reflect the oil content of the varieties.

6.2.1.7 Sensitivity Tests

Since in many instances in the absence of consistent data over the period, estimated values were used in the analysis. Thus, it is imperative to test the sensitivity of the estimated ROR for the key economic parameters. One of the key variables in the analysis is the research and extension cost. As mentioned in the previous sections, several agencies were involved in sunflower R&D activities, but the associated costs were not available. Therefore, it was decided to test the sensitivity of the results for a 25 percent increase in research and extension costs. When the costs were increased, the estimated IRR declined to 6 percent (Table 6.2). Accordingly, the NPV of the benefit stream at the 10 percent discount rate was found to be negative.

Table 6.2 ECONOMIC IMPACTS OF SUNFLOWERS RESEARCH AND DEVELOPMENT FOR VARIOUS SCENARIOS

Scenario	Net Present Value (10 Percent Discount Rate) (Z$ Millions)	Internal Rate of Return (Percent)
• Base Run	5.33	12
• Research and Extension Cost increased by 25 Percent	-ve	6
• Price Based on Oil Content Using Current Adoption Rate		
→ Oil Content Ratio 2.7 Percent	60.01	23
→ Oil Content Ratio 2.0 Percent	37.86	20
• Price Based on Oil Content Entire Area Under Improved Varieties		
→ Oil Content Ratio 2.7 Percent	119.97	29
→ Oil Content Ratio 2.0 Percent	72.13	24

Source: Zimbabwe Impact Assessment Team Estimates.

The survey revealed that two local varieties are very widely grown in the communal area. The most common variety used is an open pollinated black landrace, originating from the improved variety Peredovick, which was first introduced into the communal areas during the early 1960s. The variety originally had a 40 percent oil content, but the oil content of the present day landrace is around 20 percent. The second popular variety is a white striped landrace,

Russian White, the type that is used to feed birds in Europe and North America. The oil content of this landrace is around 10 percent. However, most of the improved varieties have an oil content of more than 40 percent, as shown in Table 2.3. As pointed out earlier, varieties were selected for oil content, but the farmers are being paid on the basis of weight. Therefore, there is no incentive for farmers to grow varieties with higher oil content, unless they are associated with higher yields.

There is a definite need to have a critical review of the pricing policy for sunflower. Given the current price, and the oil content of the landrace, price per unit of "oil" was determined. Assuming a ratio of 2.7 and 2 percent for the relative oil contents of the improved and "local" varieties, the net benefit stream, NPV, and ROR were estimated (Table 6.2).

Assuming the current rate of adoption of improved varieties (45 percent in the communal areas and 60 percent in the commercial area), the NPV and ROR were estimated for the two ratios. If the ratio of the oil content is assumed to be 2.7 percent, the estimated ROR was 23, and the corresponding NPV, using the 10 percent interest rate, was Z$ 60 million. When the ratio was decreased to 2 percent, the estimated ROR was 20, and the NPV, using the 10 percent interest rate, was Z$ 37.86 million. If one assumes the entire communal and commercial areas are under improved varieties (an extreme case), then for the oil content ratio of 2.7 percent, the estimated NPV, using the 10 percent interest rate, was Z$ 120 million, and the ROR 29 percent. When the oil content ratio was reduced to 2 percent, the ROR was 24, and the corresponding NPV, using the 10 percent interest rate, was Z$ 73 million.

Although the farm level profits were not estimated for this pricing scheme based on oil content, the results clearly show that the farm level profit can be much higher. This may also induce the farmers to increase the area under sunflower production, use improved seed, and purchased inputs in the production of sunflower.

6.3 INTERMEDIATE IMPACTS

Intermediate impacts focus on the ability of the research system to efficiently produce the research output. These are changes that occur in the enabling environment of TDT which can improve or worsen the efficiency and effectiveness of the research system. These include human resources development, availability of financial resources, changes in procedures and techniques, and the strengthening of linkages with the collaborating institutions.

6.3.1 Availability of Human Resources and Financial Resources

Availability of trained manpower and adequate funding on a sustainable basis are necessary pre-conditions to enhance the performance of any research system as well as to ensure institutional sustainability.

6.3.1.1 Human Resources

Research work in sunflower has traditionally been conducted by the government through the Crop Breeding and Agronomy Institutes of DR&SS, Other areas, such as entomology, pathology, and nematology, are covered by the Plant Protection Research Institute, while

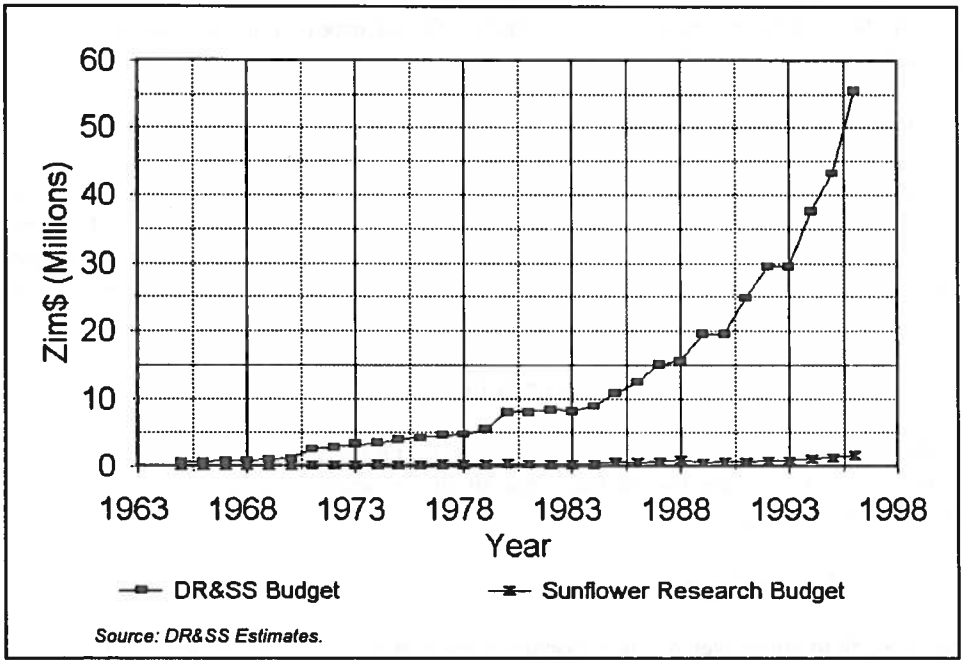
services in soil science are provided by the Chemistry and Soils Research Institutes. Adaptive research is conducted by the Farming Systems Research Unit.

The continuous brain drain, lack of adequately qualified research staff, and delays involved in approving frozen appointments, have contributed negatively to the performance of the research system in general. The departure of the sunflower breeder in January 1996 has affected the program significantly. Currently, the groundnut breeder is also handling sunflower. Similarly, the sunflower agronomist is currently responsible for the agronomic work in groundnuts. The number of on-farm trials on sunflower conducted by the FSRU has also declined over the years. Thus, it is very clear that the sunflower R&D programs did not significantly improve the staff allocation to sunflower research. Staff continuity in the maize breeding program (with 4 leadership changes between 1932 and 1988) has been cited as one of the important factors responsible for higher returns to hybrid maize research and extension (Kapfuma, 1992). Given the importance of sunflower in the communal area, as well as in the edible oil sector, attempts should be made to provide adequate human capital to sunflower research, and a multi-disciplinary research team should work on the various aspects of this crop.

6.3.1.2 Financial Resources

The budget for DR&SS and for sunflower research for the period of this analysis are shown in Figure 6.2.

Figure 6.2 DR&SS AND SUNFLOWER RESEARCH BUDGETS IN NOMINAL TERMS



In nominal terms, the budget for DR&SS has increased over time, but the sunflower research budget does not exhibit a corresponding increase.

6.3.2 Linkages with Other Organizations

Good collaboration and linkages between research, extension, NGOs, credit and marketing institutions, are important in contributing to the successful growth of sunflower production in Zimbabwe. Besides research in government departments, in the recent past sunflower research has been conducted by private companies. Interaction between researchers and processors is non-existent.

There are a number of NGOs working on establishing sunflower oil expressing technology in the rural areas. The first organizations that have been instrumental in the development of the small-scale expresser industry are Appropriate Technology International (ATI) through the Zimbabwe oil press project, Intermediate Technology Development Group (ITDG), and ENDA Zimbabwe.

There are strong linkages between DR&SS, seed companies, and the CFU. Despite the potential that exists for coordination and linkages among the various stakeholders in sunflower R&D, very little progress has been made in this area.

6.4 PEOPLE LEVEL IMPACT - OTHER TYPES

6.4.1 Environmental Impact

Sunflowers can be relatively successfully grown in the low rainfall areas of the natural regions. The majority of the communal farmers do not apply any fertilizers to sunflower. Thus, one could claim that this soil mining effect could have some negative impact on the soil.

On the other hand, sunflowers are a useful crop in areas where rainfall is marginal or where input costs for items like fertilizer, seed and insecticides are limiting. Sunflowers could be used as an alternative winter crop in areas where late frosts are not expected. In addition sunflowers are not affected by witchweed and are used to control this plant parasite in crop rotation. They provide an alternative crop where a wide rotation is necessary to control diseases in other crops, thus, reducing the amount of chemicals used in farming. In this context, given the increase in area under production, growing sunflowers has a positive environmental impact. In the absence of bio-physical data to conduct systematic analysis, it is impossible to assess the net environmental effect of the sunflower R&D..

6.4.2 Sociocultural Impact

Sunflower can be grown in marginal environments, are relatively quick maturing, and fit well in situations where the season has started late, or where the other crops have failed. Sunflowers can be planted as a secondary crop in the better rainfall areas when main crops have been planted and a farmer wishes to fully utilize the available land and machinery.

Sunflowers provide a ready source of nectar and pollen for bees, and an additional source of income can be derived from hives placed around sunflower crops. Thus, sunflower provides income for those who live and farm in the most vulnerable environment.

The communal area survey also revealed that in NR III, sunflower ranked 3rd as the main source of income, and in NRs II and IV ranked 4th and 5th, respectively, as a main source of income. As a secondary income source, sunflower emerged as the most important source in NR II, and was considered relatively important in NRs III and IV, as reported by 20 percent of the sample across the three regions. The main use of the income generated from sunflower was to purchase groceries in order to meet daily household needs, as reported by approximately 35 percent of the sample farmers in NRs II and IV. Thus, it can be concluded that sunflowers contribute to food security in a positive manner in the vulnerable areas of the communal farming sector.

In conclusion, investments in sunflower R&D are socially profitable. In addition, the crop contributes significantly in improving the food security in the most vulnerable farming areas in Zimbabwe. The environmental impact is inconclusive.

CHAPTER 7. MAJOR CONCLUSIONS, RECOMMENDATIONS AND LIMITATIONS OF THE STUDY

7.1 INTRODUCTION

Sunflowers have been grown at the Harare Research Station since 1912. However, the sunflower breeding program was officially established at Salisbury Research Station in 1975 as part of the oilseed breeding program. The main objective of this program was to develop cultivars that have the potential of producing high oil yields per unit area of land, under varying environmental conditions. From 1984, single cross hybrids were produced, since most of the inbred sunflowers were reasonably vigorous, and the resultant hybrids gave relatively high yields. The first three-way hybrid was produced and tested during the 1995/96 cropping season.

To date, only two locally bred hybrid cultivars are marketed in Zimbabwe. The first hybrid, Msasa, was released in 1985. A second hybrid, Mopane, was released during the 1990 season. In addition, a number of other hybrids, which were brought in by the international seed companies, are also available in the market.

Along with the varietal development, considerable research has been conducted to determine the appropriate management practices resulting in several agronomic recommendations. The agronomic recommendations are not variety specific, and are still blanket in nature.

As a part of the continuation of SACCAR's training on impact assessment methodologies, given the overall continuous decline in the budget of DR&SS, it was decided to look at the socioeconomic impacts of oilseed R&D activities in Zimbabwe. The specific objectives of this study are to describe and understand the existing sunflower production systems in Zimbabwe, to trace the evolution of research and the enabling environment with respect to sunflower technology development and transfer, to assess the impacts of sunflower research and the enabling environment, to conduct a preliminary analysis of the effects of recent market liberalization of the oilseed industry, and to assess the policy implications for future investments in research and the enabling environment. Both primary and secondary data were used in the analysis. Sunflower is grown by both communal and commercial sector farmers in Zimbabwe. Using a standard questionnaire and multi-stage sampling, information was collected from 224 communal farmers in Natural Regions II, II, and IV. Using a standard mail questionnaire, information was collected from the commercial farmers across the country. However, some of the data required for conducting the impact assessment (especially cost information) were not available, making it necessary to rely on various assumptions and estimates.

A comprehensive impact assessment of any agricultural R&D activity includes an effectiveness as well as an efficiency analysis. The various aspects of impact include production and income effects, environmental impact, intermediate impact, as well as socio-cultural impact. The effectiveness analysis looks at the direct product of R&D activities, and involves comparing achievements against quantified targets. This is only possible if the targets are clearly specified. In the absence of clearly specified targets (time dependent), it is extremely difficult, or impossible, to conduct an effectiveness analysis. In the case of the Zimbabwe sunflower

research program, goals and major objectives were laid out, but specific time dependent targets were not specified. Thus, the study concentrated on efficiency analysis, i.e., comparing the social costs and returns of the sunflower R&D investment.

A surplus approach was used to estimate the rate of return (ROR) to R&D investment. A simple benefit - cost analysis technique was used for ROR estimation. In addition to the rate of return analysis, a qualitative assessment of institutional, environmental, and sociocultural impacts of sunflower R&D investment was carried out. The results of the survey and the major conclusions of the study are presented in the following sections.

7.2 SURVEY RESULTS

The survey covered a total of 224 communal area farmers in Natural Regions II, III, and IV, and 16 commercial farmers across the country. The major results of the survey are:

7.2.1 Communal Growers

- A total of nine crops were grown by the communal area sample farmers during the 1995/96 season. Sunflower ranked as the third most grown crop, and is produced by half of the sample farmers in NR II, a quarter in NR III, and one-third in NR IV.

- As a primary source of farm income, sunflower ranked 4th in NR II and IV, and 3rd in NR III. As a secondary source of income, sunflower emerged as the second most in NR II, and ranked 3rd in NR IV and 5th in NR III. The income generated from sunflower was mainly used for purchasing groceries, agricultural inputs, clothes, and paying school fees.

- More than 70 percent of the communal farmers interviewed did not know the name of the cultivars they were growing. Peredovick, and its derivatives, are the most commonly grown traditional varieties. Of the improved varieties, the hybrid Masasa is grown by farmers across the three NRs, followed by Pannar varieties. Forty-five percent of the communal sector farmers are growing improved varieties.

- Sunflower appears to be a universally adopted crop among the communal area farmers. The land preparation and planting methods used by the communal sector farmers are in accordance with the recommendations. Communal farmers use almost 2½ - 3 times the recommended seed rate. The majority of the communal area farmers do not apply fertilizer (83 - 100 percent across the region). The most commonly used basal fertilizers are compounds D and L, and was applied either before or at planting. The majority of the sample farmers perform the first weeding between 2 and 4 weeks after emergence. There are variations in the number of subsequent weedings done across the regions and between seasons. Most farmers (80 percent in NR II, 95 percent in NR III, and 0 percent in NR IV) do not practice any pest and disease control measures for sunflower.

- The mean yield of sunflower ranged between 481 - 894 for improved varieties, and 514 - 682 for traditional varieties. Seed yields of traditional varieties are comparable to those of the improved varieties. This may be due to the poor management of improved

varieties. However, the oil content of the traditional varieties (15 - 20 percent) is much lower than that of the improved varieties (40 percent).

- Prior to 1995, most sunflower seed was marketed through the GMB. Currently, there is a significant drop in the proportion of the communal farmers marketing sunflower through the GMB.

- Less than 10 percent of the communal farmers are aware of the recent market liberalization.

- Ninety-eight percent of the sample farmers surveyed across the NRs, did not use any credit for sunflower production. Very few seasonal loans are provided by AFC for crops other than maize and cotton. Over 60 percent of the farmers surveyed in all three NRs belong to farmer extension groups. The entire sample in NRs II and IV, and only 27 percent in NR III, seek extension advice on sunflower production. The major source of extension advice is AGRITEX.

7.2.2 Commercial Growers

- For the large-scale commercial farmers, the average area under sunflower was 33.7 hectares during the 1995/96 season.

- The improved varieties used by the large-scale commercial farmers are PNR 7369, Hysum 33, Mapone, and Masasa. About 60 percent of the sample farmers are growing improved varieties.

- The average seed rate used is 5.5 kilograms per hectare. Compounds D and L are the commonly used basal fertilizers, and the fertilizer rate ranged between 175 kilograms to 350 kilograms per hectare, with 80 percent of the farmers applying more than 250 kilograms per hectare. Ammonium nitrate is the commonly used fertilizer for top-dressing. The application rate for most farmers ranged between 100 - 300 kilograms per hectare. All sample farmers seemed to be following the recommendation for weed control. In general, very few farmers used chemicals to control pests and diseases. Overall, sunflower management practices followed by commercial farmers were in accordance with the recommendations.

- A greater proportion of the sample commercial farmers growing sunflower market their sunflower in compounds. Thirty-nine percent of the sample farmers are aware of the changes in marketing arrangements. Fifty percent of the respondents stated that the market liberalization will not affect the area under sunflower production.

- Thirty-six percent of the commercial farmers use credit for sunflower production. The major sources of credit (90 percent) are the banks, followed by AFC.

- Most of the commercial farmers obtained advice from other farmers (58 percent) and chemical companies (42 percent). Only 8 percent obtained advice from DR&SS and AGRITEX.

- The average yields obtained by the sample commercial farmers are above the national average reported, but below the potential realized at research stations. The average yield for the 1995/96 season was 1,423 kilograms per hectare, and 32 percent of the sample farmers realized a yield level of over 2 metric tons per hectare. The yield level obtained during the 1995/96 season was less than the previous year which may be due to poor rainfall distribution.

7.3 IMPACT ASSESSMENT RESULTS

- The estimated ROR for sunflower R&D investment in Zimbabwe over the years 1976 to 2000 is 12 percent. The net present value of the investment at the 10 percent discount rate is Z$ 5.33 million. Given the social time preference rate of 10 percent (real), the investments in sunflower R&D are socially profitable.

- When the research and extension cost was increased by 25 percent, the estimated ROR declined to 6 percent, indicating that the estimated ROR is very sensitive to changes in research costs.

- Using current adoption rates of improved varieties, if the pricing is based on oil content, the rate of return for the investment increased up to 20 (for the oil content ratio of 2) and 23 percent (for the oil content ratio of 2.7). Correspondingly, the estimated NPV at the 10 percent discount rate increased up to Z$ 60 million. If one assume the entire area under improved varieties and pricing based on oil content, then the rate of return increases up to 29 percent and 24 percent, respectively, for the oil content ratios of 2.7 and 2.0. The corresponding NPVs for the investment at the 10 percent discount rate are Z$ 120 million and Z$ 72 million.

- In terms of intermediate impacts, the available financial and human resources for sunflower research did not increase significantly. On the contrary, the human resources had declined over time due to the continuous brain drain and staff mobility. There are strong linkages between DR&SS, seed companies, and the CFU. Despite the potential that exists for coordination and linkages among the various stakeholders in sunflower production, marketing, and processing, very little progress has been made in this area.

- The environmental impact of sunflower production is difficult to estimate. The crop is grown in the marginal, low rainfall environment with very little added input, thus having a negative impact on soils. Sunflowers are also used in crop rotations to control witch weed and reducing the incidence of pests and diseases, thus, having a positive impact on the environment. In the absence of bio-physical data to conduct systematic analysis, it is difficult to assess the net environmental effect of the sunflower R&D.

- Since the crop is grown successfully in the marginal environment, and the income generated is used to purchase groceries to meet the daily needs of the households in the natural regions, it has a significant positive impact on food security.

7.4 CONCLUSIONS AND IMPLICATIONS

Major conclusions and implications of the impact assessment study are:

- Sunflower appears to be a universally adopted crop in the communal areas across all three natural regions. The area under sunflower has increased substantially over the years. The production potential of the available improved varieties is much higher than the average yields obtained by the communal farmers. The farmers consider it to be a "scavenger crop", thus use very little purchased inputs. The adoption of improved varieties and better management practices can substantially improve the productivity and overall production of sunflower in the communal farming sector. There is a need for on-farm testing of improved agronomic practices in order to identify and recommend the appropriate critical crop management practices to fit the socioeconomic conditions of the specific target groups.

- Currently, the selection of varieties is based on oil content, but pricing is based on weight and not on oil content. Therefore, there is no incentive for the farmers to use improved varieties. If the pricing was based on oil content, then this will provide an incentive for the farmers to use the improved varieties and better crop management practices. If the pricing is based on oil content, based on the current level of adoption, the ROR for the R&D investment is almost doubled, and the relative profitability of the crop at the farm level will improve significantly. Therefore, there is a critical need for reviewing the pricing policy of sunflower.

- Given current pricing policy of sunflower, future breeding work should target for both higher yield and oil content. Given the low level of input use, "N" use efficiency can also be a criteria in breeding and selection.

- With the emergence of the seed companies as alternative sources of improved varieties, there is also a need to critically examine the role of the public sector, private sector, and NGOs in sunflower R&D in Zimbabwe.

- The main lesson from the various impact studies conducted so far is that an *ex-post* impact assessment is difficult if no mechanism is in place to collect the relevant data on a continuous basis, i.e., a monitoring and evaluation system for R&D activities. It is also clear that the usefulness of the *ex-post* impact studies are limited, and the greatest benefit of impact assessment can only be realized if it is used as a planning tool, i.e., *ex-ante* analysis. Thus, DR&SS should seriously consider establishing a monitoring and evaluation system for research in order to facilitate effective planning, priority setting, and impact assessment.

7.5 LIMITATIONS OF THE STUDY

This study has several limitations which should be considered when interpreting the results and the accompanying recommendation. The limitations are related to the availability and quality of data used in this assessment because the sunflower R&D programs were designed without due consideration for the need to collect information to be used for impact assessment. Given

the data problems and techniques used, it was difficult to separate the effects of the different components of sunflower R&D.

- The yield levels without sunflower R&D, which are important in the calculation of benefits, had to be estimated. Given the absence of baseline data, the process was extremely difficult. Extrapolations and opinions of key informants were used to calculate the "without" technology yield levels.

- The response from the mail survey was much lower than expected, this reduces the level of confidence in interpreting the results for the commercial farming sector. There could be a bias resulting from self-selection.

- The absence of appropriate data made it impossible to adequately assess the impact of sunflower R&D on the environment, gender, employment, and food security.

- Because of the changes occurring within the oilseed industry and in the country of Zimbabwe as a result of ESAP which is now going into phase II as ZIMPREST, future impact of sunflower R&D is difficult to predict

Despite these limitations the study is still useful in providing information on the current production practices followed by both large-scale commercial farmers and smallholder farmers in Zimbabwe. The sunflower production in the communal farming sector is on the increase, and the results of this study clearly indicate that the ROR on past investments in sunflower R&D in Zimbabwe is attractive enough to warrant more investment. Farm level ans social profitability could be substantially improved, if pricing is based on oil content.

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ANNEXES

ANNEX I

OILSEEDS SURVEY
QUESTIONNAIRE FOR COMMERCIAL FARMERS

Impact Assessment of Oilseeds Research and the Enabling Environment in Zimbabwe: 1975 - 1996

October 1996

(Questionnaire for Large Scale Commercial Farmers: Groundnuts Growers)

Department of Research and Specialist Services,
P. O. Box CY 594
Causeway
Harare

Name of Farmer/Farm _____
_____
_____

Location _____

Natural Region (Encircle) IIa; IIb; III; IV; V.

Description of Production Systems

1) Characteristics of the Farm

Total Size of Farm _____(Hectares)

Which crops were grown on the farm in **1995/96** and what area (in Hectares) was grown to each?

Maize	_____	Groundnut	_____
Sunflower	_____	Soybeans	_____
Sorghum	_____	P. Millet	_____
Bambaranuts	_____	Rapoko	_____
Cotton	_____	Tobacco	_____
Other (Specify)	_____	_____	

2) How many of the following implements do you own?

Tractors (Working)	_____	Ploughs	_____
Cultivators	_____	Ridgers	_____
Harrows	_____	Planters	_____

Other Implements: (Specify) _____

Do you hire any equipment? Yes ___ No___.
If yes, which equipment do you hire? (Select code given below) _____

Equipment code: *Tractor = 1; Plough= 2; Cultivators= 3; Ridgers= 4; Harrows= 5; Planters=6:*
Other Implements (Specify) _____

3. INCOME

What farming enterprise is the main source of farm income? _____
1 = Maize; 2=Groundnut; 3=Sunflower; 4 = Soybeans; 5= Sorghum; 6 = P. MILLET; 7= Bambaranuts; 8 = Rapoko; 9 = Cotton; 10 = Tobacco, 11 = Livestock; 12 = Poultry

What are the other sources of income?_____
1 = Maize; 2=Groundnut; 3=Sunflower; 4 = Soybeans; 5= Sorghum; 6 = P. MILLET; 7= Bambaranuts;
8 = Rapoko; 9 = Cotton; 10 = Tobacco, 11 = Livestock; 12 = Poultry;
13 = Other source (Specify) _____

4) Cultural Practices in Sunflower Production

Operation	1985	1990	1995
Method of land preparation			
Planting method			
Variety			
Seed rate			
Basal fertilizer: Type			
Amount (per hectare)			
Time of application			
Method of application			
Top Dressing: Type			
Amount (per hectare)			
Time of application			
Method of application			
Weeding:Time of first			
No. Of subsequent weedings			
Pest and disease control: Type			
Amount applied			
Time of application			
Method			
Average Yield (kg/Ha)			

5) Details of oilseed production

Were you already growing the following crops by 1975?
If not, when did you start growing the following crops?

Crop	Grown before 1975	Year started
Groundnuts	_____	_____
Sunflower	_____	_____
Soybeans	_____	_____

6. Labor

What is the size of your labor force? Permanent_____ Casual _____

Do you experience any shortage of labor during crop production? Yes ___ No____

If yes, in what crop and operation does the shortage occur?

Crop	Operation
----------	----------
----------	----------
----------	----------

Crop code: *1 = Maize; 2=Groundnut; 3=Sunflower; 4 = Soybeans; 5= Sorghum; 6 = P. MILLET; 7= Bambaranuts; 8 = Rapoko; 9 = Cotton; 10 = Tobacco,*

Operation code: *A =Land preparation; B = Basal fertilizer application; C = Top Dressing application; D = Pest and disease control; E = Weeding; F = Harvesting*

7) Marketing

Where did you sell the following crops:

CROP	In 1996	In 1995	Previous Years
Groundnuts			
Sunflower			
Soybean			

For each of the oilseed crops, are you going to continue selling to the same outlet as in 1996? Please explain why.

Crop	Yes/No	Reason for changing/not changing
Groundnut	_____	_____
Sunflower	_____	_____
Soybean	_____	_____

Are there any changes in rules and regulations for crop marketing that you are aware of?
Yes ____ No_____

If yes, what do you know about the changes?

_____

_____

Are these changes going to have any effect on area planted to the following crops:

Crop	Yes/No	Change	
		Increase	Decrease
Groundnuts			
Sunflower			
Soybeans			

8) **Support services**

a) **Credit**

Do you use credit to purchase inputs into the following crops?

Groundnuts Yes/No
Sunflower Yes/No
Soybeans Yes/No

If yes,

	Groundnut	Sunflower	Soybean
For how long has credit been used?	_____	_____	_____
Source of credit	_____	_____	_____

Are you able to pay back the credit each season? Yes ____ No ____.

Are you satisfied with the services you get from the credit Institutions? Yes ____ No _____

Please explain._____

If not, why? _____

If using credit and aware of changes in marketing rules and regulations, do you think the liberalization will affect the availability of credit?
(Yes/No)

Explain

_____

Do you think the liberalization will affect the cost of credit? (Yes/No)

Explain _____

b) **Extension**

Do you get advice for growing the following crops from any of the listed sources? (Tick the appropriate)
Are you satisfied with the extension services provided to you? Yes/No

	Groundnuts	Sunflower	Soybeans	Satisfaction
AGRITEX	_____	_____	_____	_____
Chem Companies	_____	_____	_____	_____
NGO	_____	_____	_____	_____
DR & SS	_____	_____	_____	_____
Other Farmers	_____	_____	_____	_____
Others (Specify)	_____	_____	_____	_____

OILSEEDS SURVEY
QUESTIONNAIRE FOR COMMUNAL FARMERS

Impact Assessment of Oilseeds Research and the Enabling Environment in Zimbabwe: 1975 - 1996

September 1996

(Questionnaire for Communal Farming Sector)

Department of Research and Specialist Services,
P. O. Box CY 594
Causeway
Harare

Name of Farmer/Farm _____
Village _____
District _____

Natural Region IIa; IIb; III; IV; V.

Date of interview _____

Interviewer _____

Description of Production Systems

1) Characteristics of the Farm

Total Size of Farm _____
(Hectares/Acres, Please Specify)

Which crops were grown on the farm in **1995/96** and what area was grown to each?

Crops	Area (specify units).
Maize	_____
Groundnut	_____
Sunflower	_____
Soybeans	_____
Sorghum	_____
P. Millet	_____
Bambaranuts	_____
Rapoko	_____
Cotton	_____
Tobacco	_____

2) Resource endowments

How many cattle do you own? _____
Of these how many are used for draught power _____

Do you own any donkeys? Yes____ No ____

Of these how many are used for draught? _____

Are your draught animals adequate for your requirements? Yes____ No ____
If not, how do you make up for the shortage?
1 = Sharing; 2 = Hiring; 3 = Borrowing

Which implements do you own?

Implements:	Number owned
Tractors (Working)	_____
Ploughs:	_____
Cultivators:	_____
Ridgers:	_____
Harrows:	_____
Planters:	_____
Other Implements: (Specify)	_____

Do you hire any equipment? Yes ___ No___.
If yes, which equipment do you hire? _____

Do you borrow any equipment? Yes ___No ___.
If yes, which equipment do you borrow? _____

Equipment code: *1 = Plough; 2 = Cultivators; 3 =Ridgers; 4 = Harrows; 5 = Planters:*
Other Implements (Specify) _____

3. **INCOME**

What farming enterprise is the main source of farm income? _____
1 = Maize; 2=Groundnut; 3=Sunflower; 4 = Soybeans; 5= Sorghum; 6 = P. MILLET; 7= Bambaranuts; 8 = Rapoko; 9 = Cotton; 10 = Tobacco, 11 = Livestock; 12 = Poultry

What are the other sources of income?_____
1 = Maize; 2=Groundnut; 3=Sunflower; 4 = Soybeans; 5= Sorghum; 6 = P. MILLET; 7= Bambaranuts; 8 = Rapoko; 9 = Cotton; 10 = Tobacco, 11 = Livestock; 12 = Poultry 13 =Remittances; 14 =Off-farm Income; 15 = Other source (Specify) _____

In average years, do you normally produce adequate food for your family? Yes ___ No___.
If not, how do you make up for the deficit? Explain.

_____

What is the main **use** of your income from the following crops mainly used for?

Crop	Main use
Sunflower	_____
Groundnut	_____
Soybeans	_____

Use code: 1 = Household daily requirements, 3 = School fees, 4 = Clothing; 2 = Agricultural inputs

4) **Details of oilseed production**

Were you already growing the following crops by 1975?
If not, when did you start growing the following crops?

Crop	**Grown before 1975**	**Year started**
Groundnuts	_____	_____
Sunflower	_____	_____
Soybeans	_____	_____

5) Cultural Practices in Groundnut Production

Operation	1985		1990		1995	
	Traditional	Improved	Traditional	Improved	Traditional	Improved
Method of land preparation						
Planting method						
Variety						
Seed rate						
Basal fertilizer: Type						
Amount (per hectare)						
Time of application						
Method of application						
Top Dressing: Type						
Amount (per hectare)						
Time of application						
Method of application						
Weeding:Time of first						
No. Of subsequent weedings						
Pest and disease control: Type						
Amount applied						
Time of application						
Method						

6) Cultural Practices in Sunflower Production

Operation	1985		1990		1995	
	Traditional	Improved	Traditional	Improved	Traditional	Improved
Method of land preparation						
Planting method						
Variety						
Seed rate						
Basal fertilizer: Type						
Amount (per hectare)						
Time of application						
Method of application						
Top Dressing: Type						
Amount (per hectare)						
Time of application						
Method of application						
Weeding:Time of first						
No. Of subsequent weedings						
Pest and disease control: Type						
Amount applied						
Time of application						
Method						

7) Cultural Practices in Soybean Production

Operation	1985		1990		1995	
	Traditional	Improved	Traditional	Improved	Traditional	Improved
Method of land preparation						
Planting method						
Variety						
Seed rate						
Basal fertilizer: Type						
Amount (per hectare)						
Time of application						
Method of application						
Top Dressing: Type						
Amount (per hectare)						
Time of application						
Method of application						
Weeding:Time of first						
No. Of subsequent weedings						
Pest and disease control: Type						
Amount applied						
Time of application						
Method						

Which method did you use to transport the following crops to the marketing point?

Groundnuts _____
Sunflower _____
Soybean _____

Method: 1= Scotchcart,; 2 = Lorry; 3 = Wheelbarrow; 4 = Bus

What problems do you experience when transporting your oilseed crops to the marketing point? _____
*1= Shortage of Transport,; 2 = Transport too expensive; Other (Specify)*_____

For each of the oilseed crops, are you going to continue selling to the same outlet as in 1996? Please explain why.

Crop	Yes/No	Reason for changing/not changing
Groundnut	_____	_____
Sunflower	_____	_____
Soybean	_____	_____

Are there any changes in rules and regulations for crop marketing that you are aware of? Yes ____ No_____

If yes, what do you know about the changes?

_____
_____

Are these changes going to have any effect on area planted to the following crops:

Crop	Yes/No	Change		
		Increase	Same	Decrease
Groundnuts				
Sunflower				
Soybeans				

10) **Support services**

a) **Credit**

Do you use credit to purchase inputs into the following crops?

Groundnuts Yes/No
Sunflower Yes/No
Soybeans Yes/No

If yes,

	Groundnut	Sunflower	Soybean
For how long has credit been used?	_____	_____	_____
Source of credit	_____	_____	_____

Are you able to pay back the credit each season? Yes ____ No _____.

Are you satisfied with the services you get from the credit Institutions? Yes ____ No _____

Please explain._____

If not, why? _____

If using credit and aware of changes in marketing rules and regulations, do you think the liberalization will affect the availability of credit?
(Yes/No)

Explain

_____

Do you think the liberalization will affect the cost of credit? (Yes/No)

Explain _____

b) **Extension**

Do you get advice for growing the following crops from any of the listed sources? (Tick the appropriate)

	Groundnuts	Sunflower	Soybeans
AGRITEX	_____	_____	_____
Chem Companies	_____	_____	_____
NGO	_____	_____	_____
DR & SS	_____	_____	_____
Other Farmers	_____	_____	_____
Others (Specify)	_____	_____	_____

Are you a member of extension training group? Yes ___ No ____

If not, what are your reasons for non-membership?

_____

If yes, how often do you receive advise from extension agents?

_____

Are you satisfied with the extension services provided to you? Yes ___ No ____

Do you seek extension advice or it is brought to you? _____

c) **Farmer organization**

Are you a member of the Zimbabwe Farmers Union? Yes/No
If not, why? _____

If yes, what assistance do you receive from this organization with respect to production of oilseeds?

_____

_____

11) **Family size**

Size of the family available for farming

	Males	Females
Adults (Above 15 yrs)	_____	_____
Children	_____	_____
Permanent Workers	_____	_____

Characteristics of the person who makes decisions about farming on the farm

Who makes decisions about farming on the farm? _____
Age of decision maker _____
Sex _____
Highest educational level attained _____

{Thank the farmer}

ANNEX III Table 1 NATIONAL SUNFLOWER PRODUCTION STATISTICS -- 1979 - 1996

Year	Area (Ha)	Production (Tonnes)	Average Yield (kg/ha)
1979	24,888	9,270	372
1980	24,910	10,972	433
1981	24,804	12,676	379
1982	27,691	8,952	323
1983	16,156	3,373	209
1984	38,475	8,770	228
1985	35,719	18,106	507
1986	38,400	18,360	478
1987	86,646	26,026	300
1988	107,637	64,713	601
1989	124,416	60,814	489
1990	139,065	63,990	460
1991	149,931	63,963	427
1992	135,291	19,503	144
1993	139,720	67,650	484
1994	117,800	48,620	413
1995	139,600	22,160	159
1996	108,200	50,600	468

Source: CSO, 1996.

Annex III Table 2 SMALLHOLDER SECTOR GROUNDNUT PRODUCTION STATISTICS -- 1979 - 1996

Year	Area (Ha)	Production (MT)	Average Yield (Kg/Ha)
1979	20,000	7,000	350
1980	20,000	8,000	400
1981	22,000	11,000	500
1982	25,000	7,500	300
1983	12,313	2,424	197
1984	32,821	6,753	206
1985	31,249	16,065	514
1986	34,700	16,400	473
1987	74,620	21,120	283
1988	91,806	54,330	592
1989	114,072	54,057	474
1990	130,000	59,000	454
1991	140,000	59,000	421
1992	126,279	17,536	139
1993	134,800	61,650	457
1994	116,800	47,620	408
1995	131,800	19,800	408
1996	103,500	46,700	408

Source: CSO, 1996.

Annex III Table 3 LARGE-SCALE COMMERCIAL SECTOR GROUNDNUT PRODUCTION STATISTICS -- 1979 - 1996

Year	Area (Ha)	Production (MT)	Average Yield (Kg/Ha)
1979	4,888	2,270	464
1980	4,910	2,792	569
1981	2,804	1,676	598
1982	2,691	1,452	540
1983	3,843	949	247
1984	5,654	2,017	357
1985	4,470	2,041	457
1986	3,700	1,960	530
1987	12,026	4,906	408
1988	15,831	10,383	656
1989	10,344	6,757	653
1990	9,065	4,990	550
1991	9,931	4,963	500
1992	9,012	1,967	218
1993	4,920	6,000	1,220
1994	1,000	1,000	1,000
1995	7,800	2,360	303
1996	4,700	3,850	819

Source: CSO, 1996.

ANNEX IV Table 1 BENEFIT AND COST STREAM FROM SUNFLOWER R&D -- 1976 - 2000

Year	Z$ (Millions)		
	Gross Benefits	Total Costs	Net Benefits
1976	0.000	3.423	-3.423
1977	0.000	4.307	-4.307
1978	0.000	3.450	-3.450
1979	0.000	3.777	-3.777
1980	0.000	4.840	-4.840
1981	0.000	6.586	-6.586
1982	0.000	4.236	-4.236
1983	0.000	4.169	-4.169
1984	0.000	4.921	-4.921
1985	0.000	6.835	-6.835
1986	0.000	6.279	-6.279
1987	15.605	9.722	5.883
1988	56.079	12.528	43.551
1989	33.010	12.944	20.066
1990	27.470	12.451	15.019
1991	17.748	12.520	5.228
1992	22.287	11.697	10.589
1993	46.084	8.730	37.354
1994	14.065	7.718	6.347
1995	22.284	11.280	11.003
1996	18.191	10.301	7.890
1997	14.850	12.391	2.459
1998	12.122	14.949	-2.826
1999	9.896	18.082	-8.186
2000	8.078	21.920	-13.842

Source: Impact Assessment Team Estimates.

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