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RESEARCH, DEVELOPMENT AND INNOVATION (RDI) UNIT  
DP/ZAM/90/010  
REPUBLIC OF ZAMBIA

Technical report: Agronomy subsector\*

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by the United Nations Industrial Development Organization,  
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## 0.0 ABSTRACT

The present Technical Report analyzes the present situation in agriculture in Zambia. Trends and objectives of the two major subsectors, crops and livestock production, are explained, and links between inputs and outputs of ZIMCO/INDECO subsidiaries and non-ZIMCO companies and institutions are explored.

Formulation of an R & D Unit in the sector of agriculture has been proposed. The main elements of the RDU's activities in the sphere of agronomy/agriculture are

- to maintain a balanced program of research, development, and innovation in technology supported on the basis of scientific excellence and relevance to the agricultural and food industries;
- through this research, to provide technical support and options for the agricultural, food, and related industries and to meet both national and ZIMCO/INDECO objectives; and
- to apply the research and technology transfer base to the wider use of biological resources.

This Technical Report is an integral part of the Terminal Report "Assistance to ZIMCO RDI".

## 1.0 INTRODUCTION

Technology is knowledge. It is built into tools and other capital equipment; it is embodied in manufactured products and it is part of the skills which farmers, farm suppliers, and agricultural products processors bring to their professions and enterprises. But knowledge unused adds nothing to the output of goods and services people consume.

Agricultural progress has been founded upon the application that depends on not just whether the techniques are productive, but also includes an assessment of the economic costs and returns to innovation, and the availability convenient to the innovator of the full array of component pieces of the technical package, an availability that reflects the organization of farm supply channels, the operations of a credit system, the availability of transport, the access to product markets, and so on.

The economic and organizational feasibilities of applying a technical innovation in the production process depend on expected prices and markets and the decisions of industry and government. It depends too on the capacity of a national economic infrastructure to handle the delivery of factors of production and to make effective the demand for the product. In many, if not most, developing countries, the economic and organizational feasibilities of innovation are the factors severely limiting the useful adaptation of modern agricultural technologies. In Zambia, ZIMCO/INDECO's farms are an exception because they can adopt modern agricultural technologies.

Traditional rural farmers find it difficult to accept new technology, inasmuch as it alters their style of living. In contrast to this, the group usually called the small-scale farmers, initiated by the "Global 2000" project, is willing to alter their life style and these people are capable of rapidly adapting to the conditions of productive farming, accepting instruction from the extension service. For these reasons, it appears wise that all forms of development of agriculture in Zambia are worth supporting. Consequently, this is where ZIMCO/INDECO also have a wide scope of potential influence.

Also, ZIMCO/INDECO and their subsidiaries have (and have started exploiting) a wide field of development of commercial farms, i.e., those farms which can adapt and master new technologies most rapidly.

This report is devoted to the task of advancing this process through identification of potential new projects and links and through the activity of the new Research & Development Unit (RDU) being set up at ZIMCO/INDECO.

## 2.0 ANALYSIS OF PRESENT SITUATION IN AGRONOMY

### 2.1 Zambia

There are 75 mln hectares of the country's total land, 41 mln hectares are suitable for agriculture, but only 1.4 mln hectares are cropped annually. Over 10 mln hectares are available for grazing<sup>1</sup>.

#### 2.1.1 Agricultural sector

The 1989-90 season was generally unfavorable for crop production throughout the country. The significant rainfall deficits adversely affected area planted and yields. The problem was exacerbated by poor supply of inputs. There was a shortage of both basal and dressing fertilizers due to late arrival of fertilizer imports. Cooperative Unions also lacked transport to get inputs to farmers in time.

Other economic variables such as the availability and adequacy of credit, and efficiency of marketing services also adversely affected the performance of the crops and the livestock branch. Timing of announcement of preplanting prices and determination by farmers of the adequacies of such prices were also crucial, it determining the area planted.

Growth prospects are overshadowed by likelihood of a not very good agricultural season, continuing high oil prices and lower copper prices, and GRZ will be glad to achieve its target of a 3 per cent rise in GDP. A poor agriculture season has led to another year of recession in 1990. The Gulf crisis has been putting pressure on the reform program. The budget emphasizes stability and economic liberalization. The budget projects a substantial cut in the deficit to just under ZMK 1,200 mln. The deficit is to be financed by ZMK 67 mln in domestic non-bank borrowing and ZMK 1.12 mln in external borrowing. Total external borrowing was projected to be about ZMK 3.3 bln, with a balance of some ZMK 2.2 bln being used to make repayments to the bank systems. There would be no borrowing from the banking systems in

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<sup>1</sup> data from the Ministry of Lands, Water and Natural Resources



1991, in order to reduce money supply growth<sup>2</sup>. Subsidies are expected to decline significantly in real terms, thanks to the recent moves to liberalize maize marketing and reduce the retail price of maize meal.

The livestock branch was similarly adversely affected by the unfavorable weather conditions. Cattle in dry parts did not have sufficient forage for feeding. Also diseases such as Foot and Mouth, Corridor, East Coast Fever etc. affected this group of livestock production. Lack of transport affected diseases control measures<sup>3</sup>.

Poultry production was affected by diseases too, and by shortage and poor quality of stockfeed. It is not clear how unfavorable weather affected the production of sheep, goats and pigs. Pigs production like that of cattle and poultry was affected by the shortage and poor quality of stockfeeds.

Fish consumption is reported to decline as a result of population growth.

According to Ministry of Finance the drought conditions which began late in growing season (February) had caused a drop in yields for most crops.

Since the agricultural sector depends heavily on rainfall, any shortfall in rains adversely affects both crop and livestock production. Until irrigation facilities are well developed, agricultural output will continue to be heavily dependent on rainfed cultivation with due susceptibility to variable weather. Weather factors were mainly responsible for the decline in the area under crop production and yields.

As for the future, it is necessary that more concerted effort be made to develop irrigation facilities and to have buffer stocks which will shield the nation against adverse conditions. Research efforts to develop drought resistant, disease and resistant, early maturing varieties should also be intensified. Extension staff should also be active in informing the farmers especially in drought prone areas of the use of appropriate seeds and farming practices. Institutional support services such as credit, pricing policies, and timely supply of inputs (seeds, fertilizers), or permanent culture have to be improved.

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<sup>2</sup> Zambia Country Report No. 1 (1991)

<sup>3</sup> Economic Report (1990)

### 2.1.2 Companies and institutions

These include ZIMCO/INDECO subsidiaries, non-ZIMCO companies, and various institutions. Prominent are

- Ministry of Agriculture,
- Ministry of Cooperatives,
- Mount Makulu Research Station (improving new varieties of food and cash crops),
- UNZA - School of Agricultural Science & School of Veterinary,
- NCSR (coordination of research in agriculture, food technology, livestock and pesticides and forestry),
- Zambian Bureau of Standards,
- Mulungushi Investments (ranching and dairy),
- National Commission for Development Planning (taking care of nationwide planning and coordination).

## 2.2 ZIMCO and INDECO

A complete list of subsidiaries is given, and the situation at selected subsidiaries is analyzed.

### 2.2.1 List of subsidiaries

ZIMCO subsidiaries and associate companies involved in or bordering on the agricultural sector are listed in Annex A-1.

### 2.2.2 Analysis of selected subsidiaries

During the UNIDO mission to Zambia under the ZIMCO Technology Audit project (also referred to as the first mission) and during the field mission under the present project (referred to as the second mission), a member of ZIMCO/INDECO subsidiaries were analyzed as to their performance and agro-related R & D. Those companies already covered under the ZIMCO Technology Audit (1989) are treated here in only the briefest outline.

#### KAWAMBWA TEA COMPANY LIMITED (KTC) (first mission).

Major constraints in tea development include:

- (a) problems in the management of the estate;

- (b) insufficient local and foreign financial resources;
- (c) low yields;
- (d) high incidence of termite infestation after planting;  
and
- (e) insufficient water for irrigation.

MPONGWE DEVELOPMENT COMPANY LIMITED (MDC) (first mission).

Coffee plantation is on high level and coffee processing is of high quality, so the product is sold at world market prices. The farm switched to sorghum instead of mealie meal maize but encountered financial difficulties. The production of flowers, seed maize and other seeds, and potatoes is satisfactory.

It is recommended that for field crops, each new element being introduced should be evaluated according to large scale field trials before it is applied into the crop system. This includes new varieties, new pesticides, data of sowing, rate of fertilizer, timing and rate of irrigation.

ZAMBIA CASHEW COMPANY(ZCC) (first mission)

The cashew nut trees as a rule start producing within four years, but trees planted in 1987 have not yet started producing economic yields. The processing depended on the 39,000 old trees in 1989. The processing capacity of the plant is therefore not met forcing the company to import raw cashew from Malawi.

The recommendation is to

- further evaluate small scale processing techniques for full control of enlarged processor required by 1992;
- establish improved varieties in large scale quantities to expand and sustain the development;
- evaluate CNSL byproduct for the market;
- evaluate waste cashew apple for new product (soft drink).

Most of cashew trees showed signs of pest and disease attack due to inadequate extension services to small scale farmers. The neglect was also due to the absence of an organized market for the raw nuts. ZCC has established these marketing facilities. The establishment of grades and improvement of seedlings and spraying provide new incentives.

NATIONAL MILLING COMPANY LIMITED (NMC) (both missions)

Trading in salt and rice. Potential technology research activities are in stockfeeds formulation by cooperation with research institutes.

INDECO MILLING LIMITED (first mission)

Indeco Milling Ltd. was established to provide good quality mealie meal to people (at lowest cost possible) and stockfeeds for poultry and cattle. There are four main problems at the company, which should be solved in the near future:

- Increase output of mealie meal and maintain its quality.
- Increase output of stockfeed by expanding the use of locally available materials.
- Substitute imported ingredients for stockfeeds by locally available materials.
- Diversify the range of products to expand business operations.

Indeco Milling needs the same information as National Milling, but the sharing of optimum "recipes" for innovated stockfeeds (as well as milling techniques etc.) may pose a problem because the two companies should each have adequate motivation for improvement and innovation but they should not unduly compete with one another, being both under the ZIMCO/INDECO umbrella. The same applies to activities in marketing if the same RDI results are to be passed on to different companies in the same branch of business.

KABWE INDUSTRIAL FABRICS LIMITED (KIFCO) (first mission).

Originally the company produced exclusively jute bags and twine. Difficulties in importing raw materials led to a strategic reorientation under the Kenaf Development Project: The production of kenaf has been promoted with a view to increasing the local production of grain bags. Imported bags have been used for many years in the bagging of agriculture produce but it has become a heavy drain on foreign exchange. The major problems have been lack of support and funding of kenaf research. GRZ established the Kenaf Development Company to promote kenaf growing. The FNDP projected the cultivation of 800 hectares and production of 650 tons in the 1989/90 season. Project cost is ZMK 2 mln for the

research component, and ZMK 6 mln for the provision of extension and other support services.

**Objectives of RDI:**

- a) develop high quality kenaf varieties;
- b) establish kenaf extension services.

**Recommended activities:**

- a) collect, evaluate and select suitable varieties;
- b) develop suitable production packages;
- c) provide appropriate research and extension infrastructure;
- d) conduct farmers field days and mobile sources;
- e) train staff.

**ZAMBIA AGRICULTURAL DEVELOPMENT LIMITED (ZADL) (both missions)**

Production can be improved through higher attention paid by management to

- improvement of the cropping system of malt barley;
- testing new formulations of stockfeeds for dairy cattle and pigs of different category;
- marketing of fruits, vegetables, and their products (mango, ginger, garlic);
- better management of ranching cattle.

**NKUMBA FARM (ZADL)**

Cattle feeding takes about 5 months from 120 kg to 300-350 kg. It should however continue to 450 kg, for better economy and meat quality. Some 666 cattle are handled by 26 men. Veterinary inspection takes place every week.

**NKUMBA PIGGERY (ZADL)**

A staff of 6 manage manpower of 650. Rearing from R.S.A. and Zimbabwe stock. There are 200 sows; 10 to 12 pigs per litter; 1740 pigs annually. Pig feeding: 700 pigs monthly, sold at 80 kg weight. Of these, 85 % are contracted to ZAP, but ZAP now has no money to pay for the pigs.

**ZAMBIA SUGAR COMPANY LTD. (ZSC), NAKAMBALA ESTATE (second mission)**

The estate has industrial, agricultural, and project engineering

operations.

**Agronomy:**

Total area of the estate:	13,000 ha
Area suited to irrigation:	9,894 ha
Area planted to farmers' cane:	2,500 ha

There are three varieties: early, mid-season, and late. Each of them has been selected for the characteristics which suit the local climatic condition, harvesting and irrigation techniques, and soils.

**Planting:**

The cane is grown on small banks 1.5 meters apart. Seeds material from young cane is 50 cm long with 3-5 rings of buds and is planted 5-7 cm deep in the soil.

**Irrigation:**

The cane plant requires about 2,000 mm of water per annum for optimum growth; 750 mm is rainfall and 1,250 mm has to be supplied by irrigation.

**Irrigation management:**

740 ha by overhead sprinkler irrigation and 9,238 ha by flood or surface irrigation. By either method 62.5 m<sup>3</sup> of effective water are applied per one irrigation and the average field receives about 20 irrigations in an annual cycle. In cold season (July and August) the cycles are spaced at 16 days, whereas in October it is 8 days.

**Harvesting:**

Yield of cane, 12-15 months old, is 80-135 tons per hectare. The last 4-6 weeks before harvesting there is no irrigation; this assists ripening.

**Ratoons:**

After harvest and transportation of cane from the field, fertilizer and water are applied and a new growing cycle commences. The Estate can harvest 9-10 crops before the fields are replanted.

Cane farmers themselves grow 720 ha of cane. Kaleyá Smallholders

Company Limited (owned by Commonwealth Development Corporation, Barclays Bank Zambia Limited, The Development Bank of Zambia, and ZSC) was formed to develop and plant 1800 hectares of sugar cane.

**Other enterprises:**

Molasses and Urea/Molasses Plant produce 120 tons per day. Citrus plantations are 1 ha. Quarry turns out 50 m<sup>3</sup> of stone per day. Concrete blocks (troughs) are also made (up to 4,000 a week).

**Cane haulage:**

A cane haulage fleet of tractors and trailers, operating in three shifts, transports 6,000 tons of cane from fields to factory daily. In spite of the factory being situated near the center of the cane estate so that haulage distance is kept to a minimum, the estate transport travels over two million kilometers each season. The longest haul is 20 km. Each tractor with two trailers transports 25 tons of cane from the field to factory. Each field is burnt prior to harvesting and all cane from that field must be delivered to the weighbridge at the factory within 45 hours.

**Estate irrigation scheme:**

Ten pump stations pump 24 hours per day to supply and distribute 10 m<sup>3</sup>/sec to the 9,984 ha estate, and 1.6 m<sup>3</sup>/sec to the Kaleya Smallholder Company Limited. In actual day to day running the estate total demand is being kept to 16,000 kW or less. There are 10 pump stations (48 pumps). Main pipeline and night storage dams deliver water to 14.4 km of earth canal and conduits across the flats. There are 24 km of 48", 36", and 21" diameter steel pipelines laid above ground to ensure their safety against corrosion. These feed 24 night storage dams which store water during the night to fluid irrigate during the day. There are secondary and tertiary canals and approximately 250 km of concrete lined canals. Tree irrigators control this flow of water for 8 hours per day seven days per week.

**In-field application:**

The water in the tertiary canals is dammed up by means of specially designed portable gates, and is syphoned out of the canal through two-meters syphons of 7.5 cm diameter having a capacity 0.5 m<sup>3</sup>/sec to each furrow 400 meters long.

**Overhead irrigation:**

This is applied onto 704 ha.

**Factory department:**

The original factory of U.K. design has a capacity of 7,000 tons per day. Sugar is processed from April to November. There are two independent lines at the milling factory.

**Boiler plant:**

It has three sections (36, 78 and 91 tph of bagasse). Electricity is generated by three 2-MW and one 4-MW turboalternator sets. Talofloe Refinery produces directly white sugar (45,000 tons).

**Packaging:**

Industrial plastic packaging, or consumer packaging (0.5, 1, 2, 10, and 50 kg plastic and paper containers).

**Warehousing:**

Capacity is 15,000 tons of sugar.

**Personnel:**

340 staff, 40 expatriates, 7500 non-staff employees. The largest employer is the estate's agricultural department with a manpower over 4000. The department recruits up to 1,200 seasonal cane cutters.

**Inputs in agriculture:**

Seed sets every year for 1,000 ha cane plantations; irrigation water from Kafue River 136 mln cubic meters; power 16,000 kW day by day; fertilizers, herbicides, growth substances and insecticides; fuel oil.

**Inputs in factory:**

Fuel oil, fuel wood, 32 different chemicals as Talocide, Talofloe, Talocep, Talo, tri-sodium phosphate, aluminum sulphate, phosphoric acid, hydrochloric acid, chlorides, sodium carbonate, sulfur, caustic soda, and industrial lime (this being the only local input). Power 19,000 kW per day. Packaging material (plastic and paper).

**Outputs:**

130,000 tons of sugar (refined white 45,000 tons, plus a balance of brown crystal sugar). About 20,000 tons is exported.



**Byproducts:**

**Bagasse**, fibrous residua of the cane are used as fuel for the boilers.

**Molasses**, 40,000-50,000 tons; part of this is sold to local farmers, part is mixed with urea and sold to farmers as cattle feed. Most molasses is used for distilling alcohol and conversion into yeast.

**Filter cake** is used as phosphate fertilizer.

**ZAMBIA MALTING LIMITED (second mission)**

The company intends to run a 14,000-ha estate. The first phase will involve 5,000 ha under center pivot sprinkler system, containing a well and a pump; a mobile boom 564 m long with sprinkler (area 100 ha); operation 18 hours per day; expected yield 3.5 5 tons per ha.

**Cropping system:** crops rotation (malting barley, soya and cctton; two harvests nually).

The condition of barley for malting has a considerable effect on the yield and quality of the product. Besides varietal and species purity and satisfactory "grain color", malting barley should be of good bacteriological quality and be fit for storage.

High-nitrogen barley is unsuitable for malting because yield of extract is reduced and its quality impaired.

- (i) As grain nitrogen content increases, starch content decreases. It is the starch converted to maltose and dextrans that is important to fermentable constituent of the malt extract.
- (ii) High-nitrogen barley requires a longer time for modification, and a longer malting time entails more rootlet development and greater respiratory and metabolic loss.
- (iii) High-nitrogen barley does not modify to the same extent as low-nitrogen barley does, however long a malting time is allowed.
- (iv) The malt from high-nitrogen barley contains relatively more of soluble protein or albuminoid material than that from low nitrogen barley; this soluble protein will pass into the extract, forming haze, and possibly impairing the keeping quality of the bear. Development of bacteria is more likely to occur in liquor with a

high albuminoid content.

High nitrogen content in barley is about 1.5%; some 38% of this appears in the beer in the form of soluble nitrogen compounds, the proportion of the total N entering the beer being somewhat larger from two-row than from six-row types.

The sequence of operations in malting as follows: (1) kiln drying, (2) screening, (3) storage, (4) steeping, (5) draining, (6) spreading on malting flour, (7) turning or ploughing, (8) drying in malt kilns, (9) screening (removal of malt culms). Malting operations: The yield of malt from barley is 75%, 1.3 tons of barley are required to produce 1 ton of malt. The loss is made up in the following way: small grains 5%, moisture loss in preliminary drying 5%, removal of culms 3%, respiration loss 3%, moisture loss in drying the malt to 3% m.c. 9%. The dried grain is screened to remove the rootlets - called malt culms - which are now dry and brittle. The culms amount to 3-5% of the product. The screened product is malt.

#### RDI activities:

To obtain and evaluate malting barley varieties from Zimbabwe and select types most suitable for the local conditions. To evaluate malting barley according to specific characteristics:

- High germination capacity and energy with adequate enzymatic activity<sup>4</sup>.
- Absence of de-husked or broken grains, and of grains mechanically damaged in threshing.
- Capacity of grain modified by malting to produce a maximum of extract when husked prior to fermentation.
- Low content of husk.
- Low protein (1.35-1.75% N content) and high starch contents.

#### ZAMBIA SEED COMPANY LIMITED (Zamseed) (second mission)

Established in 1981 as parastatal associative organization by ZIMCO (40%), ZSPD (20%), ZSCM (20%) Swedish Seed (10%) and Swedish Fin. (10%).

Trading in seeds of crops cash crops (no trading however in cotton, coffee, tea, tobacco, kenaf, and rubber). Major trading

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<sup>4</sup>Using Inframatic 8620 (NIR) analyzer and Falling Number 1800 analyzer, cf. Chapter 6.4.

in cereals (maize, wheat, rice, millet, sorghum), oil crops (sunflower, groundnuts), pulses (soybeans, beans, peas), roots (potatoes and cassava), vegetables (onions, carrots, all brassicas, tomatoes) and fodder crops.

The company has a 1,500 ha estate used for where under controlled planting of special seed crops, which are evaluated under strict conditions for certification of seed products.

Selected seed (50 kg bags).

Seed type:	Number of 50 kg bags:	
	1989/90	1990/91
maize	266,856	143,633
soybeans	51,737	49,843
wheat	24,243	19,042
potatoes	1,409	1,271

What are the criteria of certification for seed wholesalers? There are four requirements placed upon a breeder in developing stocks of new variety for commercial multiplication. Three - purity, quality and health - are common to all multiplication systems and are basically the requirements of certification at a very high level; the fourth - **uniformity** - is a special requirement placed upon the breeder by custom and usage as well as, much more formally in recent years, by DUS testing.

In meeting these requirements of purity, quality, and health, the breeder is simply doing it at in an extremely high level; so standards must be of the highest.

The problems posed by the **uniformity** requirement vary with the crop. A clone is a clone, so here the problems are generally nil or at most slight, though recurrent somatic mutations, such as bolters and wildings in potatoes, may have to be rogued out. Since DUS tests impose a requirement for a near absolute uniformity an elaborate system of successive ear-row examinations is usual.

In practice, experienced breeders and officials perform DUS tests appropriate to the crop:

- (1) Distinctness (is it different from other varieties currently on the official list?)
- (2) Uniformity (is it sufficiently uniform to meet the published arbitrary requirements?)

- (3) Stability (does it breed true from year to year having regard to any inherent reproductive peculiarities of the crop?).

DUS tests establish the legal identity of the variety and, in addition, demonstrate that it is potentially certifiable at a very high level.

Commercial multiplication of stocks, whether or not a PVR (plant variety rights) scheme is in operation, is dominated by the demands of AOSCA certification.

If the uncertified product is permitted it would probably be called commercial seed.

Zamseed has very good relation with breeders at Mount Makulu; for field crops they publish recipes on how to use seeds and grow the crops. The level of this instructive reading is sufficient but lacks information e.g., on deep sowing or seed dressing. Precautions must be matched to the level of hazard in case of using treated seed for animal feed or consumer food. Instructions should always be given in this respect.

#### ZAMBIA COFFEE CO. (second mission)

Coffee is mainly grown in Northern, North-Western, Luapula, and Copperbelt provinces. It is grown by estates, commercial farms, and smallholders. This last-mentioned group depends on rainfed production and consequently, quality of the coffee berry tends to be poor. The FNDP recognized that coffee is increasingly becoming an export crop in terms of diversifying the export base of the economy. As such, provision of credit to small scale coffee growers to facilitate an increase in the area cultivated and provision of extensions service has to be a key subsector policy objective.

The present situation: Lack of inputs (potassium fertilizer), decreasing price of coffee from US\$ 3000 per ton to US\$ 2000 and the very low yield of 0.28 tons/ha are major constraints for the smallholders. Commercial farmers grow coffee under drop irrigation (MDC). The extension services from the Coffee Division of Lintco to smallholders are insufficient. Coffee plant processing units are at Mpongwe, Mazabuka, and Galaun's Farms. Coffee berry disease is the most important disease in Zambia; chemical control is very expensive and RDI is oriented to resistant cv. such as Ca-Timor. Harvesting period begins in May. Irrigation is necessary to improve the growth of green berry, not

to induce flowering.

Plans exist to

- (a) intensify and expand coffee production in order to meet export quotas and generate surplus to satisfy domestic demand;
- (b) increase income generating opportunities of the rural population.

Target for 1993 is 3,500 tons of clean coffee beans (present production, in 1990, being 1,296 tons). The activities for the development of this cash crop are to

- (i) provide short and long term credit;
- (ii) increase the area under coffee, improving agronomy practice (pruning and processing of coffee beans);
- (iii) establish coffee estates, outgrowers scheme, and organization of a small scale irrigated coffee settlement scheme for drop irrigation system;
- (iv) improve extension services.

### 2.3 Companies and institutions outside ZIMCO

Commercial farmers include Galaun Holdings Ltd., Kyindu Ranch-Meat Factory, Buccaneer Product Ltd., Lusaka Cold Storage (Luscold), King Farms Products Ltd., Lendor Agricultural Holdings, Chibote Farm, etc.

Traditional agricultural production - includes subsistence farmers.

Mulungushi Farms, formerly ZIMCO - variegated activities.

Small scale farmers, a relatively new group said to include some 450,000 farms, related to the "Global 2000" project. They contribute more than 60% of the total food production.

### 2.4 Performance trends

Lack of rainfall had a direct impact on both production and area planted. Available data show that maize production declined by 41 per cent to 12.1 million bags (1.09 mln tons) from 20.5 mln bags (1.09 mln tons) in 1988/89. Increased retentions by peasant farmers meant that the market maize crop for 1990/91 (April--March) showed an even greater reduction, falling by 48

per cent to 7.1 mln bags (639,000 tons) from 13.6 mln bags (1.22 mln tons). Market seed cotton was down 42 per cent to 30.5 mln kg from 52.7 mln kg. Output from groundnut fell by 52 per cent to 149,000 bags (11,920 tons), while that of sorghum was down by 47 per cent to 217,680 bags (19,591 tons). The one crop which seems to have benefited from the dry conditions was tobacco, with production increasing by 38 per cent to 4.7 mln kg in 1988/89.

**Maize self-sufficiency:** Present area under maize is 60.1% (1990). In theory the shortfall should have been adequately covered by the 8 mln bags (720,000 tons) stored from previous crop surpluses. However, GRZ has confirmed that much of this surplus is unusable due to poor storage<sup>5</sup>. The reality is that it is not known exactly how much maize will be available from last season's marketed crop and the 8 mln bags reserve. Additionally, Zambia is to buy 60,000 tons of maize from Zimbabwe<sup>6</sup>.

Another complicating factor has been the decision to liberalize maize marketing<sup>7</sup>.

One reason for the big drop in maize output in 1989/90 was the unattractive price which led farmers to cut back plantings. In an attempt to prevent further cutback in 1990/91, GRZ in June raised maize prices by 76 per cent to ZMK 500 for a 90 kg bag.

The liberalization of maize marketing has been welcomed by donors and commercial farmers, but there have been warnings from economists that it could undo much of the work of the last two decades to encourage small scale farmers out of subsistence production and into the commercial sector. Marketing is one of the biggest problems for peasant farmers.

The objectives are to

- a) develop a strong institutional framework that will spearhead the development of irrigation;
- b) promote the diversification of cropping patterns with a view to increasing food and agricultural production; and
- c) identify additional areas with irrigation potential.

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<sup>5</sup>Zambia Country Report No.4 (1990).

<sup>6</sup>Zambia Times, 25 May 1991.

<sup>7</sup>Zambia Country Report No.4 (1990).

The strategies are

- a) establishing and sustaining a credit scheme for the promotion of irrigated agriculture;
- b) developing water storage facilities and irrigation infrastructure;
- c) developing gravity fed systems for small-scale irrigation schemes for increasing production of coffee;
- d) extending the electricity grid to cater for irrigable areas;
- e) preparing a national water resource master plan.

The Tazara Corridor projects aim at developing commercial farms along or near the Tazara railway. Implementation of this program started three years ago. The rate of implementation of the project is rather slow due to insufficient funds and lack of machinery. Per year about 50-100 farms in each block is established. These farms range between 50-250 ha.

In 1990, total land under irrigation during the year was estimated at 35,000 ha. National Irrigational Development Fund which was expected to rapidly increase lands under irrigation did not have a good impact due to insufficient funds.

<u>Area name</u>	<u>Plan</u>	<u>Established</u>	<u>No. of farmers</u>
Katikulula	90,000 ha	6,000 ha	60
Munte	215,000 ha	10,000 ha	101
Manshya	147,000 ha	16,000 ha	182
Kanchibiya	197,000 ha	8,000 ha	143
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Total	649,000 ha	40,000 ha	486

## 2.5 Agricultural subsectors

Crop and Livestock systems represent the two main subsectors. They have a number of characteristics in common (the need for flexible use of resources, capital and labor) and a number of important differences (labor requirements high in cropping, and seasonal; greater opportunities for investment in extension services). The issues of individual segments of these subsectors are outlined below.

### Wheat (0.9%)

Wheat as a dry season irrigated crop has a three times higher potential than rainfed one. Maize, cotton, and sunflower are the

best grown after wheat as timelines of land preparation can provide difficulties. Rainfed wheat production is generally on the increase in the high rainfall areas of Northern Province. The expected increase in marketed production of rainfed wheat was by 77.3 per cent. This can be attributed to the attractive producer floor price which increased by 115.8 per cent over producer floor price during the foregoing period.

#### Rice (0.1%)

The objective of the rice subsector was to increase rice production in order to attain self sufficiency and generate a surplus for export. Production has declined by 21.5%. Despite this, marketed production was estimated to be 16.8 percent higher than last year. This can be attributed to an increase in the producer floor price of 119.2%.

#### Sorghum (3.6%)

Sorghum is an important staple food crop for people in dry areas along the Zambezi and Luangwa Valleys, and some parts of the North-Western Province. Production of sorghum declined by 6.8% only. Sorghum which is mostly grown by small-scale farmers is expected to record an estimated 189.9% increase in marketed production. The introduction of outgrowers scheme by National Breweries increased sorghum production for use in brewing.

#### Millet (3%)

This crop is grown to regional self-sufficiency. Production increased at a lower rate than the increase in area by 15.7% and 24.2% respectively. Despite the increase in production, market production is expected to fall by the same level although there is an increase of 119.6% in producer floor price. This is mainly due to the farmers retaining more for their own consumption.

#### Cassava (8.2%)

Estimation of both production and marketed production figures has been problematic due to the continuous harvesting practice and the selling of the crop on the informal market. Cassava continues to be important because it can be produced on marginal lands under unfavorable weather conditions. It is being promoted as a famine relief crop and important component for stockfeed.

#### Sunflower (3.5 %)

The total production for the 1989/90 season was increased as compared to 1988-89 by 32.8% and was 399,313 bags (50-kg). This meant that there was an increase of 34.8% in yield per hectare. Total sales increased by 15%.



**Soybeans (2.35%)**

There was an increase in total production of soybeans from 228,645 bags (90-kg) in 1988/89 to 297,677 bags in 1989/90, but the area planted also was increased by 39.7%. Present production of soybeans in the country was only sufficient to meet one third of the total requirement for stockfeed production<sup>a</sup>.

**Mixed beans (2.1%)**

Despite the increase in area planted by 42%, total production declined by almost the same margin. Production declined from 270,164 bags (90-kg) during the previous season to 159,026 bags in 1989/90.

**Groundnuts (6.4%)**

The area increased by 28%, the total production declined by 17%. The decline in production had no impact on market production which was expected to increase by 162%. The increase in sales was attributed to attractive prices which went up by an average of 102% for both Chalimbana and Makulu Red varieties. The 1989/90 prices were attractive when compared to 1988/89 prices where the average increment was a mere 22.5%.

**Seed Cotton (5.1%)**

The area under seed cotton declined by 40% in 1989/90 season. The decline in the area planted and total production were partially due to adverse weather conditions experienced during the 1989/90 season. The planting season for the cotton is mid-November to half of December. The decline was also due to inadequacy of pesticides to control pests.

**Flowers**

Zambia's potential for exports of flowers and produce is not fully used because of limited expansion and investment opportunities but also because of prohibitive air freight prices.<sup>o</sup> The Zambia Export Growers Association (ZEGA) will fall short of its export targets this year. The freight rate for flowers, \$1.50 to 2.10 by National Air Charters (NAC), is high and exports of sweet corn and melons are no longer viable.

The underlying cause pushing air freights up is the artificially high cost of aviation fuel in Zambia.

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<sup>a</sup>R.L. Bwalya in INDECO Review, Vol. 8, No. 1.

<sup>o</sup>Times of Zambia, 24 April 1991.

**Livestock branch:**

Indicative figures are: total cattle 2,168,310, sheep 31037, goats 490,239 and pigs 201,591. In 1990, cattle was estimated at 2.9 mln with approximately 80% in the traditional sector and 20% in the commercial sector. In 1990 there was an outbreak of Foot and Mouth Disease in Nakonde District of the Northern Province. Most peasant farmers sell off their cattle when drought or disease strikes.

Diseases are controlled by Central Veterinary Research Institute. Routine vaccination campaigns were undertaken to control some major livestock diseases (FMD, Hemorrhagic, Septicallmia, Contagious bovine, Pleura Presumosis and rabies in areas at risk. However, the inadequate transport slowed down veterinary control efforts.

**Poultry branch:**

There are five major hatcheries in Zambia. The biggest are Hybrid (2), Caledonian, Golden Cross, and Tamba. That produce about 90.9% of total poultry production. Incubator capacity in 1989 remained at about 30 mln day-old chicks per annum. Some hatcheries were closed in 1990 due to disease problems. Shortage of stockfeed continued during 1989 production.

A modern hen can lay 255 to 260 eggs annually. Management is as crucial as a balanced diet is, in achieving desired results. With careful management it is not difficult to achieve as high peak production and thereafter a consistent and prolonged high production. Feed consumption per unit of eggs (10 eggs) is about 1.95 kg feed by a layer to produce a unit of eggs in an ideal situation under average conditions.

**Training, Extension and Research**

CVRI, the Regional Tsetse Training School, and Management Tsetse Control Services in conjunction with some international agencies. Training program in Artificial insemination.

**Beef**

Objectives are to

- a) increase beef production mainly among small-scale and peasant farmers (Global 2000);
- b) increase per capita consumption;
- c) expand the export markets for beef.
- d) diversification into ranching and farming.

Memaco is an example here.<sup>10</sup> Memaco, a ZIMCO subsidiary and the sole marketing company for ZCCM, has developed 3,000 hectares for agricultural and livestock farming. The Memaco farm in Kabwe started operations in 1987 and now has

- 410 ha of maize, 233 of soybeans, 50 of wheat, 21 of barley tobacco, and 5 of potato fields
- 800 pigs, 230 cattle, 7,000 poultry (producing eggs);.

The farm expects to earn about ZMK 236 mln in 1991 and, following expansion, ZMK 144 mln in 1992.

FNDP targets for cattle slaughtering:

1991	1992	1993
93,000	96,100	99,300 cattle

Dairy prices were increased several times. DPB and FNDP intend to

- a) increase production of milk and milk by-products in conformity with public health standards;
- b) increase processing capacity;
- c) improve the milk marketing system.

The target is to increase total milk production from 60.5 mln liters in 1988 to 70.3 mln liters in 1993. The strategies to be pursued are:

- a) increasing the dairy herd and milk yields levels;
- b) improve the existing genotype;
- c) improving nutrition through improved pastures, better quality and quantity of supplementary feeds;
- d) improving extension services;
- e) reviewing the producer price.

#### Pig production

The objective is to

- a) increase the production of pork and pig related products,
- b) utilize byproducts such as blood, bones, hairs, condemned carcasses, derived from pork processing for various industrial uses.

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<sup>10</sup>"Memaco: From selling copper to farming", Zambia Daily Mail, 27 April 1991.

Strategies include

- a) integrating pig programs into general extension services to the pig industry
- b) ensuring supply of quality stockfeed in adequate quantities
- c) modernizing and expanding existing plants.

## 2.6 RDI

Obviously, there is no clear distinction between research, development and innovations, but an effort has been made here to tread each of the three separately.

### 2.6.1 Research

R & D facilities in stockfeed formulation supported by computerized system could be installed at NMC. Facilities and know-how for achieving refinement in blending sorghum/maize flour with wheat flour for the purpose of baking bread could be looked into. Increasing output of mealie meal and maintaining its quality is a problem. Millers need the latest information of top technology milling, processing, stock feeds formulation. They need technological information on stockfeed formulation processing, technology of cereals, bread-baking technology, breakfast cereals and other processed products. The RDU should provide this from the National and World information services.

### ZCC

Field trials are needed for evaluation of new varieties, rate and timing of fertilizers and pests control such as termite, bugs, *Helopeltis* spp., mildew of the inflorescences.

Evaluation of intercropping during the first two years of growth and after third year by which time the trees should come into bearing, reaching full production within the next 7 years and continuing to yield for up to 30 years.

ZCC activities include

- cashew nut Research and Development Project worth ZMK 1.97 mln;
- installing processing machinery;
- increasing the supply of plant seedlings to farmers;

- and  
- development of export markets.

#### Zambia Coffee Co.

##### Major activities:

- a) To obtain and evaluate coffee varieties from various parts of the world;
- b) To screen new insecticides and fungicides available to coffee plantation and recommended usage against coffee pests and diseases (CBD and rust *Hemileia vastatrix*).

#### Kawambwa Tea Company

Assistance is certainly required to the nascent company R & D Unit, in order to augment the current agronomic investigations as to improvement of tea quality, thereby linking field and cultural practices to the end product for the market.

The tea nursery program for 80 hectares of new tea plantation should involve selection of high yielding tea based on cuttings. Selection of mother bushes for vegetative propagation is based on their high yielding characteristics, good tea quality and other desirable properties, such as easy plucking types that branch freely having a good spread with a dense plucking table and showing a quick recovery from pruning.

Critical factors in this area are: environmental (weather, soil, topography), insufficient irrigation, genetic variations (seedling), management (type of tea, fertilizers application, pruning cycle, plucking round and systems), the pluckers (knowledge about the operation, age and experience, health condition, skill and speed).

A joint KTC-GRZ research and development program is ongoing to provide back-up services in all aspects of the tea business. The unit is successfully conducting field trials, nursery and fuelwood plantation management. The estate has a working relationship with the Tea Research Foundation of Central Africa (Malawi) as a member.

#### Zambia Agricultural Development Ltd.

Company needs research activity in technology transfer in the field crops system, mainly special crops, in the form of field trials, mix farming and agriculture machinery. Research in market windows for special crops.

#### **Nakambala Estate Sugar Company**

The research section is continually engaged in research activities to ascertain the optimum methods of cane culture by field trials specifically for Nakambala conditions, namely evaluating sugar cane varieties and their resistance to smut *Ustilago stitamine*. To find out from trial results, the optimum level of fertilization by various chemicals for the most economic production. To find the most effective means of ripening (sugar content) cane both by natural and artificial means. To find the most effective control of weeds. To find the most effective use of irrigation water and check on resulting soil conditions. Establishment of clean-seed nurseries for use in commercial planting. Research is linked to South Africa Sugar Cane Research Station.

#### **ZAFFICO**

The corporation needs to establish R & D which would focus on developing new innovative uses of ZAFFICO's products and bringing to management's attention new developments in the industry. It could focus on finding outlets and alternative uses for small-size roundwood (mainly pine), crooked logs and cutoff sawmill residues (slab and chips) and other sawmill assortments. In addition, it could research the techniques of logging, use of animal traction as substitute for some mechanized techniques. In logging, oxen skidding with private contractors for eucalyptus poles is being tried with significant cost reductions. Thinning and replanting must be suitably combined.

Workshop innovation in the area of spare parts. In forest research the aim is to expand research activities for both indigenous and exotic species in all aspects of growth and utilization. The main areas of emphasis are in forest protection, silviculture in high rainfall areas for species producing good timber, establishment of trial plantations of indigenous timber and fruits. Research work in forest products covered the suitability of exotic and indigenous timber species for a variety of panel products and pulp and paper. Agro-forestry Research worth ZMK 10.853 mln is planned under FNDP.

### **2.6.2 Development**

#### **Zambia Coffee Co.**

##### **Activities:**

- a) To improve agronomic practice and pruning systems;
- b) To find the optimum level of fertilization by various chemicals for economic production.

**Zambia Agriculture Development Ltd.**

ZADL needs removing bottlenecks, improvement of malt barley cropping, marketing for cash crops such as mango, garlic, ginger, fruit and vegetables.

Improvements are needed of the machinery for cultivation, fodder harvesting and evaluation of stockfeed.

**Mpongwe Development Company**

MDC needs improvement of storage system, coffee processing (huller and aspirator, storage bins and sorting equipment).

**ZCC**

RDI will develop new varieties budded on local rootstock of cashew nut.

**NMC**

Needs to increase output of mealie meal and maintain its quality.

Facilities/know-how for achieving refinement in blending sorghum/maize flour with wheat flour for the purpose of baking bread could be looked into.

**Indeco Milling**

Improvement of hardware, removing bottlenecks, saving energy, improving working conditions and safety at work. Rehabilitation of existing plants.

**2.6.3 Innovations**

Innovations are new ideas, methods, practices or techniques which provide the means of achieving sustained increases in farm productivity and income. It is the innovator's job to encourage farmers to adopt innovations of proven value. Some innovations originate from agricultural research stations, others from commercial farms abroad. Innovations relate to objects, social acts, and abstract ideas.

**Zambia Coffee Co.**

Establishment of clean-seedlings nurseries for use in commercial planting.

**National Milling Co.**

NMC needs research in stockfeeds formulation and better feedback from clients and research in local resources such as alternative

components of stockfeeds and so decreasing dependence on import of essential ingredients. For these purposes, establishment of a NIR reference laboratory instrument under RDU can utilize innovations in stockfeed production and utilize lime stone flour during process formulation.

NMC innovation in formulation of stockfeeds and improvement of feedback with clients such as Supa Baking; improvement of the quality of flour.

#### **Indeco Milling**

Innovation mainly in formulation of stockfeeds production and improvement of feedback with clients.

#### **Zambia Cashew Company Ltd.**

Improve the pest control after planting new cashew trees. Improve cashew clonal budding material in nursery. Potential development and innovative activities: CNSL could be used as a product for impregnation of pools in ZAFFICO. Full harvest gives 15,000-25,000 tons of cashew apples which are wasted; the same amount will be from small-holders. These wastes could be used for soft drink and byproducts: tannin, gelatine, and a component for stockfeed.

#### **Mpongwe (MDC)**

Needs better flexibility in confronting the market.

#### **ZAFFICO**

Fire prevention is important. Processing: Improve sorting timber, improve technical skills through in-house training. Evaluate CNSL for treated poles to decrease present import of creosot from the U.K.

#### **R & D at Sugar Cane Co. Nakambala Estate:**

Mechanization of harvest and transport systems by network analysis. Increasing plant capacity by 20-25%; Financing gap: US \$ 55 mln is needed to raise and export to 50,000 tons of sugar expanding sugar cane plantation by 20-25%. The main problems hindering the development of sugar cane production have been the small profit margin, an aging processing plant which has curtailed efficiency in operations, and insufficient availability of foreign exchange. The objective is to increase production of centrifugal (brown) sugar.

Strategies to boost production from 155,000 tons to 169,000 tons (1993) are:

- a) increase area under cultivation through the



- establishment of a second sugar estate;
- b) increasing yields;
- c) increasing capacity utilization of the sugar mill;
- d) opening new markets for Zambia sugar and sugar products;
- e) utilization of molasses for biotechnology production.

### 3.0 INPUTS AND OUTPUTS

#### 3.1 Major inputs of agriculture

- Fertilizers:** Lime, Nitrogen, Phosphorus, Potassium, Sulfur.
- Agro-chemicals:** Insecticides, fungicides, herbicides, and growth regulators.
- Components for stockfeeds:**
- fish meal, vitamins, minerals, dicalcium phosphate, limestone flour, maize byproducts, cotton seed cake, sunflower, soybeans, groundnuts;
  - Panoxin/Doquin plus, trace elements, methionine and lysine.
- Seeds of:** Maize (single hybrid, three way cross hybrid), irrigated wheat, rainfed wheat, sorghum, rice, soybean, sunflower, groundnuts, beans, cotton, malting barley, Rhodes grass, Chloris guyana, seed of vegetables, Star grass, (Cynodon plempfuensis/C. aethiopica) and others. Microbiological treatments seeds of Leguminous crops based on Rhizobium spp.
- Seedlings:** Coffee, tea, cashew, mango, rubber.
- Energy:** Electric power, fuel oil, animal power, solar energy.
- Irrigation water:** Underground and surface water.
- Agricultural equipment.**

#### 3.2 Major outputs of agriculture

##### Cereals as food crops:

- maize, wheat, rice, sorghum, millet;
  - other food crops: cassava, bean, potatoes, fruits - pineapple, mango, papaya, avocado;
- vegetables: onion, garlic, brassicas, tomatoes, cucurbitas, capsicum and others;
- cash crops: cotton, coffee, tea, tobacco, sorghum, soybean, sunflower, malting barley, groundnuts, flowers, kenaf, sugar cane.

##### Seeds and seedlings for above food and cash crops:

- fodder crops: hay, silage, other fodder;

- livestock: cattle, pigs, calves, sheep and goats;
- milk, poultry, eggs;
- raw materials for industry: sugar cane, kenaf, malting barley;
- forestry timber and poles.

### 3.3 List of major inputs and outputs (for individual companies and institutions)

#### AFE Ltd.

Inputs: purchased  
Outputs: agriculture machinery & equipment (retail)

#### Amalgamated Millers Zambia

Inputs: maize  
Outputs: mealie meal  
Byproducts: germ, bran

#### E. C. Milling

Inputs: maize, components of stockfeeds  
Outputs: mealie meal & stockfeeds  
Byproducts: germs, bran

#### Choma Milling Co. Ltd.

Inputs: maize  
Outputs: mealie meal  
Byproducts: germs, bran

#### Indeco Milling Co.Ltd.

Inputs: maize, component of stockfeeds  
Outputs: mealie meal & stockfeeds  
Byproducts: germs, bran

#### Industrial Development Corp. Ltd.

Inputs: steel and aluminum material  
Outputs: agricultural equipment

#### Kabwe Industrial Fabrics

Inputs: kenaf, jute, row plastics  
Outputs: mealie meal bags

#### Kawambwa Tea Co. Ltd.

Inputs: fertilizers, agro-chemicals, irrigation water, seedlings of bananas, packaging material, seedlings of eucalyptus tree

Outputs: tea, fruit of bananas  
Byproduct: fuel wood

**Lusaka Engineering Co. Ltd.**

Inputs: steels, aluminum material,  
Outputs: metal products (windows & doors frames, bus  
bodies, nails & bolts, furniture,  
agricultural implements)  
Wastes: see Technical Report "C"

**Mpongwe Development Co. Ltd.**

Inputs: fertilizers, agrochemicals, irrigation water,  
potatoes and vegetables, oil, petrol, corms  
of gladioli  
Outputs: foods crops, cash crops (soybeans, sorghum,  
coffee, cut of gladioli), seeds crops (maize,  
potatoes, beans and others)  
Byproducts/wastes: maize cob, straw, hull of coffee berry

**Mulungushi Investments Ltd.**

Inputs: 3 days old chicken  
Outputs: mixed (bus services; farms; milling &  
stockfeeds; poultry), innovation in ranching

**Zambia Sugar Co. Ltd. Nakambala Estate**

Inputs: fertilizers, agrochemicals, wood fuel  
electric power, water, chemicals, cement,  
fuel oil  
Output: sugar  
Byproducts/wastes: molasses, molasses-urea feed, fertilizer  
bagasse

**National Milling Co.**

Inputs: maize, wheat  
Outputs: mealie meal, flour, and stockfeeds  
Byproducts/wastes: wheat bran, germ

**Nchanga Farms Ltd.** crops & livestock

**Ndola Lime Co.** lime

**United Milling Co. Ltd.** mealie meal

**Zambia Agricultural Development Ltd.**

Inputs: food and cash seeds, fertilizers,  
agrochemicals, fuel oil, electric power,  
stockfeed, water

Outputs: milk, cattle beef, pigs, food crops, cash  
crops  
Byproducts/wastes: maize cobs, straw, pig dung

**Zambia Cashew Co.**

Inputs: seedlings, fertilizers, agrochemicals, cashew  
nuts, packaging material, fuel oil  
Output: cashew nuts  
Byproduct/waste: cashew nut shell liquid (CNSL), cashew  
apple

**Zambia Coffee Co. Ltd.**

Inputs: fertilizers, agrochemicals, irrigation water,  
fuel oil  
Output: coffee  
Byproducts/waste: hull of coffee berry

**Zambia Forestry and Forest Industry Corp. Ltd.**

Inputs: seedlings, fuel oil  
Outputs: timber, pulp & wood product  
Byproducts/wastes: slabs and chips, fuelwood

**Zambia Maltings Ltd.**

Inputs: fertilizer, seed barley, agrochemicals, fuel  
oil, malting barley, sorghum  
Outputs: malt, malting barley  
Byproduct/waste: malt culms

**Zambia Seed Co. Ltd.**

Inputs: seed, agrochemicals, packaging material  
Outputs: seeds ready for sowing  
Byproducts/wastes: impurities, non-standard seeds  
agrochemical waste

**Zambia Agricultural Development**

Inputs: fertilizers, seed of food and cash crops,  
agrochemicals, fuel oil, stockfeed, calves,  
water, sanitary chemicals, veterinary,  
feedlot, sucking pigs, cattle for breeding  
and feeding  
Outputs: milk, beef, pigs, sheep, sucking pigs for  
sale, goats, maize, commercial seeds,  
flowers, oil crops, fruits, vegetables  
Byproducts/wastes: pigs dung, manure

**Zimco Institute of Management training, incl. training in  
management for agriculture.**

#### 4.0 LINKS

Five different types of links are considered below.

##### 4.1 Process flow and other in-house links

- in Zambia Agricultural Development  
between crops subsector >>> livestock subsector  
between sow rearing >>> piggery
- in Zambia Sugar Co.  
sugar cane >>> sugar factory
- in MDC  
coffee plantation >>> green coffee >>> coffee factory
- in Kawambwa Tea Co.  
green tea leaves >>> tea processing factory
- in ZCC  
cashew kernels >>> Cashew nuts processing factory
- in National Milling Co.  
bran with other compounds >>> stockfeeds
- in INDECO Milling  
milling wastes + compounds >>> stockfeeds

##### 4.2 Company-to-company input-output links

- in ZADL  
fodder for dairy cattle >>> milk production >>> DPB
- in ZADL  
seed crops >>> Zamseed
- in ZADL  
pigs >>> ZAP, Cold Storage
- in KTC  
tea >>> wholesale >>> retail
- Supplier of fertilizers  
>>> KTC, Nakambala Estate, ZADL, MDC
- in Mpongwe Development Company Ltd.  
with seed crops >>> Zamseed
- in NCC  
>>> crops subsector (Tea Estate, ZCC, Nakambala, MDC etc.)

#### 4.3 Links between subsectors

There are a number of links between crop and livestock production systems that are relevant to a discussion of alternatives for these regions. There are links relating to access to vegetation resources and the use of crop residues by livestock, the exchange of food and other goods and the exchange or hiring of labor.

Nkumba Piggery is producing pigs at a very good level. They also have ranching which is not very good and also, there is enough arable land there where maize for feeding the pigs could well be grown without irrigation. This would have the positive effect of saving in the transport of feed, i.e., maize, which could be crushed in a hammer crusher (mill), a method they are employing anyway for purchased maize.

#### Cash links:

- in National Milling Co.  
(flour, NaCl) >>> Supa Baking
- Nakambala Estate  
(sugar) >>> Breweries, Supa Baking
- farmers  
(kenaf) >>> KIFCO
- farmers  
(oilcrops) >>> Premium Oil, R.O.P.
- farmers  
(cereals) >>> Milling Co.
- farmers  
(milk) >>> Dairy Produce Board
- farmers  
(animals) >>> meat factory (Cold Storage, ZAP)

#### 4.4 Links to other sectors of national economy

- Agricultural sector >>> Transport sector (harvesting of maize, oil crops)
- Transport of fertilizers >>> Crops sub-sector
- Producers of fertilizers >>> Agricultural sector
- Producers of maize >>> any Milling Co.
- Producers of wheat >>> National Milling Co.
- Producers of seed crops >>> Zambia Seed Co.
- Producers of coffee >>> Zambia Coffee Co.
- Producers of vegetables >>> Zambia Horticulture
- Producers of fruits >>> Mwinilunga Canneries etc.

- Nakambala Estate >>> farms (molasses)
- any Milling Co. >>> farms (stockfeed)

#### 4.5 Links to Government and non-ZIMCO institutions

Agricultural systems have six functional components:

- 1) Production refers to the physical tasks involved in cultivating crops and rearing livestock.
- 2) Supply and credit are concerned with obtaining the physical inputs.
- 3) Marketing is concerned with the storage, transport, and sales of the output.
- 4) Research aim to discover new facts about agriculture.
- 5) Extension aims to transfer this knowledge to producers.
- 6) Regulation is concerned with the allocation of resources such as land and water, with agricultural rules, with quality control and so on.



## 5.0 FORMULATION OF RDU IN AGRICULTURAL SECTOR

Objectives, activities, and outputs of the RDU are considered in this Chapter.

### 5.1 RDU objectives

The objective of the RDU is to assist ZIMCO/INDECO to define a strategy of management and operation in RDI in single companies to raise the level of operating competence of research, development, and innovation activities and provide the basis for long term performance. Ministry of Agriculture called for the strengthening of agricultural research and extension services<sup>11</sup>

The general objectives to be pursued by RDU in the agricultural sector are as follows:

#### 5.1.1 Improvement of products

- diversification of crops;
- improving varieties of crops;
- improvement of livestock husbandry;
- improving quality of: flour, mealie meal, edible oil, slaughter-weight (pigs, cattle, poultry)

#### 5.1.2 Utilization of wastes

Examples of utilizable wastes:

- ZCC byproduct CNSL as waterproof material for impregnation of poles,
- Nakambala Estate molasses
- ZADL pig dung,
- maize cobs,
- straw.

#### 5.1.3 Applicability of special products or wastes

Each of these can find some specific use such as molasses in agricultural sector, food industry sector, maize cobs in chemistry sector.

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<sup>11</sup>Times of Zambia, 25 May 1991.

#### 5.1.4 Sharing of laboratory and testing equipment within the agro and food sectors

Standardization of inputs and outputs in agro-industry and food wholesale.

#### 5.1.5 Sharing of know-how

Example: In dry milling of sorghum<sup>12</sup> the wheat milling processes using roller mills are not appropriate for these cereals because the bran and germ of sorghum and millet pulverize easily to a fine powder which is difficult to separate from the fine flour. There can be two stages:

- (1) abrasive peeling, to remove bran, and
- (2) pulverizing of the peeled grains.

Byproducts of maize: Approximately 180 kg of cobs are obtained from each ton of maize shelled. The annual production of cobs in Zambia alone is of the order of 1 mln tons. Cobs consist principally of cellulose 35%, pentosans 40%, and lignin 15%.

Agricultural use: litter for poultry and other animals, mulch and soil conditioner, animal and poultry feeds and carriers for insecticides and other pesticides by granular formulation.

Industrial use: in vinegar manufacture, for cleaning, burnishing, polishing and roofing, bricks and ceramics, oil well drilling, filler for explosives, plastics, glues, adhesives, rubber compounds and tires. Industrial uses based on chemical properties include manufacture of furfural, manufacture of fermentable sugars, solvents and liquid fuels; production of charcoal, gas and other chemicals by destructive distillation; use as solid fuel (oven-dry cobs have a caloric value of about 18.6 MJ/kg); and in the manufacture of pulp, paper and board.

The RDU should function as a reference laboratory for assessments of grain, milk fat, oil, bread because parties to contracts have no one to tell them who is right and who is wrong in disputes over quality.

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<sup>12</sup>Perten, F.A.O. study, 1977.

## 5.2 RDU activities

An expert with agricultural research and technology experience will undertake the following activities in RDI:

- RDI consulting on agricultural problems in subsidiaries;
- mediation of intra-sectorial and inter-sectorial contacts and links in agro-industry;
- collection and dissemination of scientific and RDI information
- technology auditing within the agriculture and food industry;
- preparation and start up of RDU data banks;
- acquisition, verification, recording, and updating of data for data banks;
- organization of training, meeting, and ad hoc teams addressing agriculture and food industry.

### 5.2.1 RDI consulting

UNZA, NCSR, Mount Makulu, Ministry of Agriculture etc.

### 5.2.2 Mediation of intra-sectorial and inter-sectorial contacts and links

The types of links are discussed in the main Terminal Report.

### 5.2.3 Collection and dissemination of scientific and RDI information

This is an activity which is best conducted centrally, by the RDU, for all companies concerned (and also for non-ZIMCO sector).

### 5.2.4 Technology auditing (of subsidiaries not covered by the ZIMCO Technology Audit)

This should first include the Sugar Company Limited, Nakambala Estate, Zambia Seed, Zambia Malting Ltd., Zambia Coffee Co.

### 5.2.5 Organization of training

In-house training in subsidiaries; RDI training participated by research institutes (local or foreign), UNZA, and the Bureau of Standards; training by manufacturers who develop new technology and supply equipment and/or instrumentation.

### 5.3 RDU outputs

Five types of outputs are considered in the sections 5.3.1 through 5.3.5.

#### 5.3.1 RDI promotion

- Appointment of a specialist in agriculture (agronomy science)
- Information to subsidiaries, Ministry of Agriculture, NCSR, Mount Makulu etc. that RDU ZIMCO/INDECO was established for the agriculture sector
- Promotion of local R & D for adaptation of imported technologies in coordination with NCSR and other centers
- Monitoring and evaluation of technology from inside and outside the country with a view to current and future projects
- Evaluation of new technology in local environment; new varieties, hybrids, cropping systems, methods of pests control
- New formulation of stockfeeds.

#### 5.3.2 RDI coordination within the RDU group

The coordinated information strategy, with emphasis on consistency in the communication messages and co-operative extension, should lay the foundation for rationalizing the various services to agriculture and should prove the value of a coordinated campaign to the farmer.

Coordination of the RDI activities within the ZIMCO group:

- Setting up ad hoc teams to solve specific problems, with the participation of specialists from the subsidiaries, research institutes, etc.
- Exercising a degree of control over the subsidiaries' RDI through redistribution of R & D funding and of

- RDI derived benefits.
- Providing bidirectional feedback between corporate and company level RDI.

### 5.3.3 RDI cooperation and planning at nationwide level

For the efficient development, movement, modification, and adoption of technologies the RDU should ensure that all members of the chain are in contact and that they have the resources and policy environment needed to promote cooperation.

RDI cooperation and RDI planning in relation to non-ZIMCO/INDECO entities operating at the Government level, the University level, and the company level.

Identified cooperation and planning elements are as follows:

- Establishing and maintaining linkage between the research and development activities of the NCSR, the Mount Makulu Research Station, the UNZA and other institutes abroad, and the proposed RDI activities of the ZIMCO/INDECO subsidiaries and associate companies. The RDU should also maintain links with the Zambia Bureau of Standards.
- RDI activities and services in the sectors mentioned above.
- Outline of information services supporting the RDI activities.
- Gathering, sorting, analyzing and disseminating information on ZIMCO/INDECO:
  - RDI activities (results)
  - products and their properties
  - wastes
  - technical and scientific instruments available in the country
  - advising in the choice of technology.

### 5.3.4 RDI conducted by the RDU

Design of RDI pilot problems:

- objectives and kind of trials, economical boon, deadlines;
- design of trials, trials systems;
- requirements and conditions;

- cooperation;
- what kind of criteria must be evaluated;
- methods of evaluation, mean statistics;
- stage, substage and data of report;
- upscaling;
- forms of utilization of results of RDI activity.

### 5.3.5 RDU information services

This includes data acquisition, RDI surveying, information on technology upgrading, and information on the transfer of know-how.

#### 5.3.5.1 Data acquisition

Elements of data acquisition are shown in the following sections.

##### 5.3.5.1.1 Data acquisition techniques

- interviews
- questionnaires from ZIMCO/INDECO subsidiaries
- statistics from subsidiaries; identified bottlenecks; expansion, upgrading, and investment projects;
- data from international research centers;
- data from national research center and field station;
- data from Information Center of the Ministry of Agriculture;
- data from Vienna Agroindex;
- data from CAB (Commonwealth Agricultural Bureau);
- data from special crop field station of Malawi, Kenya and R.S.A.;
- lists of projects to be launched;
- lists of contact persons in individual companies/professions.

##### 5.3.5.1.2 Information on RDI

This should derive from and/or relate to technology audits, market windows, and the global situation on market and its trend. Also should include financial information (lack of cash, discount

cash flow, profit/loss). Yet another type of information concerns problems with pests, diseases, and weeds. Low quality of product should also be centrally known. Problems with wastes and environment are to be monitored. Spare parts are a Special component of the information system.

#### 5.3.5.1.3 Information on technology upgrading

- services and technical support direct from the manufacturer;
- reliability and performance of processes;
- comprehensive solutions and customized technology packages;
- expertise across a full range of services from feasibility to pilot system, from system design to manufacturing, from installation to technical support.

#### 5.3.5.1.4 Information on the transfer of know-how

Technology transfer is a powerful tool for promoting and accelerating sustainable economic development. However technology has usually been developed for specific purposes in a partial environment; consequently in the process of transfer it is frequently necessary to adapt it to the local conditions or modify the physical, social, and economic environment so that the technology will work.

Technology cannot on its own stimulate and sustain the development process, it requires a policy, institutional, economic, and social environment within which it can prosper. In addressing how the process of technology transfer might be improved, we should convince ourselves of the economic, commercial, and social constraints and then develop strategies and tactics for overcoming them, for improving their adaptation and adoption.

The major constraints in agriculture relate to the following factors<sup>13</sup>:

- (i) policies which do not encourage research, development, or technology transfer;

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<sup>13</sup>Bennett Andrew J., 1988

- (ii) the ability of the end user to afford the costs or risks of acquiring the technology;
- (iii) the absence of trained and experienced people who are able to analyze problems and develop or adapt technologies;
- (iv) the shortage of, or lack of, information on existing technologies and the conditions under which they do or do not work satisfactorily;
- (v) the absence of market opportunities that render it worthwhile for farmers to adopt new technologies;
- (vi) social attitudes or pressures which prevent the exploration of new ideas.

Solution for these constraints do not lie in the domain of, nor are they the responsibility of any single group; government, aid agencies, the private sector and farmers should all be involved. Information has a key role to play.

#### 5.3.5.2 RDI surveying

This involves

- Identification of production constraints
- Identification of technology related losses such as due to harvest and post harvest
- Data dissemination, how to disseminate and who is the including the decisions of recipient.

#### 5.3.5.3 Data dissemination

Local publications, circulars, technical news, letters, fax, telephone etc. as well as public mass media can be used. Seminars and workshops are important. Frequent discussions with farmers should play a key role.

The recipients of information are

- ZIMCO/INDECO executives;
- subsidiaries' RDI;
- Technology, financial, and sales managers of subsidiaries;
- GRZ;
- non-ZIMCO companies and institutions;
- general public.



## 6.0 RDU OPERATION IN AGRONOMY

### 6.1 Schedule of operations

After establishing of RDU the activities should include section:

- Phase I (start-up and routine)
- Phase II (up-scaling and integration).

### 6.2 RDU staff

One staff member is needed for agronomy/agriculture.

Guidelines for national staff:

He (she) should be qualified for research, technology and innovation studies in agronomy. The pertinent job description is appended as Annex A-2.

### 6.3 RDU methodology

Work plan recommendations for the R & D Unit in the agricultural sector:

- (1) A framework of guidelines for action for the development and transfer of technology and widespread use of appropriate indigenous technology among farmers.
- (2) According to national or company priorities, set up minimum programs which include information, manpower, and ways of transformation, development, and innovation.
- (3) A monitoring and regulatory mechanism for the inflow of foreign technology and equipment.
- (4) Strengthening and/or establishing industrial or agricultural technology information systems and linking them with regional and international systems.
- (5) Collecting and disseminating information on technology in the informal sector.
- (6) Search by key words such as "tea - pruning", data from data bases (CAB, AGRIS, Tea Research Institute, etc.) published in scientific and technical literature.
- (7) Establishing ad hoc teams of consultants; nomination of pilot project manager.
- (8) Development of pilot projects on appropriate technologies.

- (9) Costs/benefit evaluation.
- (10) Training programs.

Some suggestions for profit/cost/benefit calculation (topics to be covered):

- The innovating farmer
- The idea of benefit
- Discount cash flow
- Cost/benefit analysis proper
- Economic index selection (new varieties)
- Calculation of gross margins, net margins, costs structure for products (meat, eggs, poultry, milk, crops), measures of output, costs, margin, and profit
- Suggested layout for the calculation of net margin from a cash crop enterprise, from a livestock enterprise
- Marketing and processing of farm business survey data
- Experience with computing systems for farmers.

#### 6.4 RDU premises and facilities

Premises are covered in the main Terminal Report.

Facilities specific to agriculture include recommended laboratory instruments, plus access to computer network.

Laboratory facilities:

The RDU will operate instruments for Standardization of inputs and outputs for agro-industry, food industry, and food wholesale products. References for four recommended laboratory instruments follow.

- (1) INFRAMATIC 8620 is a NIR analyzer with 20 discrete narrow-band filters. It is microprocessor controlled and includes a keyboard and software for calibration of inputs and instrument diagnosis. Inframatic can be applied to testing grain, forage, animal feed, pet food, oilseed, milk powder, butter, cheese, yoghurt, meat, wine, tobacco, yam, cassava, fabrics, wool, rubber, etc.

Technical specifications: analysis time 20 sec, weight 15 kg, power 110, 220, 240 V 50/60 Hz. Serial interface RS-232. Calibration capacity: 18 different samples. Printer, clock and calender.

Sample presentation: powder, paste, liquid.

Software: analysis, statistics, and calibration. The instrument can analyze: moisture, protein, lysine, methionine, aminoacids, fat and its characteristics, free fatty acids, lignin, saccharides, sucrose, lactose, maltose, fructose, glucans, starch, malt quality, bakery quality, glucosinolates, chlorophyll, carotene, nicotine, gossypol, phthalic acid, malt extract, alpha acids.

Sample types: cereals, milling outputs, malt processing outputs, oil and pulps crops, feeds (meat bone powder, blood powder, yeast, stockfeeds, hay, clover, alfalfa, silage, fruits, vegetables. foods like dairy products, meat and meat products, soft drinks and other foods (chocolate, cocoa, coffee, tobacco, spices, and edible fat).

Supplier: PerCon

Tonndorfer Weg 11-13

Tel. 040/66 09 49 P.O.

Box 730 330

Telex 215 324 hira d W.-Germany

Fax 040/668 20 44 (2)

(2) **Glutomatic 2100/2200**

For gluten determination in wheat flour and mealie meal. IIC-Standard No. 137 for determination of wheat gluten quality. Fully automated; simple operation; rapid and reproducible results; no need for special conditioning or chemicals; approved for gluten Index for determination of wet gluten quality.

(2a) Centrifuge 2015 with safety locking lid for wet gluten determination (6000 5 rpm).

(2b) Glutork 2020, automatic gluten drier for dry gluten determination with timer. 4 minutes at 150°C.

(3) **Falling Number 1800**

For double determination of alpha-amylase activity.

International Standard Method Specifications. Microprocessor controlled alpha-amylase analysis system.

(4) **Laboratory Mill**

Large disk type mill for pellets, grain and oilseeds, net weight 34 kg, capacity 50 g in 10-15 sec. Power 1 or 3 phase 50/60 Hz (0.75 kW).

Supplier: FALLING NUMBER AB, Box 5101, S-141 05 Huddinge,  
Sweden.

Tel: 08-88 09 90, telex 10810 Cereal S, fax 08-88 12 10.

### 6.5 RDU financing

Estimation of funding for equipment for standardization of inputs, outputs and products:

Equipment	Estimated price [US \$]
1. Inframatic 8620	20,000
2. Falling Number 1800	4,000
3. Glutomatic 2100/2200	4,000
4. Sample Mill 3660	2,000
Total	30,000

Note: Inframatic 8620 and Sample Mill 3660 work together.

These two instruments (#1 and #4) are regarded as indispensable and their total cost of US \$ 22,000 is included in the budget envisaged for upscaling the RDU (cf. Annex 7 of the main Terminal Report). The remaining two instruments (#2 and #3), while very useful, can be dispensed with until funding is secured by ZIMCO.

## 7.0 RDI PROBLEMS TO BE ANALYZED

"In the agriculture, most, if not all, farmers farm for profit. They may - and usually do - have other objectives as well; they are no different in this respect from other businessmen. But however many objectives a farmer may have it is unlikely, these day, for profit not to come high up on the list, if not at the top."<sup>14</sup>

It is against this background that the search for meaningful measures of enterprise profit should be explored.

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<sup>14</sup>A.K. Giles, University of Rearing, 1986.

## 8.0 R & D PRIORITIES

### GRZ priorities:

- a) increase of production in the traditional sector by 7 to 10%;
- b) improvement of the marketing facilities of the traditional sector;
- c) improving animal health so as to reduce calf mortality, so that concomitant improvements in breeds and feeding will yield higher productivity;
- d) upgrading the slaughter and storage facilities to international standards;
- e) revamping livestock and pasture research services and integrating livestock and crop production;
- f) Fertilizer marketing system:  
Organizations involved in farmer training in Zambia include the International Fertilizer Development Center (IFDC) of USA and the NCZ.

The fertilizer marketing system must be made more effective through strengthening fertilizer research and soil testing so that agronomists and extension workers can provide small-scale farmers (who are the majority) with better advice on use of the chemical fertilizers, and also through programs to enable the less fortunate farmers to obtain fertilizer loans. Many small-scale farmers in Zambia apply less than the recommended fertilizer rates or do not use any because of limited resources.

Commercial farmers and companies now are allowed to import their fertilizers.

Zambia derives its fertilizers from three sources including NCZ of Kafue; the local plant is expected to play a leading role in fertilizer supply.

Plant rehabilitation is underway at NCZ to raise capacity utilization.

"Agriculture, an economy with potential for sustained growth, must command the highest

priority."<sup>15</sup> Fertilizer must be the backbone to achieve this. Zambia is well endowed with rich soils but high yields can only be obtained with good use of fertilizers.

ZIMCO priorities:

- General priority is profit for each subsidiary and for the ZIMCO group.
- Priority is also given to securing the expansion of the stockfeed industry.

Strategies:

- ensuring quality stockfeed supply to the industry;
- involving cooperative Unions in stockfeed distribution;
- strengthening extension services to small scale production of cashew nuts;
- research of the possibilities of growing alternative crops: rubber (Hevea) plantation should have intercropping and leguminous crops for microbial nitrogen enriched soil;
- ricinus 'castor growing;
- activation of kenaf project;
- soybeans hectareage should be increased;
- inoculation of pulp seeds with Rhizobium.

RDU priorities: Must conform to both GRZ and ZIMCO/INDECO priorities.

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<sup>15</sup>"Jack up fertilizer sales, urges minister"; report on fertilizer marketing seminar opened by Minister of Cooperatives; Times of Zambia, 23 April 1991.



## 9.0 RDI POTENTIAL

Selected potential new projects and technology transfers are outlined.

### 9.1 Potential new projects

- Product innovation and cooperation of milling companies with Premium Oil. Oil extraction from maize germ: the maize germ from the mill is first dried to about 3% m.c. and then extracted with solvent while at a temperature of about 121°C. The oil content of the germ is reduced by extraction from 18-25% to about 6% in the germ cake. The extracted oil is purified by filtering through cloth, using a pressure of 552-690 kN/m<sup>2</sup>. The oil is rich in essential fatty acids, has a specific gravity of 0.922-0.925, and finds use as a salad oil. Its high smoke point also makes it suitable for use as a cooking oil.
- Biotechnology for agriculture:
  - microbial inoculants,
  - mycorrhizal tablets and similar fertilizer substitutes,
  - microbial insecticides,
  - antisera and hybridoma technology for diagnosis of diseases, and vaccines.

#### Objectives:

- 1) To make the public aware of biotechnology and related technology. Strategies involve the interaction between and among the research, clientele, and extension-communication systems so that there is constant feed forward and feedback; Public awareness information research and technology centers visits for collection of data.
- 2) Low cost printed materials that explain certain new technologies.
- 3) Instructive material of manufacture technology and equipment.
- 4) Demonstration plots in various areas of the country.
- 5) Media linkages to serve as an avenue for information sharing.
- 6) Radio communication for local farming stations.

- 7) Agency linkages as dissemination efforts.
- 8) Training to upgrade technical skills and enhance positive attitudes to technology.

- Small scale production of microbial insecticides. Small scale production in tropics is cheaper due already to the fact that the requirement of input energy to maintain the cultivation temperature is substantially lower than in moderate climate, or even negligible. This advantage makes it clear that it is here where the small scale production can successfully compete with big producers. Another advantage is that long-term storage poses fewer problems, inasmuch as the products will be implemented locally. Utilization of microbial insecticides is the natural way of pests control.<sup>16</sup>

Registration by GRZ should be introduced. Imports of insecticides could be reduced by starting own production based on *Bacillus thuringiensis*, *Metarhizium anisopliae* and *Verticillium lecanii* are examples.

## 9.2 Potential technology transfers

Alley Farming can serve as an example. Developed for tropical Africa in Nigeria at the International Institute of Tropical Agriculture, Ibadan it is suitable for KTC estate for rural people living at the estate. Alley cropping involves agro-forestry to simulate the nutrient recycling activity of forest trees. Deep rooted perennial shrubs are planted in rows and the "alleys" between the shrubs are cropped. Occasional pruning of the shrubs provides mulch cover, crop nutrients and organic matter, but, in addition, can provide firewood, livestock browse and yam stakes. Alley cropping was developed primarily for small-scale farmers, but has since been adapted for mechanized farms as well. Alley cropping reduces the use of nitrogenous fertilizers; *Leucanea leucocephala* is one of the trees recommended for the "alleys".

## 9.3 Subsectorial specifics

New crops and varieties:

New varieties of maize Opaque-2 maize should be imported and

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<sup>16</sup>It is known that DDT is still used by Zamseed. This practice should be discontinued.

grown but only for stockfeeds. They give higher contents of lysine. Ricinus 'Castor' Plantation should be tried, too.

**Fertilizers:**

In biotechnology for agriculture, new microbial inoculants should be examined for screening.

**Pesticides:**

Nakambala estate should go into microbial production of insecticides, to utilize waste molasses.

**Techniques :**

The instruments specified in Chapter 6.4 can test the quality of agro-industry inputs and outputs, and also foodstuffs.

## 10.0 RECOMMENDATIONS IN THE AGRONOMY SECTOR

### 10.1 Recommendations on cooperative linkage between RDU and ZIMCO subsidiaries

- 1 RDU should initiate an evaluation of a ZCC byproduct the CNSL (cashew nut shell liquid) for better use of the liquid which now is burned. It could be used for impregnation of poles produced by ZAFFICO for ZESCO.
- 2 In 1989, ZAFFICO imported from the U.K. 681 tones of creosot for waterproofing of poles. RDU should help to contact ZCC with ZAFFICO and to develop a new method of waterproofing the poles and perhaps other products as well. CNSL from ZCC might be the right impregnation agent.
- 3 Valorization of cashew apples at ZCC and smallholders. The cashew apples are now left to rot on the ground after cashew kernels harvesting.
- 4 RDU should be active in the evaluation of selected intercropping products (chili, bell pepper) during the first 3 years after planting the cashew trees.
- 5 ZSC at its Nakambala estate, need to solve the optimization of their company transport in hauling in the harvested sugar cane to the weighbridge and the sugar factory. Computer assisted network analysis should be used here.
- 6 Research the possibility of growing alternative crops:
  - rubber (Hevea) plantation should have adequate intercropping and should have leguminous crops for microbial nitrogen intake into soil (from the atmosphere)
  - the kenaf project should be activated for KIFCO
  - soybean hectarage should be increased; this depends on the pricing policy. Investigate possible price modifications. Also, an increased level of seed inoculation should be considered .
- 7 Product innovation through RDU-initiated cooperation of milling companies with Premium Oil and R.O.P. Oil extraction from maize germ is a project worth considering. - This gives very high quality salad oil and cooking oil.

8 Proposal of a mixed-products farm at Nkumba Piggery. Grow feed maize around the piggery; process all harvest by hammer mill locally; and save on transport etc.

10.2 Recommendation on cooperative linkage between RDU and non-ZIMCO institutions.

- 1 RDU should arrange for sharing of laboratory and testing equipment within the agro and food sector.
- 2 National Milling and other millers such as United Milling need standardization of inputs as well as of outputs, because the quality of bread and biscuits depends on the quality of flour and this again depends on quality of the grain.
- 3 RDU should cooperate with the Zambia Bureau of Standards to improve standardization of inputs and outputs in agro-industry and food wholesale.
- 4 RDU should function as a reference laboratory for assessment of grain, milk, fat, oil, seed and so on, because parties to contracts have no one in Zambia to tell them who is right and who is wrong in disputes over quality.
- 5 The RDU should be equipped, by UNIDO or by INDECO, with the INFRAMATIC 8620 which is NIR analyzer. This instruments can test the quality of agro-industry inputs and outputs, and also foodstuffs. Other instruments have also been recommended.
- 6 Small scale production of microbial insecticides. It is know that DDT is still used by Zamseed, which is very bad. Registration of pesticides and insecticides by GRZ should be introduced. Imports of insecticides could be reduced by starting own production.
- 7 Nakambala should go into microbial production of insecticides, to utilize waste molasses.
- 8 In biotechnology for agriculture, new microbial inoculants should be examined for screening. Then it will be unnecessary to artificially introduce nitrogen into soil.
- 9 New varieties of maize should be imported and grown, but only for stockfeeds. They give higher contents of lysine and

this in turn increases weight increments in poultry and pigs.

- 10 Maize byproducts should be utilized. Approximately 180 kg of cobs are obtained from each ton of maize shelled. The annual production of cobs in Zambia is about 1 million tons! It can be used in agriculture as

- litter for poultry and other animals,
- mulch and soil conditioner
- animal and poultry feed, and
- carrier for insecticides and other pesticides by granular formulation. It can however also be used in industry in
- the production of vinegar
- cleaning,
- burnishing and polishing,
- roofing, bricks, and ceramics,
- oil well drilling,
- filler for explosives, plastics, glues, adhesives, rubber compounds, and tires but also for the production of
- furfural,
- fermentable sugars,
- solvents,
- liquid fuel,
- charcoal,
- chemicals by destructive distillation,
- paper and cardboard, or can be used as solid fuel.

- 11 Proposal on how to utilize milk from small-scale farmers who keep some 80% of all dairy cattle in Zambia.

Dairy Produce Board is incapable of ensuring continual collection of milk to dairy from this group of cattle farmers. The reason is that the collection routes are rather scattered and for reasons of economy but also for technical reasons the milk would not arrive unimpaired at the dairy.

It is recommended that milk is centrifuged on site (i.e., at the farms) and churned to butter and white cottage cheese.

The VIS should support local centrifuging of milk using hand-operated centrifuges, just as it does support

expansion of local hammer mills.<sup>17</sup> VIS supports local milling of maize in rural hammer mills and also trains the hammer mill operators. Rural workshops worth ZMK 37,328,726 will be built by VIS in provincial centers in 1991, and the Copperbelt Cooperative Union (CCU) has bought hammer mills worth ZMK 2.5 mln for its depots.

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<sup>17</sup>"VIS trains mill operators", Times of Zambia, 24 April 1991.

## 11.0 CONCLUSION

This Technical Report is part of an interdisciplinary effort to upgrade research, development, and technology at ZIMCO/INDECO and in Zambia in general.

It is concluded that

- an agronomy/agriculture specialist should be engaged at the Research and Development Unit of ZIMCO/INDECO
- a variety of potential projects in agronomy/agriculture are worth analyzing, monitoring, and reviewing with a view to full implementation;
- the link between agriculture and industry should be strengthened.



## ANNEX A-1

## ZIMCO/INDECO subsidiaries and associate companies involved in the agronomy subsector

Company	Bordering on sector(s)	Principal products/services
AFE Ltd.		trading in agriculture machinery & equipment (retail)
Amalgamated Millers Zambia Ltd. (incl. E C Milling, Robin Hood, Ghirardi	F	mealie meal stockfeeds mealie meal & stockfeeds
Choma Milling Co. Ltd.	F	mealie meal
Indeco Milling Co. Ltd.	F	mealie meal & stockfeeds
Industrial Development Corp. Ltd.	C,F,T	mixed
Kabwe Industrial Fabrics		mealie meal bags
Kawambwa Tea Co. Ltd.	F	tea, banana
Lusaka Engineering Co. Ltd.	T	metal products (window & doors frames, bus bodies, nails & bolts, furniture, agriculture implements)
Mpongwe Development Co. Ltd.	F	farm crops, gladioli, seed potatoes, coffee
Mulungushi Investments Ltd. formerly ZIMCO	F,T	mixed (bus services; farms; milling & stock- feeds; poultry)
Zambia Sugar Co. Nakambala Estate Ltd.	F	sugar cane, molasses/urea feed fertilizer and spec. feed
National Milling Co.	F	mealie meal & stockfeeds salt, rice trading
Nchanga Farms Ltd.	F	crops & livestock

Ndola Lime Co.	C	lime
United Milling Co. Ltd.	F	mealie meal
Zambia Cashew Co.	F,C	cashew nuts
Zambia Coffee Co. Ltd.	F	coffee
Zambia Forestry and Forest Industry Corp. Ltd.		timber, poles & wood product
Zambia Maltings Ltd.	F	malt, malt barley
Zambia Seed Co. Ltd.	T	seeds trading
Zimco Institute of Management	C,F.T	training

A=agricultural, F=food industry, C=chemical industry, T=transport

## ANNEX A-2

## Job description for Agronomy/Agriculture specialist

## Duties:

- To participate, under the general direction of the RDU Head and in close cooperation with the other staff members, in the startup and routine work of the RDU.
- To close monitor all RDI activities in agriculture (crops and animal husbandry).

The specialist will be expected to perform the following activities:

- review the results of the "ZIMCO Technology Audit" in given professional area
- follow the technology audit at other ZIMCO/INDECO subsidiaries
- introduce a methodical approach to evaluation of existing and future agricultural requirements in the ZIMCO/INDECO group
- extract relevant data from the technology audits
- generate and update lists of all inputs, outputs, and wastes in agriculture
- convert above lists to data banks input format
- assist companies in accelerating existing R & D
- identify RDI problems to be analyzed and potential new RDI projects to be launched
- make efforts to initiate the utilization of wastes from agriculture and look for economical, effective, and environmentally harmless waste disposal methods
- advise companies on utilization of waste outside agriculture
- take an active part in dissemination of information on agricultural R & D problems
- write a list of R & D contact persons at all companies which can maintain links in the area of R & D to other sectors
- mediate company-to-company links in agriculture
- establish a system of information in RDU for computer data bank
- advise RDU Head on participation by professionals from agriculture in the work of the ad hoc teams on cross-sectorial or multi-sectorial projects
- provide help to subsidiaries in their efforts to establish, expand, or reorient their R & D departments
- establish and maintain linkage between NCSR, UNZA, international research centers in agricultural sector,

national research institutes, and traders who ensure inputs for agricultural sector and RDU in the area of agriculture

- look for natural or local resources which can be used for the solution of agricultural problems
- advise on the rehabilitation of equipment for alternative production
- advise on development of relations between agriculture and food processing within a comprehensive agro-industry utilizing natural resources and operating without wastes.

## ANNEX A-3

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