Ministry of Lands, Agriculture, Fisheries,
Water and Rural Resettlement

FARM MANAGEMENT HANDBOOK FOR FARMERS

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Contents

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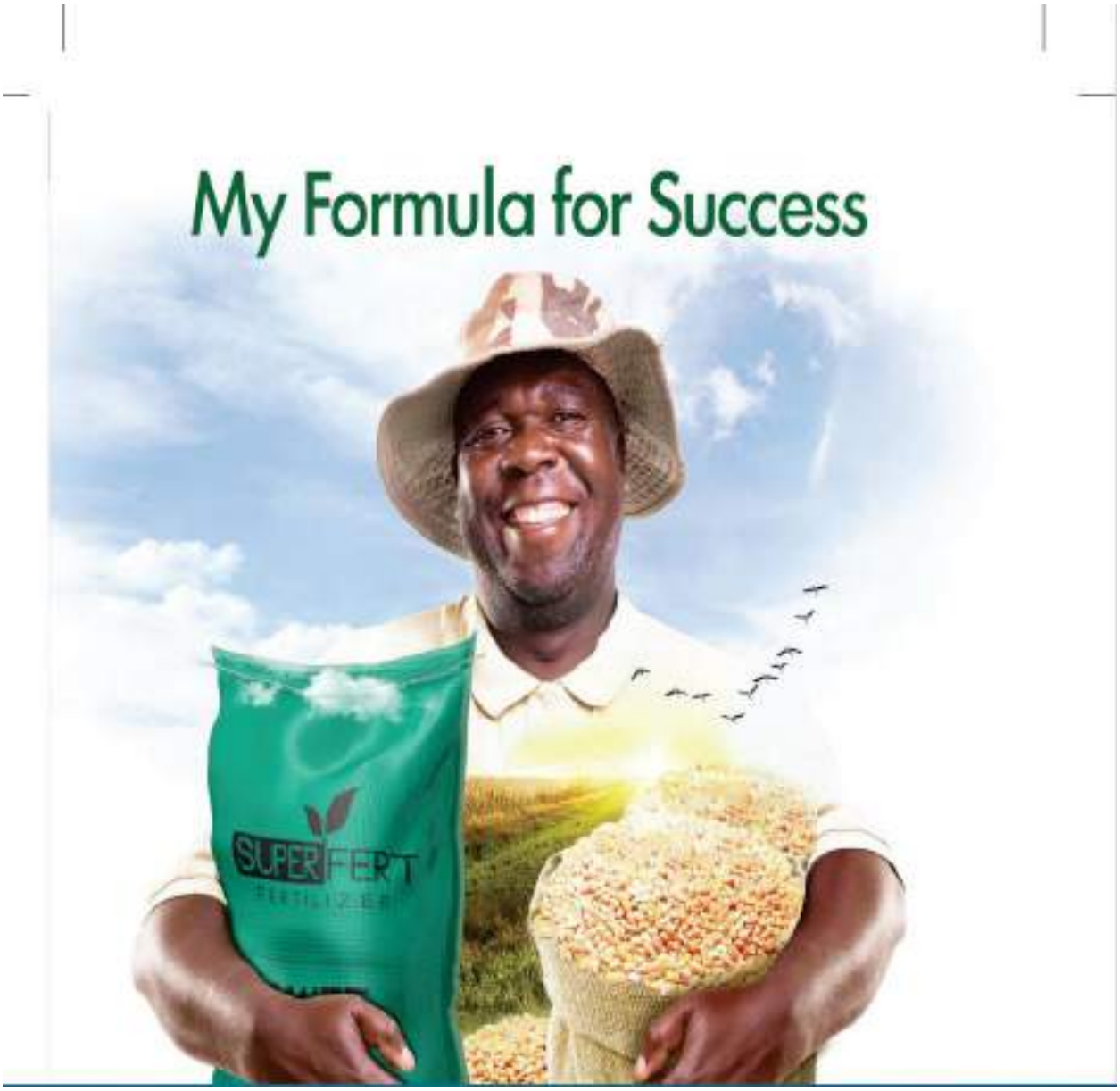
THE MANUAL

The Farm Management publication was developed specifically for all those who would want to become Lead Farmers. It is going to serve as a reference point for all farmer categories in Zimbabwe. It is the Ministry's hope that farmers will use this manual and be able to improve on production and productivity thereby reversing the negative trends suffered by the Sector in the past 2 decades



FARM MANAGEMENT

Farm management is a decision-making process. It is a continual process. The decisions are concerned with allocating the limited resources of land, labor, and capital among alternative and competing uses. This allocation process forces the manager to identify goals to guide and direct the decision making" (Kay and Edwards 1994)

FINANCE

Taxes

Who is eligible?

- Any commercial farmer with business income is eligible for taxation. Farmer must be registered with the Zimbabwe Revenue Authority (ZIMRA) and submit their annual retums i.e. estimates of annual profit.

Income tax: Rate and calculation

- A farm is a business entity therefore it is required to pay 30% of their annual return like any other business. However, the annual tax amount can be staggered quarterly as follows: -

Pay By Date	***Tax amount (check with your accountant or local ZIMRA Offices)***
25 March	*10%*
25 June	*25%*
27 September	*30%*
20 December	*35%*

If farmer pays himself or a manager a salary above the tax free level s/he should register for PAYE deducted monthly.

Allowances

Farmers have a prerogative to claim for allowances for the following expenses.

- Costs of stumping and clearing land.
- Costs incurred for any soil and water conservation works.

- Costs for aerial and geophysical surveys.
- Costs for building workers' accommodation.
- Fencing etc.

Value Added Tax (VAT)

If farm's income is greater than the stipulated income, then s/he is eligible for VAT registration. Farm produce is zero rated i.e. farmer is exempted from paying VAT, but are still required to register.

Insurance

Types of insurance

Type	**Coverage**	**Conditions**
Crops	field to floor; hail; fire; lightning; malicious acts while in storage, dropping crop grade as a result of water damage prior to harvest e.g. for winter crops like wheat, summer crops like soya beans. Rust attack cover in Soya beans, pest attack e.g. quelea birds and locust or grain borer in transit.	Fill proposal form for the crop **TOTAL SUM ASSURED= EXPECTED YEILD x PRODUCER PRICE** Producer price is estimated according to costs/ expenses incurred where the producer price is not announced prior to harvest. The premium= total sum assured x n% (n depends on type of crop). The value of n for soya beans 3%, wheat 4%, and all other crops are 3%. One off payment is made or monthly instalments in 90days during the cropping season.
Livestock	Cover for all risk e.g. theft, fire, lightning, accidents, malicious damage, and all diseases.	

Terms/ Conditions of insurance

Procedure for making claims

- Call the insurer regarding the claim and supporting evidence should be made available.

Livestock

Loss	**Documentary requirement**	***Issuing Officer***
Death due to disease	Post mortem report	*Veterinary Officer*
Malicious damage / injury	Slaughter order	*Veterinary Officer*
Theft	Police report	*Police Officer*
Lightning	*Post mortem report*	*Vet / Police Officer*

- Payment is made for the losses once the above is complied with.

Crops

- Call the insurer within 48 hours regarding loss, then the insurer will send assessors who will assess the damage or loss and agree on the figure with the farmer and then payment will be made.

Agricultural Finance

- The best source of farming capital is from <u>profits</u> generated on farm activities. Finance from borrowing can be in three categories;

Category	**Requirements**
Short term loans	Repaid in 18 months or less and is used to finance the annual production cycle. Short term loans are required for items like fertilisers, seed, labour, chemicals etc.
Medium term loans	The loans intended for pumps, purchase of machinery etc. They are repaid in 5 years or under.
Long term loans	These are loans with a repayment period of more than five (5) years and are usually required for major developments like the purchase of land, dam construction etc.

Sources of Finance

The major sources can be classified under formal and non-formal.

Category	Type	Advantages	Disadvantages
Formal	Financial Institutions e.g. banks, building societies	Can give as much as one needs.	Need for collateral security.
	Input Suppliers	Get back-up support or technical advice. -Minimal or no collateral security required.	- Normally give a limited loan -Area specific or relate to company interests in certain parts of the country.
	Commodity marketing institutions	-Assured of a market for the commodity. -Technical support service provided. -Minimal or no collateral security required.	-Loan is commodity specific. -Limited market choice for the produce. -Market conditions may change.
Informal Sources	Friends/Relatives	-Interest may not be charged. -Very few formalities involved. -No collateral security may be required.	-Repayment period may be too short for farmer to have produced and sold commodity.
	Conversion of assets	-Assists in getting rid of useless or under-utilised items on the farm.	-May sell critical assets and leave the business under-capitalised. -May lose on price if sale is done in a hurry.
	Lease back Selling out asset with an agreement from the buyer to lease back**.**	-Access to a lump sum. -There is business continuity.	-Farmer loses ownership and control. -May lose on price if sale is done in a hurry.

	Leasing / hiring out Hire out of asset	-Collecting income from idle assets. -Benefits from improvements on assets e.g. land.	-May lead to destruction of resources if not well planned. -Assets hired out may come back in unusable state.
	Joint ventures Conversion of a farm to a private company and floating shares.	-No risk of losing some property. -Retains personal motivation and confidence. -May get better technical advice.	-Farm needs to maintain a very high level of performance to maintain the presence of partners. - Many decision-makers may lead to confusion.

Interest and redemption on loans

Factors that influence the cost of capital:

- Amount of capital to be borrowed.
- Time period in which the capital will be used before repayment.
- Rate of interest.
- Bank charges.

Loan repayment

When money has been borrowed the repayment is composed of:

- Interest (this is the charge for borrowing money and is calculated on an annual/monthly basis.
- Redemption (this is the repayment of the sum borrowed, the principal amount of the loan) and the farmer is usually expected to pay regular amounts periodically.

Loan Application

- Always submit your loan application well before the season starts.
- It should be filled clearly and all required and accurate information provided.
- Falsified personal information may lead to prosecution orders by the lending institution.
- Technical and financial information about the farming activities may be required by the lender e.g. Profit and Loss Account, balance sheet, enterprise, whole farm and cash flow budgets for period when the loan is required.

- Aim to repay the loan over an asset's/project's life time e.g. a short term loan, should be repaid within one season and avoid spilling into the next season.
- Borrow when it is absolutely necessary.
- Repayment of loans should not be postponed. If it has to be done, do so with the concurrence of the bank.
- Borrowed capital should always be used for the intended purpose.
- If one follows the basic borrowing principles, then chances of failure will be greatly reduced.

- **Never borrow to bolster a failing enterprise unless the reasons for failure have been thoroughly investigated.**

Enterprise Selection

Selection of a suitable enterprise or mix of farm enterprises to undertake on a farm is critical. Proper selection of what to do is key in enhancing the success of a farm business and minimises the chance of defaulting on loans obtained by the farmer. While most lenders, particularly formal, require the farmer to draft a project proposal to accompany the loan application, it is true that a significant number of financiers do not due proper due diligence in as far as following up on the feasibility, viability and general truthfulness of information submitted in the project proposal/business plan. The lack of diligence is particularly common among informal lenders and micro financiers who often offer expensive loans (high interest rates). As a farmer, particularly new ones, you need to understand first your soil type, agro climatology of the area your farm is located and the crop & livestock requirements that can be supported on your farm/plot among others. We present some key factors that as a farmer you should consider before settling on a particular mix of crop and or livestock enterprise.

Factors to consider when selecting farm enterprises

Climatic factors

- Is the crop/cropping system suitable for local weather parameters such as temperature, rainfall, sun shine hours, relative humidity, wind velocity, wind direction, seasons and agro-ecological situations?

Soil conditions

- Have you sampled your soils?
- What are soil types on the farm/ plot?
- Is the crop/cropping system suitable for local soil type, pH and soil fertility?

Water

- Do you have adequate water source like a tanks, wells, dams, etc.?
- Do you receive adequate rainfall?

- Is the distribution of rainfall suitable to grow identified crops?
- Is the water quality suitable?
- Is electricity available for lifting the water?
- Do you have pump sets, micro irrigation systems?

Cropping system options

- Do you have the opportunity to go for inter- cropping, mixed cropping, multi-storeyed cropping, relay cropping, crop rotation, etc.?
- Do you have the knowledge on cropping systems management?

Past and present experiences of farmers

- If you have tried the enterprise before, what were your previous experiences with regard to the crop/cropping systems that you are planning to choose?
- What is the opinion of the Local Extension Officer?

Expected profit and risk

- How much profit are you expecting from the proposed crop/cropping system?
- Whether this profit is better than the existing crop/cropping system?
- What are the risks you are anticipating in the proposed crop/cropping system?
- Do you have the solution? Can you manage the risks?
- Is it worth to take the risks for anticipated prof- its?

Economic conditions of farmers including land holding

- Are the proposed crop/cropping systems suit- able for your size of land holding?
- Are your financial resources adequate to manage the proposed crop/cropping system?
- If not, can you mobilize financial resources through alternative routes?

Labour availability and mechanization potential

- Can you manage the proposed crop/cropping system through your family labour?
- If not, do you have adequate labourers to manage the same?
- Is family/hired labour equipped to handle the proposed crop/cropping system?
- Are there any mechanization options to substitute the labour?
- Is machinery available? Affordable? Cost effective?
- Is family/hired labour equipped to handle the Machinery?

Technology availability and suitability

- Is the proposed crop/cropping system suitable?
- Do you have technologies for the proposed crop/cropping system?
- Do you have extension access to get the technologies?
- Are technologies economically feasible and technically viable?
- Are technologies complex or user-friendly?
- Market demand and availability of market infrastructure
- Are the crops proposed in market demand?
- Do you have market infrastructure to sell your produce?
- Do you have organized marketing system to reduce the intermediaries?

- Do you have answers for questions such as where to sell? When to sell? Whom to sell to? What form to sell in? What price to sell for?
- Do you get real time market information and market intelligence on proposed crops?

Policies and schemes

- Do Government policies favour your crops?
- Is there any existing scheme which incentivises your crop?
- Are you eligible to avail those benefits?

Public and private extension influence

- Do you have access to government and private extension officers?

Availability of required agricultural inputs including agricultural credit

- Do you get adequate agricultural inputs such as seeds, fertilizers, pesticides, and implements in time?
- Do you have access to institutional credit?
- Post-harvest storage and processing technologies
- Do you have your own storage facility?
- If not, do you have access to such facility?
- Do you have access to primary processing facility?
- Do you know technologies for value addition of your crop?
- Do you have market linkage for value added products?
- Are you aware about required quality standards of value added products of proposed crops?

Farm Planning and Budgeting

Farm Production Plan

Cropping Programme

List crops and the area in hectares by year

Field No.	**Crop**	**Area in ha**				
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**

- Give the details of rotation principles (Refer to CA and crops sections) and the assumptions on annual cropping area (Refer LUP Section).
- General production assumptions and detail (yields, plant population, fertilizer use, labour, machinery and equipment, harvesting methods etc).

Livestock programme

- State the type of livestock to be kept and the production/sales policy e.g. breeding and sale of two year steers and heifers, pen feeding etc.
- Show the herd build up and composition by year.

Example: Beef

	Number of animals				
	Year 1	Year 2	Year 3	Year 4	Tear 5
Bulls					
Cows					
Bulling heifers					
Heifers 1 year +					
Steers 2 years+					
Steers 1 year +					
Calves					
Purchases					
Total					
Sales					
Total					

Give assumptions on calving rates, weaning rates etc.

Production practices (feeding principles, grazing, breeding etc) (Refer to Livestock Section).

Farm Budgets

Type	Usage
Whole Farm	• For measuring overall farm profitability.
Partial Budget	• For measuring effect of small changes at the farm.
Gross Margin Budget	• To measure the profitability of an enterprise.
Cash-Flow Budget	• To estimate the availability and need of cash during the year.

Guide to Farm Budgeting

- Define the cropping programmes and determine the target output levels.
- Workout the enterprise gross margin budget by:
    - Listing all operations to be carried out.
    - Estimating all input requirements for each operation.
    - Estimating costs of inputs and prices of output.
    - Calculate the gross margin (Gross Income less Total Variable Costs).
- Estimate farm overhead costs.
- Estimate loan repayments on medium and long term capital.
- Put all enterprise budgets together to come up with a whole farm budget.

Examples of Calculating Unitary Costs

Labour Cost

The cost of labour varies from time to time.

Calculating cost per Labour Day

Grade of worker	General worker	Charge hands	Foreman & driver	Heavy duty driver	*Average worker*
% of total workforce	80%	6%	13%	1%	
Basic monthly wage (A)					
Basic annual wage (B)/(Ax12)					
Annual accommodation(C)					
Total (D)					
Workforce Compensation @ 6% of D (E)					
Annual lightning allowance (F)					
Contribution to pension fund 2% of B (G)					
Protective clothing 5% of B (H)					
Dues for National employment council for Agric Ind (I)					
Labour cost /year (B+E+F+G+H+I) (J)					
Labour cost /month (K)					
Labour cost / day (k/24.6)					

Annual accommodation, Annual lightning allowance, Dues for National Employment Council for Agriculture Industries are gazetted by the interested parties.

A labour day is about 8 working hours and there are 24.6 labour days per month

Livestock Enterprise Budget

Cattle Account : - 1 October Year ..... to 30 September Year .....

Opening Stock (start of year)				**Closing Stock (end of year)**		
No	Value	Total	Class of stock	No	Value	Total
2	2,000	4,000	Bulls	2	2,000	4,000
20	400	8,000	Breeding Cows	25	400	10,000
5	300	1,500	Bulled heifers	7	300	2,100
15	200	3,000	Heifers 1-2 years	15	200	3,000
8	300	2,400		8	300	2,400
8	200	1,600	Steers 2+	7	200	2,100
15	60	900	Steers 1+ Calves	17	60	1,020
Birth 17 calves	-			Deaths 1 calf		
Purchases	-			Sales 8 Steers	350	2,800
Total (A)		**21,400**		**(B)**		**27,420**
Gross Income (A-B) Trading Profit		6,020				
		27,420	TOTAL			27,420

Gross Income (Trading profit)		**6,020**	
Variable costs			
Dips and medicines		**500**	
Labour			**800**
Transport		**300**	
Total Costs		**1,600**	
Gross Margin	**(6,020 -1600)**	**4 420**	

Crop Enterprise Budget

There are several ways of compiling a crop enterprise budget. In this manual two methods are presented. The first one is mainly aimed at ensuring that the farmer can easily record inputs and costs at each stage of the production cycle. It emphasizes the different stages of the operations. The other method is the one which emphasizes the returns at different yield levels. The first method is presented below. The other method is shown on sample budgets at the end of the section.

Crop Enterprise Budget Sample: Method 1				
Activity	**Unit**	**Quantity**	**Price**	**Total (US$)**
Preparatory cultivation				
a) Machine / labour	No of hours			
b) Animal / labour	Labour Days			
Sub Total				
Seeds and sowing				
a) Cost of seed	Kgs			
b) Cost of seed treatment	Grams			

c) Cost of sowing (Human Labour)	Labour Days			
d) Cost of thinning/gap filling	Labour Days			
Sub-Total				
Manures and Fertilizers				
a) Cost of organic fertiliser	Tonnes			
b) Application cost (Human Labour Male)	Labour Days			
c) Cost of fertilizer	Kgs			
	Kgs			
	Kgs			
d) Application cost (Human Labour Male)	Labour Days			
Sub-Total				
Weed control				
a) Cost of Manual weeding	Labour Days			
b) Cost of herbicide if any				
i) Pre-Emergence	Litre			
ii) Post Emergence	Litre			
Sub-Total				
Plant Protection				
a) Cost of bio-agents	Kgs			
b) Cost of pesticides	Litres			
c) Cost of Fungicides	Litres			
d) Cost of Application	Labour Days			
Sub-Total				
Irrigation cost if any	Power			

i) Water Charges/levy (ZINWA)	cubic metres			
ii) Power Charges (ZESA)	KWHr			
Sub-Total				
Cost of harvest				
a) Combined harvester	Hours			
Post-harvest charges				
b) Cleaning and bagging (Human Labour)	days			
Sub total				
Total cost of cultivation				
Yield Kgs/Ha. and returns				
a) Qty. produced in Tonnes per Hectare	Tonnes/HA			
b) Gross Returns received per ha	USD $			
c) Total cost involved per Ha	USD $			
d) Gross Margin per HA	USD $			
e) Cost benefit ratio (Gross Returns divided by Total Cost)				
f) Break Even Yield (Total Cultivation Costs /Price)	Tonnes/HA			
g) Break Even Price (Total Cultivation Costs /Yield)	$/Tonne			

Whole farm budget format

Crop/Livestock/fish enterprise	**Area/herd**	**Gross Income**	**Total Variable Costs**	**Gross Margin**
1. Maize 2. ……				

3. ……				
Total				
Less fixed/overhead expenditure Loan Repayments (Medium and long term)				
Whole farm Profit				

Partial Budgeting

Four factors considered:-

- What new or additional costs will be incurred?
- What current income will be lost or reduced?
- What current costs will be reduced or eliminated?
- What new income will arise?

Situations in which partial budgeting are applicable for decision making include the following:

a. Change in the combination of enterprises:

   i. Substituting a new enterprise for an existing one

   ii. Change in size or scale of an enterprise

   iii. Introducing a supplementary enterprise

b. Change in production methods or management practices:

   i. Buying a new machine/plant

   ii. Adopting a new technology e.g. herbicide use, conservation agriculture (CA), artificial insemination (AI), feed formulation

By comparing total reduction in profit with total increase in profit, the net change in profit can then be worked out:

Additional Income (AI)	Reduced income (RI)
Reduces cost (RC)	Additional Cost (AC)
Total Gain (A) = AI + RC	Total Loss (B) = RI + AC

Net change in profit = A – B

Net Gain: (AI+RC) > (RI+AC)

Monthly Cash-flow budget

Items	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Cash Inflow (sales)													
Maize													
Cotton etc													
Beef etc													
Capital Loan													
Total													
Cash Outflow													
(Expenses)													
Seed													
Fertilizer													

Chemicals													
Labour													
Feed													
Veterinary Costs													
Transport													
Repairs &													
Maintenance													
Packaging													
Water													
Electricity													
Salaries & bonuses													
Office Expenses													
Staff Costs													
Interest													
Office Expenses													
Staff Costs													
Interest													
Capital loan Repayments													
Total Outflow													
Net Cash flow (Inflow-outflow)													
Cumulative Cash flow													

Farm Development ANNUAL CASH FLOW

Activity	**Year 1**	**Year 2**	**Year 3**	**Year 4**	***Year 5***
Cash inflow (Sales)					
1. Maize					
2. Soya Bean					
3. Poultry					
4. Capital Loan					
Total					
Cash Outflow					
(expenses)					
Seed					
Fertilizer					
Chemicals					
Labour					
Feed					
Veterinary Costs					
Transport					
Repairs &					
Maintenance					
Packaging					
Water					

Electricity					
Salaries & bonuses					
Office Expenses					
Staff Costs					
Interest					
Capital loan Repayments					
TOTAL OUTFLOW					
Net Cash flow (Inflow-outflow)					
Cumulative Cash flow					

Farm Business Plan Format

- Title Page
- Introduction
- Objectives
- Project Description
- Management Structure and Staffing
- Production Plan
- Marketing Plan
- Financial Plan
- Justification/Strengths Weaknesses, Opportunities and Treats Analysis

Evaluation of Farm Performance

Records and Record keeping

Records enable management to measure performance of each enterprise and then of the whole farm.

Physical performance

During the production process inputs (seed, fertiliser, labour fuel, feed etc.) are used to produce output. We need to measure the use of these resources against the level of output.

Some measures of performance for crop enterprise may include: -

- Yield (tonnes per ha)
- Labour (days per ha)
- Fuel (litres per ha)

Livestock Physical Performance Records: - examples

Beef: - calf growth (weight gains), weaning rates, calving rates, feed intake, conception rates, disease incidence.

Dairy: -milk yields per cow, milk quality (butterfat, protein, total solids etc.), calving rates, conception rates, feed intake, lactation length, days to peak milk yield, disease incidence

Pigs: -litter size, farrowing cycle, feed intake, pig growth (weight gains), and disease incidences

Financial performance

At the end of the season, we need to know how well individual enterprises performed and contributed to whole farm profit. It is important that the necessary information is collected regularly and accurately.

The Cash Book

The cash-book is a simple list entry system. It is one of the recording formats used on the farm that records all cash transaction during the year.

Example of a Cash Book

Item	Comment	Cash in	Cash out	Balance
Balance b/f				4000
Loan received	Bank X	5000		9000

Fertiliser (8 bags)	ım		240	8760
Fertiliser (8 bags)	Maize		240	8520
Labour	ead		500	8020
Steers (5)	to abattoir	1800		9820
Seed	Maize		600	9220
Seed	Sorghum		800	8420
Diesel Fuel (500 litres)			500	7920
School fees	Household		1000	6920
Balance **b/d**				6920

Profit and Loss (P/L) Account

- P/L Account shows the farmer the amount of profit or loss which has been achieved or incurred during the past season/ financial year.
- Profit is not only the excess of cash sales and receipts over cash purchases and expenses, but a factor of the opening and closing value of assets (valuation). That is the value of items on the farm at the beginning and end of financial year.

  The layout of a P/L for the farm will take into account the different enterprises on the farm.

Example

Profit and Loss Account for the year ended 30 September 2009.

Income	$
Sorghum	22 000
Cattle	110 000
Total	132 000

Expenditure

Sorghum	10 350
Cattle	30 000
Overheads	20 000
Total	60 000
Profit (132 000 - 60 000)	72 000

Use of income and expenditure accounts

- We can see how each enterprise performed financially and contributed to the whole farm profit. It helps us to plan for the next season.
- To compare income and expenditure accounts with the budgets that were made at the beginning of the season. If there is a difference from what we expected check if:
    - Costs are higher than expected? (Because of higher input levels or higher prices).
    - Incomes less than expected? (Because of lower yields or lower output prices).
    - Costs lower than expected? (Lower input levels or lower prices).
    - Incomes higher than expected? (higher yields or higher prices).
    - A mixture of the above.

Farm Balance Sheet

A balance sheet statement shows size of the farm business in terms of its value or net worth as at a given date.

Types of Farm Assets

These are grouped into two types, depending on their liquidity at the farm.

Current Assets*:* which can be converted to cash within one financial year.

Working Assets- Used in the production processes, such as fertilizers, chemicals, seeds, nails, broiler chickens and hoes.

Liquid Assets: Can easily be converted to cash within a short time without affecting the production of the farm e.g. cash in hand or in bank, and farm produce ready for sale.

Fixed Assets: Not easily converted to cash e.g. farm buildings, machinery, roads, soil and water conservation works, breeding stock, farm carts and oxen.

Types of Farm Liabilities

- Liabilities generally refer to amounts which the farm business owes.
  - **Current Liabilities:** Payable within one year e.g. sundry credit and bank overdraft.
  - **Long Term Liabilities:** Payable after one year e.g. medium and long term loans.

Layout Structure of Farm Balance Sheet

- On **right** hand side, are Assets and on the **left** side are liabilities. The Net Capital is the **balancing item.** If there is a surplus, the **Net Capital** is written on the left side. But if there is a deficit, it is written on the right, (the asset side) to balance. Therefore, it becomes the Net Deficit.

Balance sheet layout

Liabilities (Debts)	**Assets (Possessions)**
	Current Assets
Current Liabilities ---------$	(i) Liquid Assets--- -----$ (ii) Working Assets------$
Long Term Liabilities -------$	Total Current Assets----------$
	Fixed Assets----------$
	Total Assets----------$
	Net Deficit----------$
Net Capital.....$	
	Totals----------$XXX
Totals----------$XXX	

Interpreting the Farm Balance Sheet Statement

Farm Solvency

If the total value of assets is greater than the total value of liabilities, the farm business is said to be solvent. But if the total value of liabilities is greater than the value of assets, it is said to be insolvent.

Liquid Assets and Current liabilities

The value of liquid assets should be greater than the value of current liabilities to help the farm business to survive unexpected demands of cash.

Valuation of the assets at the farm may include: -

- **Saleable Crops in Store:** The estimated market value **less** marketing expenses to be incurred.
- **Growing Crops**: Total variable costs incurred up to date of valuation.
- **Saleable Crops ready for harvesting but still in the ground**: These should be valued like saleable crops in store minus estimated harvesting costs.
- **Stocks:** At current market value. These are possessions of the business (other than cash) that are likely to be consumed within one financial year e.g. fertilizer and working materials.
- **Livestock**: at current market value minus marketing costs (if any).
- **Land**: Current market value, plus cost of land preparation incurred.
- **Machinery and Equipment**: At original cost minus accumulated depreciation up to the date of evaluation.

General Information

Climatic Data

Significant rainfall = Rainfall in excess of a given criterion.

Rainy season = Period between October 3 and April 30.

Growing season = Period between germination and physiological maturity.

Dry spell = A period between eleven and twenty days without significant rain.

Pentad =A period of five days.

Dry pentad = A pentad period of five days without significant rain.

Wet pentad = A pentad with significant rain.

Dry day = A day with less than 1mm rainfall.

Start of season

- For general usage, 14mm of rain appears to be a suitable criterion for significant rainfall on light textured soils for seed germination. Once germinated little further rainfall is required to emergence. At this stage, plants are quite hardy and can take moderate water stress without affecting the subsequent yield.
- A period of 3 weeks is generally accepted in Zimbabwe as being the maximum one can go without replanting. If there are more than 4 pentads after the previous significant rainfall (SR), the season is considered to have a false start. The growing season is then started at the next SR with the same conditions.
- Though models for 25mm of rainfall applicable to the heavier textured soils have been included, the significance is thought to be less reliable.

End of Season

- The end of growing season is not easily defined. Obviously it can be taken as the time when plants stop growing. This can be because they have reached physiological maturity, or because they are suffering a terminal moisture stress.
- A prolonged dry spell can end the growing season, whether it starts in the middle of the rain season or later. This frequently happens in the drier areas, when the growing season effectively ends when the residual soil moisture after the last SR has been extracted from the root zone. This usually occurs 4 weeks after the last significant rainfall has been received.

SOIL AND CHEMISTRY SERVICES

These are offered by the Chemistry and Soils Institute in the Department of Research and Development (along Fifth Street Extension). The institute offers a wide range of services.

a) Pedology and Soil Survey Section

- Conducts soil resource survey and systematic soil mapping, e.g. pH, cation exchange capacity CEC, exchangeable bases;
- Conducts soils analysis for particle size and distribution - texture; soil physics laboratory where soil physical properties such as density and available water capacity are established).
- Conducts research on soil and environmental management.

b) Special Analysis Laboratory

- Conducts analysis on pesticides residues (toxicology and herbicides and formulations), of mycotoxins, gossypol determination, fatty acids determination, amino acids determination and environmental monitoring because of the increase in herbicides use.

c) The General Analytic laboratory

- Conducts analysis of fertilisers, liming materials, farm feeds, vegetables and animal products, irrigation and affluent waters and toxicological samples.

SODIC SOILS AND MANAGEMENT

Occurrence and recognition

In Zimbabwe, sodic soils (isikwakwa, simunyu or mamari) are prevalent on geological formations which are rich in sodium; e.g. the granites of the watershed and certain of the Karoo (*Triassic and Permian)* formations in the north of the country. They occur mostly in bands near water courses, or as patches usually circular in shape. The soil profile consists of a shallow, sandy soil (mostly 5 to 15cm deep) overlying an abruptly commencing highly impermeable sub-soil which extends down to bedrock. The herbaceous vegetation on these soils is sparse, and consists largely of annual and succulent plants.

Recognition of sodic soils using vegetation

In areas of more than 700mm rainfall the presence of Mopane and poor vegetation cover on the soil surface could indicate that the soils are sodic. In lower rainfall areas the presence of stunted

mopane vegetation and bare sheet-washed soil is the usual indicator, while tall healthy mopane vegetation usually means that the sodicity problems are insignificant or absent.

Recognition from erosion

Severe erosion common on sodic soils due to damage of the top soil through the development of stock path / footpath, the splash detachment with run-off due to the absence of vegetative ground cover and occurrence towards the bottom end of slopes, where the scouring action of concentrated storm drainage waters is most severe. Exposure of the sub-soil leads to the rapid development of gullies (which are extremely difficult to contain) and to severe silting of streams, rivers, and dams.

Reclamation, under dry land conditions

- Gypsum is the most effective ameliorant. Gypsum should be applied in strips on the land during the initial stages of erosion; aligned along contours and harrowed 9-15cm deep. The aim is to replace sodium in the upper layers of the soil with calcium, and improve the physical properties of the soil. The application rate of 4-8t/ha of gypsum (400-800g/square metre) promotes adequate grass growth on all four types of sodic soils.
- The following drought tolerant grasses, capable of affording good cover, are suitable for growing on ameliorated soils: *Cyndon nlemfuensis, Bothriochloa insculta, Sporobolus ioclados and Eragrostis trichophora.* If seed is not available leave the area for colonisation by indigenous grasses. The grasses should be planted soon after application of ameliorants although planting can be done during the mid-season after initial leaching of sodium has taken place.

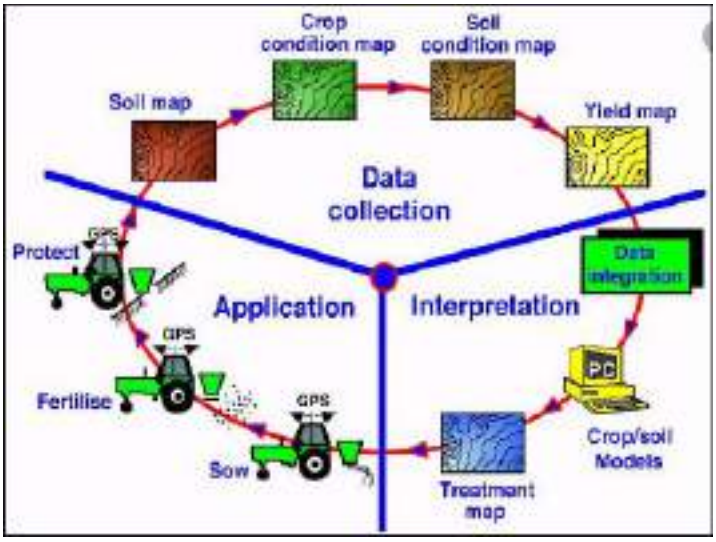
General cropping aspects

Examples of tolerance to salty soils (i.e. the ability to produce satisfactory crop yields despite saltiness of soil).

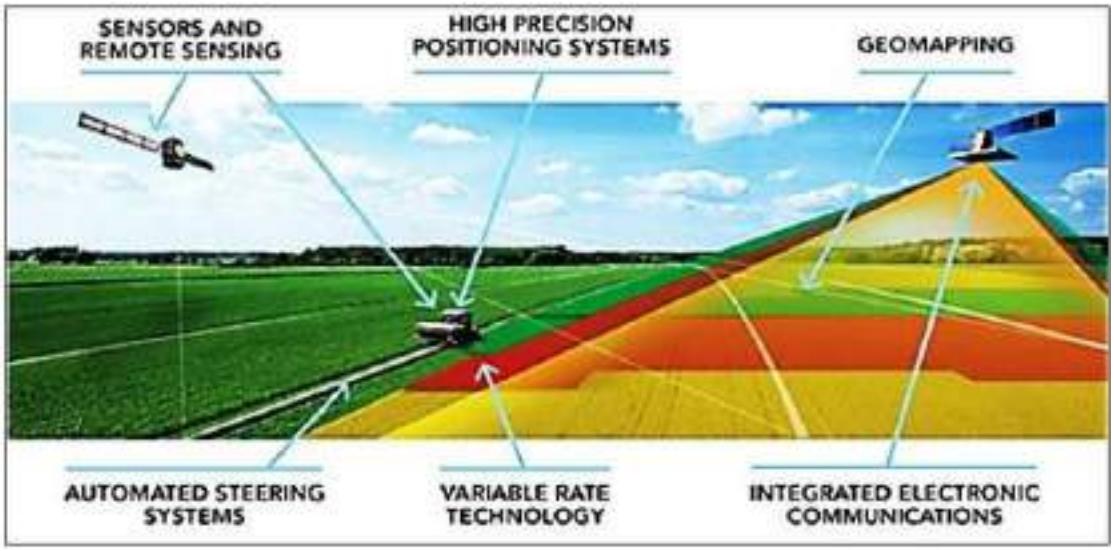
High tolerance	*Sugar bean, cotton*
Medium tolerance	*Lettuce, onions, tomatoes*
Low tolerance	*Citrus, deciduous fruit, celery, peas, potatoes*

PRECISION AGRICULTURE

Precision agriculture (PA) is an approach to farm management that uses information technology (IT) to provide, process, and analyse multi source data to manage spatial and temporal variability associated with all aspects of agricultural production to improve production and environmental quality. It aims to identify differences in soil characteristics and yield potential between areas and within the field and responds by modifying crop management practices accordingly. It is based on observing, measuring and responding inter and intra field variability in crops.



The precision farming cycle starts by identifying variability. In the end the crops and soil receive exactly what they need for optimum health and productivity. Precision agriculture systems support decision making because this allows farmers to decide and even know how much sun certain plants need and how much space to put in between crop rows. Based on real-time field information and decision making, precision farming can optimize both farm productivity and profitability, which is the key goal of every successful farmer. Precision agriculture management practices allows the farmer to reduce the use of inputs (machinery, labour, fertilizers, pesticides, seeds, water, etc.) while protecting the natural resources.



Benefits of precision agriculture

- It uses inputs in a sparingly and strategic way i.e. resource efficient
- Minimal environmental impact.
- Compile and analyze data in real time.
- Reduce water waste and improve crop management.
- Maximize resources and labour use.
- Maximises production.

Over the last few decades, many new technologies have been developed for precision farming. Some of these are satellite positioning (GPS) system, automated steering system, remote sensing, geo-mapping, and variable rate technology (VRT). Used in combination, these new technologies provide a large amount of high-resolution information related to farm management practices such as tillage, seeding, fertilization, pesticide application, and harvesting.

Technology used for precision agriculture

- The accuracy of GPS allows farmers to create farm maps with precise acreage for field areas, road locations and distances between points of interest. GPS allows farmers to accurately navigate to specific locations in the field, year after year, to collect soil samples or monitor crop conditions. farmers are able to communicate better with GPS, water and nutrient levels are better maintained with GPS and insecticides are not used as much due to GPS being utilized more. Satellite images are used to characterize a farmer's fields in detail, often used in combination with GIS, to allow more intensive and efficient cultivation practices.
- Remote sensing gives the soil moisture data and helps in determining the quantity of moisture in the soil and hence the type of crop that can be grown in the soil.
- Variable rate technology allows the farmer to control the amount of input such as seeds, fertilizers, pesticides, and water. It provides optimization on planting density and improved application rate efficiency of pest protection products and nutrients, resulting in farm cost reduction and, most importantly, the reduction of negative environmental impact.
- Geo-mapping is a technology used to create maps of various soil and crop conditions, such as soil nutrient levels, soil type, soil pH, pest occurrence, and others. Soil maps are created by sensors attached to a vehicle or from a distance, by remote sensing drones, airplanes, and satellites. In conjunction with a GPS, these sensors collect data from the field to evaluate soil and crop health and assign that information to the particular field location. Using the geo-maps, the farmer is able to precisely detect events or changes in soil properties and provide a corresponding output.
- The automated steering system allows the piece of machinery driving control, overhead turning by following the field edges, and minimizes overlapping of rows.

Hydroponics

Hydroponics is a subset of hydroculture, which is a method of growing plants without soil. It is a form of gardening that uses no soil, but instead grows plants in a solution of water and nutrients. The nutrients that the plants normally derive from the soil are simply dissolved into the water instead, and depending on the type of hydroponic used, the plant's roots are suspended in, flooded with or misted with the nutrient solution so that the plant can derive the elements it needs for growth Hydroponic. In Hydroponics, you have a 100% control of the nutrients (foods) that plants need. Before planting, growers need to check what plants require and the specific amounts of nutrients required. It can be practised anywhere in the world and it uses 20 times less water than soil based gardening. The environment should be sterile, which means no pesticides will be used. This type of agriculture uses 20% less space for growing plants. Many people believe that hydroponic plants are free from diseases. However, this is not true because the plants share the same solution. So, water-borne diseases can spread easily throughout your garden. The chances of contacting disease are more when compared to the normal gardens.

Advantages:

- Controllable food supply for the plants.
- You might have droughts or floods, but if you're growing the crops and breeding them to be hardier, you have a better chance of not starving.
- Uses 20 times less water than soil based gardening.
- Your environment is sterile, which means no pesticides.
- You'll use 20% less space for growing.
- The system water can be reused, allowing you to conserve water.

Disadvantages and Challenges

- A Hydroponic garden requires time and commitment.
- Experiences and technical knowledge is a prerequisite.
- Water and electricity risks.
- System failure threats.
- Initial setup expenses are very high
- Long return per investment.
- Diseases and pests may spread quickly.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Veld Fires and Fire Guards/Breaks

Veld fires lead to severe environmental degradation. In Zimbabwe, it is now commonly agreed that veld fires are a single significant threat to national economic recovery plans as they are destroying not only pastures necessary for the restocking exercise, they are also destroying vast plantations. The burning of vegetation in field preparation and the improper disposal of cigarette stubs are the major causes of veld fires. Veld fires impact negatively on both the natural and human environment. One way of preventing veld fires is to Prepare fire breaks on their side if there is a reasonable risk of veld fires.

A fire-break is a strip of land that has been cleared of all trees, shrubs, grass and other combustible material, providing a 'fuel free' area. A firebreak may occur naturally where there is a lack of vegetation. The purpose of a firebreak is to provide an area of reduced fuel load which will reduce the intensity of a fire and therefore allow for more effectively combating and to also serve as a line from which a back burn can be started. Fire-breaks are intended to allow access for firefighting vehicles and can provide a fuel free area from which prescribed burning can be undertaken. They may slow or stop the spread of a low-intensity bushfire however they should not be relied upon to prevent the spread of a fire. Fire-breaks are often constructed with a machine such as a dozer, front end loader, grader, and tractor or skid-steer loader. In some situations, a suitable fuel-free area may be created by other methods such as hand tools, ploughing, herbicide treatment, grazing stock and controlled fire. The minimum width is generally 3m.

The effectiveness of a fire-break depends on the width of the fire-break, the weather conditions, flame length and whether embers are being produced. A fire-break will be more effective at preventing the spread of a fire if:

- It is close to the fire ignition point so that the fire is not at its maximum flame length.
- It is approached by the flank (side) of the fire, as the flank will have a shorter flame length than the front (head) of the fire.
- It forms an effective break in both the vertical and horizontal continuity of the fuel, which reduces the flame length and makes the fire easier to suppress.
- Nearby trees and shrubs are not producing embers.
- It provides safe and efficient access for firefighting resources.

Siting of fire-breaks

Landscape position: on sloping or undulating terrain, fire-breaks should be placed low in the landscape. This will result in a fire reaching the break while travelling downslope, making it

slower, less intense and therefore less likely to cross the break. This is also a safer location for firefighters to approach a fire.

Slope: on sloping ground, fire-breaks should be constructed across the slope to follow the contour. This will slow the flow of water along the break and reduce the incidence of erosion. If it is necessary to install a break down a slope, additional measures may be required to reduce water erosion.

Waterways and wetlands: where possible, avoid fire-breaks that cross water ways and their foreshore areas or wetlands and their buffers. Water crossings are susceptible to erosion, waterlogged soils can become un-trafficable, and increase the likelihood of vehicles transporting weeds and soil-borne diseases. These areas also tend to consist of vegetation types with high fuel loads, which make fire-breaks less effective.

Fuel: fire-breaks are most effective at slowing the rate of spread of a fire in vegetation types that do not generate embers. Fire-breaks are more effective and easier to install in light fuels such as grass, rather than scrub, woodland or forest, however it is not always possible to choose the location of a fire-break.

Soil type: the structure and texture of soil will affect how prone a fire-break will be to erosion. Where possible, fire-breaks should not be constructed on fragile soils. Soils with a high proportion of organic material should also be avoided owing to their environmental significance, potential for waterlogging and the possibility that they will ignite during a fire.

Ways of creating fire guards/ breaks

Ploughed breaks: In areas where erosion is difficult to prevent, it may be preferable to construct a ploughed fire-break, rather than a graded one. Ploughing incorporates plant material into the soil, helping to bind the soil and prevent erosion. Ploughing will result in an inferior trafficable surface for vehicles and is only suitable if it is able to produce a minimal fuel surface, such as on previously mowed or slashed grass.

Herbicide treated break: Herbicide may be used in conjunction with slashing or mowing to create a low-fuel area in grass fuels. The advantages of this approach are that the soil surface is undisturbed and the roots binding the soil are retained, preventing erosion. However, this may not create a mineral earth break, so may be less effective at preventing the spread of a fire.

Grazed break: Grazing stock can be managed to reduce grass fuels. Grazed breaks can be much wider than a machine break. They are cost-effective and may be less prone to erosion. However, they will also be less effective at preventing fire spread, because some vegetation will be retained. Heavy grazing and animal traffic can reduce the surface vegetation to mineral earth. However, this is not advisable as it can degrade the soil structure and leave the area prone to erosion

Burnt break: Fire can be used to create areas of reduced fuel load in an environmentally sensitive manner. A burnt break will usually be anchored from a mineral earth break and is not a practical approach when isolated from other fire-control methods. The controlled use of fire is best applied as part of a comprehensive bushfire management strategy

Environmental and heritage impacts

Environmental and heritage impacts that may result from poorly constructed and maintained fire-breaks include:

- The spread of weeds and plant diseases. The use of earthmoving machinery in natural areas can spread weeds and plant disease. Good environmental hygiene requires machines, equipment, and footwear to be clean (i.e. free of soil clods, mud and or plant material) on arrival at the worksite, and be cleaned at the conclusion of work before leaving the site. Fire-breaks should not be constructed when soil is wet. Moisture not only provides favourable conditions for the pathogen to establish at new sites, it increases the chances that infected soil will stick to machines, equipment, and footwear making it easier to spread.
- Damage to environmentally sensitive areas including threatened species or communities.
- Damage to natural, historic and Indigenous heritage values.
- Erosion by wind and water. The effect of wind erosion can be reduced by aligning fire-breaks so that the prevailing winds blow across, rather than along them. This may not be possible in all instances, depending on the construction and location of fire-break. Water erosion occurs when raindrops hit the soil surface displacing soil particles and where water flowing over the land surface carries soil particles. Water erosion is preventable by reducing the volume and speed of the water flowing across the surface of a fire-break. The most effective way to prevent water erosion is to locate fire-breaks on flat terrain. Where this is not possible, good drainage is important. This includes structures to divert water

away from the fire-break, allowing the fire-break to shed water to reduce the volume and slow the flow of water along the break.

Export Requirements

For anyone who would want to export agricultural commodities, the following are the general requirements:

- Each shipment must be accompanied by a complete set of documentation irrespective of consignment size (i.e. Form CD1, Agro-dealer Certificate, Phytosanitary Certificate, Airway bill and packing list)
- **Agro-dealer certificate** is obtained from the Agricultural Marketing Authority (AMA). An annual registration fee can be obtained as an individual or as a company.
- **Phytosanitary certificate** is obtained from Mazowe Plant Protection Offices at fee. The certificate is signed and stamped at the airport offices. Other documents required that includes the airway bill is obtained from the airline
- **Export permit** is issued by the Ministry of Lands, Agriculture, Water and Rural Resettlement. This is issued for a specific quantity and time period.
- The export permit from the Ministry is required by Plant Health Inspectors at the export points (point of exit) as well as ZIMRA who also enter the quantities exported in their system as the exporter draws down the quantities exported against the quantities specified in the permit
- **Packaging requirements**- Packaging should protect the taste, flavour, colour and other characteristics of the product, protect the product form bacteriological and other contamination and not pass out any odour, taste, colour and other foreign characteristics to the product.
- **Labelling requirements**- Allergens must be highlighted in the list of ingredients.

Packaging Materials

How to sew pockets for delivery

- For sacks containing maize, shelled and unshelled groundnuts, coffee parchment and green coffee, sew in a straight line below the hem of the mouth of the sack with stitches 25mm apart, leaving not less than 100mm of twine free and without knots at each side of the sack.
- For sacks containing sorghum, soya beans and wheat, sew in a straight line through four thickness of sack, which is achieved by folding the mouth of the sack inwards until the folded section is between 30 and 40 mm above the level of grain in the sack with stitches

25mm apart leaving not less than 100mm of twine free and without knots at each side of the sack.

The types of twine that can be used are

- Double jute twine of good quality.
- Double cotton / rayon twine with a breaking train of not less than 150 Newton e.g. tobacco T1 twine.
- Single cotton / rayon twine with a breaking train of not less than 300 Newton e.g. tobacco T2 twine.

The maximum mass of sacks should not exceed the following: -

- Maize, sorghum, soya beans, and wheat 50kg
- Unshelled groundnuts 50kg
- Shelled groundnuts 50kg
- Cotton 250kg
- Tobacco 25kg
- Air-Cured (Burley) 100kg

Any producer in any doubt about how sacks should be sewn should enquire at the nearest marketing point where the staff will explain or demonstrate.

Twine required

- 1 to 2½ kg roll of T2 is sufficient to sew 600 bags of grain. Jute twine 1kg is sufficient for 100 grain bags or 16 cotton bales.
- Twine needs for Tobacco?

Fencing

Government Fencing Specifications; RGN no 509 of 1973 Extracts of Section 5 of the Fencing Act Chapter 185.

General

- The fence shall be constructed in a workman-like manner from beacon to beacon and online throughout. *(See Land Survey Act, chapter262, sections 32 and 34).*
- Wiring: Top strand should be not less than 1,2m above ground.
- Minimum 4 strands of wire.
- Spacing from top of post to first wire: 40mm, between wires from top down: 305mm, 250mm, 195mm.
- For wooden posts and standards this is the minimum requirement.

Straining posts and standards

- Drilled or in case of treated wooden posts/ standards, notched to correspond with the required wire spacing.
- Firmly established in the ground (and anchored with wire in case of straining posts).
- Straining posts: max 420m apart and at all points of change in line of fence; standards: max 14m apart.

Gates

- Minimum 4,25m clear opening, unless otherwise approved.
- Shall not be hung on straining posts.
- Shall have a balanced fastener.
- Where constructed across a road shall comply with the requirements of Section 33 of the Roads and Traffic Act (chapter 289).

Gate posts shall be secured either

- In concrete blocks not less than 400mm x 400mm x 300mm.
- On a base plate of surface area not less than 400mm x 400mm.

Cattle grids

- To comply with Roads and Traffic Acts section 32 chapters 289. Authority and specification for each grid to be obtained from local authority or district council.

Materials

- Fencing wire: shall be barbed wire complying with CAS No. N5:1971, Part 1.
- Steel fencing and standards: CAS No. N5:1971 Part II.
- Steel droppers: CAS No. N5 1971 Part III.
- Tying wire: diameter minimum 2,65mm (see CAS No. N5 1971 Part IV).
- Anchor wire: not less than 4 strand of 4mm each (CAS No: N5 1971 Part IV).
- Steel gate posts: CAS No. N5 1971 Part V.
- Steel gates: CAS No. N5 1971 Part VI.
- Steel straining posts: CAS No. N5 1971 Part VII.
- Wooden straining posts, standards, droppers: CAS No.07 1972.

Boundary Fencing

(Materials-approximately quantities per kilometre)

Quantity	**Material**	**Specification**
6rolls	*Barbed wire*	*2mm*
3	*1 beam posts*	*2m x 20kg*
73	*"W" standards*	*1,8m*
220	*Steel droppers*	*1m x 6mm*
9kg	*Anchor wire*	*4mm*
9kg	*Tying wire*	*2,65mm*
Alternative		
73	*"Z" heavy standards*	*1,8m*

Paddock fencing

Quantity	**Material**	***Specification***
5rolls	*Barbed wire*	*1,60mm*

3	*1 beam posts*	*2m x 20kg*
55	*"W" standards*	*1,8m*
165	*Steel droppers*	*1m x 6mm*
9kg	*Anchor wire*	*4mm*
9kg	*Tying wire*	*2,65mm*
Alternative		
55	*"Z" light standards*	*1,8m*

Labour required for fencing

One foreman and about 16 workers can do a 1km in 2days (8 hour working day).

Details of type of wire

Type	**Diameter mm**	**Gauge SWG**	**Metres/ kg**	**Metres/ standard 50kg roll**	**Remarks**
Galvanised steel	1,60	16	63	3 175	
	2,00	14	35	1 782	
	2,50	12	23	1 157	
	3,15	10	16	819	
	4,00	8	10	508	
	5,00	6	6	325	
High tensile barbed wire	2,50	12,5	23	1 150	Double strand
	1,6	16	9,5	475	
	2,12	13,5	7,5	375	
*campion	4,00 approx	8 approx	12,5	500	Note single strand, 40kg per roll

Allowance to be made for slope and extra fencing required when measurements have been made on a map or aerial photograph.

Average % slope	**Extra fencing required**	**Approx % extra**
50	*+11,7%*	*11,5%*
45	*+9,7%*	*10%*
40	*+8,0%*	*8%*
35	*+6,0%*	*6%*
30	*+4,3%*	*4,5%*
25	*+3,0%*	*3%*
20	*+2,0%*	*2%*
15	*+1,0%*	*1%*
10	*+0,3%*	*0,5%*
5	*+0,1%*	*0%*
0	*+0,0%*	*0%*

Fertilizers

Registered fertilisers

Name	**Composition (N , P, K $^{+}$)**
Ammonium nitrate	*34.5N*
Ammonium nitrate	*10-5-21%N*
Ammonium nitrate ISOP	*33.7-1.2*
Ammonium nitrate (SOP)	*32.8N-0P-3.0K-1.0S*
Ammonium sulphate	*15.6Al -28.1S*
Ammonium sulphate	*21-2-24*

Ammonium sulphate	*20.8N-24S*
Ammonium sulphate	*21N-32S*
Ammonium sulphate	*21N-23S*
Ammonium sulphate	*20.5N-24S*
Best Bloom	*15-5-32*
BMX	*1.5Cu-1.5Mn-3.0Fe-Mo220*
Calcium ammonium nitrate	*27N-7Ca*
Calcium chloride	*28.0Ca-49.0Cl*
Calcium Nitrate	*15.5N-19.5Ca*
Calcium nitrate	*15.5N-Ca19.5*
Calcium nitrate	*12.3HN-20.52Ca*
Calcium supper phosphate	*0-42-0*
Cereal blend	*8.8-18.8-7.8*
Cereal Fert	*6-17-5-10S*
Cereal Top Dressing	*24-0-18-7.20S*
Chibage fert general	*8-3.2-16*
Compound C	*6.5-17-14.24-8.2S*
Compound D	*11-20-0*
Compound J	*15-5.2-19.7-3.4Ss*
Compound L	*5.08-18.43-9.95-8Ss*
Compound S	*7-21-6.6-8.9S*
Compound T	*25N-5 P_2O_5*
Copper chelate	*14Cu*
Copper Sulphate	*24Cu 13S*

Copper truce element	*8Cu*
Cotton blend	*5-15-10*
Di-ammonium phosphate	*24-46-0*
Di-ammonium sulphate	*18N-46P-0K*
Easterna	*20-19-10*
Easterna 60	*20-20-20*
Farm and city top	*33.8-0-1.20*
Fe 6% Chelate	*6Fe*
Fe 6% Chelate	*6Fe*
Flory 2	*15-5-25*
Foliar 3X	*20-24-18*
Fruit fert	*15-5-20*
FWZ Blend	*7-14-7*
Garden fert	*15-5-25*
GAT TOM	*10-24-14-8S*
Grain Fert	*10-18-8*
Grain fert	*9-18-9*
Iron 3%	*3.0Fe*
Iron Chelate (13%)	*13Fe*
Iron chelate 11%	*11Fe*
Iron cheleta	*6Fe*
Kendall	*3.5N-15.5K_2O*
Kickstart	*10-46-10*
Lawn fert	*25-5-5*

Lime ammonium nitrate	*28-0-0*
Lime phose	*0N-8P-9K-0.5%S*
Limestone ammonium nitrate	*28%N*
Low burette urea	*46.2-0-0*
M.A.P Technical Grade	*12N-61P_2O_2*
Magnesium nitrate	*11.0N-9.0Mg*
Magnesium sulphate	*10%Mg 13S*
Maize blend	*7-14-7*
Maize Fert	*8-16-8*
Maize fert	*7-16-5*
Manganese nitrate	*11N-Mg9*
Micrel Combi	*3.35Fe-Mn1.7-Cu1.7*
Micro mix No.103	*1.0Zn-6.5Fe-0Mn*
Microfeed D1101	*Fe6.6-20Mn-1.0Zn-0.25Cu*
MKP	*52P_2O_5-34K*
MKP	*22.7P_2O_5*
Mono ammonium Phosphate	*12-50-0*
Mono Ammonium Sulphate	*12-61-0*
Morel Zinc Oxide	*78.6Zn*
Muriate of potash	*60K-48Cl*
Nitrate of potash	*50K-18S-1Cl*
Nitrosol	*8-2-5.8*
Nutriguard	*$P_2O_5$50-32K_2O*
Omni coffee blend	*14-5.8-20.0*

Omni Phos 24	*3.5N-24P_2O_5-11S*
Orgo plus slow release	*7-5-4.5*
Osmoform	*19N-5P-13K-0.02B*
Peters Excel	*13-5-20*
Planting fert	*19.25P_2O_5-12%S*
Potash T/D SOP	*17.4-0-17.4*
Potassium bicarbonate	*48Cl*
Potassium chloride	*60K_2O-47.55Cl*
Potassium chloride	*60.02-45.0*
Potassium chloride	*51K_2O-48Cl*
Potassium nitrate	*13N-38K*
Potassium nitrate	*13.0N-46.0K_2O*
Potassium nitrate	*13.0N-38K_2O*
Potassium nitrate	*12N-30K*
Potassium nitrate	*13.0N-46K_2O*
Potassium nitrate	*13N-13NO_3-38K*
Potassium sulphate	*51K-18Ss*
Potassium Sulphate	*42K16S*
Potassium sulphate	*50K_2O-16S*
Potassium sulphate	*42.0K-18S*
Potassium sulphate	*50K-18S*
Potassium sulphate	*42K_2O-16S*
Quick Grow	*20-10-20*
Rose Feed 101	*0.91Mn-3.34Fe*

Rose fert	*10-1-35*
Rose microfeed 101	*6.5Fe- 2.0Mn-1.0Zn-.025Cu*
Rose microfeed 103	*6.5Fe- 2.0Mn-1.0Zn-.025Cu-2.05B*
Seedbed fert	*7-21-8*
Seedling fertilizer	*7-20-5*
Sequential Two	*10-20-40*
Shasha Top dress	*46N*
Sodium molybdate	*10.9Na-39.5Mo*
Sodium molybdate	*39.5Mo*
SOP Solube grade	*$50K_2O$-18S*
Sulphur 95	*95S*
Tobacco blend	*6-8-15*
Tobacco blend A	*4-18-15*
Tobacco blend B	*3-24-18*
Tobacco blend C	*6-18-15*
Tobacco blend S	*7-20-7*
Tobacco fert	*7-20-7*
Tobacco Fert	*15-20-17*
Top dress fert	*34.5*
Triple supper phosphate	*25P-9S*
Triple supper phosphate	*$46P_2O_5$-2S*
Urea	*46N*
Urea	*46.3N-32S*
Veg fert	*6-15-12*

Windmill super N	*45N-1P-0K*
Zinc chelate	*15Zn*
Zinc oxide	*78*
Zinc Sulphate	*22Zn18S*

Labour and Equipment Inputs

Labour requirements-Small Scale Farming Systems

One Labour Day is 8 hours of working, although workers may not work full 8 hours depending on the work at hand or condition of the workers. To get the labour days per each enterprise activity, divide the hours of input per hectare by 8 hours.

Beans- inputs requirements

Operation	**Method**	**Hours input per ha**	**Remarks**
Ploughing	Farm / worker and 4 ox-team	8.70	Mid to late January
Planting	By hand from tin	48.50	Late January to early February
Harrowing after planting	Farmer/ worker 2 ox team	1.90	Immediately after planting late January/ early February
Fertilizing	By hand from tin	3.75	Late February to early March
Cultivating	Farmer/ worker and 2 ox team using an ox-cultivator (per occasion)	11.90	Late February / early March , immediately after fertilizing
Cultivating	By hand using hoe	136.40	Following ox cultivation in late February

Pest and disease control spraying	Knapsack sprayer	21.36	When necessary- per occasion
Pull or cut beans	By hand with or without a hoe	85.38	Late April
Transport beans to homestead and stack	Ox-cart and 2 ox team	15.05	Early May
Prepare floor	By hand	21.00	Early May
Thrash, winnow and bag	By hand , using flails or sticks	213.38	Up to late May
Other		14.14	
Total		**581.42**	

Cotton – input requirements yield 1200kg per ha

Operation	**Method**	**Hours input per ha**	**Remarks**
Destroy previous crop	Grazing		Before October
Apply lime	Hand (includes labour for cutting by oxen	28.0	mid October
Rip	Tractor (45kW)	1.44	Mid October
Light disc	Tractor (45kW)	1.12	mid October
Plough (alternative to ripping	Tractor or 4 ox- team	4.13	mid October
Apply herbicide	Knapsack	21.36	Late Oct/early Nov
Planting	Tractor + 2 row planter Or oxen + row planter	8.0 12.0	Late Oct/early Nov
Hand planting (alternative to mechanical planting) a) mark rows			

b) fertilize c) planting d) covering	Oxen+ row marker Hand Hand Oxen+ drag harrow	2.48 9.50 13.60 2.48	Late Oct/early Nov
Weed control(alternative to herbicide)	Part mechanical -tractor +in-row by hand -ox + in row by hand hand only (max 1x) thinning by hand	 1.00 17.20 7.12 17.20 70.00 53.36	Start late Nov Nov Nov Nov Late Nov 2 weeks after germination
Pest control	Knapsack or ULV (min 8 times)	170.88	Normally from 6 weeks after germination
Harvesting	Hand	500.00	From May
Total		**949.57**	

Groundnuts – input requirements

Operation	**Method**	**Hours input per ha**	**Remarks**
Ploughing	Farmer / worker and 4 ox-team	8.70	With first rains Oct / Nov
Planting	By hand from tin	48.50	Early Nov
Harrowing after planting	Farmer/ worker and 2 ox-team	1.90	Immediately after planting early Nov

Cultivating	Farmer/ worker and ox-cultivator	11.90(min 1x)	Early Dec
Cultivating	By hand using a hoe	136.40	After or following ox cultivation, early Dec
Fertilizing (top- dress)	Gypsum from tin	2.85	Last week of Dec
Loosen nuts	Farmer/ worker with 2 ox – team and plough	23.05	Early to mid-March
Lifting nuts	By hand	136.40	Early to mid-March with loosening
Transporting nuts to homestead and stack	Ox –cart and 2 ox- team	15.05	mid to end March
Preparing floor	By hand	12.35	Early March
Picking nuts	By hand using beater bars	203.55	During April
Winnowing and bagging	By hand	9.55	Following picking
Other		14.10	
Total		**516.00**	

Maize input requirement

Operation	**Method**	**Hours input per ha**	**Remarks**
Ploughing	Farmer/ worker + 4 ox –team	8.70	With first rains
Manuring (if available)	By hand from ox- cart	3.35	Before ploughing
Fertilizing	By hand from tin	9.50	After ploughing before planting

Planting	By hand from tin	34.85	After fertilizing early to mid Nov
Cultivating	Farmer /worker & ox-cultivator	9.85	2 to 3 weeks after planting end Nov or beginning of Dec
Cultivating	By hand using a hoe	70.00 (min 1 x)	
Reap & transport off the plant (no stoking)	Direct into ox cart	42.75	Any period during Jun or July
Cut heap and transport stalks after harvesting	By hand with cutting knife	0.80	After harvest
Alternative method of harvesting- cut & stook , reap off stook	By hand	21.35*	Method required more labour days
Prepare floor for shelling	By hand	2.00	End of may beginning Jun
Shelling	By using shelling cups	41.60	Any period Jun/July after harvesting
Winnowing and grading	By hand	5.90	Any period Jun/July with shelling and clearing
Bagging, weighing and storing	By hand	12.70	Any period Jun/July after shelling and clearing
Other		**16.25**	
Total		**285.25**	

Other grains

Operation	**Method**	**Hours input per ha**	**Remarks**

Ploughing	Farmer/ worker and 4 ox – team	8.70	With first rains Oct/ Nov
Fertilizing	By hand from tin	3.75	Prefer before planting in early Nov
Planting	By hand from tin	0.45 (usually broadcast0	Early to mid Nov
Harrowing	Farmer / worker and 2 ox- team	3.15	Immediately following planting or sowing
Cultivating	By hand using a hoe	66.90	2 to 3 weeks after germination, end of Nov or beginning of Dec
Reaping & transporting	Hand to sacks	380.40	Any period during Jun / July
Prepare floor	Hand	2.0	Any period before harvest
Threshing & bagging	By hand using flash / sticks	140.65	After harvesting during Jun/ July
Winnowing	By hand	15.00	After threshing during June/ July
Other		**11.90**	
Total		**632.90**	

Sunflower input requirements

Operation	**Method**	**Hours input per ha**	**Remarks**
Applying lime	By hand from tin	28.0	Late Nov
Ploughing (alternative method e.g. oxen may be considered)	Tractor and 3 disc convectional plough	1.70	Possible contract aim to complete by end of November or early Dec
Discing	Tractor and 2m disc	0.70	

Planting mark Furrow Fertilizing Planting Covering seed	2 ox- team and homemade maker by hand from tin by hand 2 ox- team and harrow	 9.5 34.85 1.90	mid Dec aim to complete 3rd week of Dec
Cultivating	Farmer/ worker and 2 ox-team and ox cultivator	1.90	2 to 3 weeks after germination
	By hand using hoe	14.0	Immediately after ox cultivation
Pest and disease control	Knapsack sprayer	21.5	When necessary
Harvesting into scotch cart	By hand using knifes	60.00	mid-April
Transport to homestead	Ox-cart and 2 ox team	15.00	mid-April
Prepare floor	By hand	21.00	mid-April
Thrashing winnowing and bagging	By hand using flails or sticks	213.5	mid to end of April
Total		**433.55**	

Tobacco air-cured input requirements

Operation	**Method**	**Hours input per ha**	**Remarks**
Seed beds	Allow 90m² of bed per hectare	350.25 per ha of crop	Aug – Nov aim to complete sowing last week of August.
Ploughing	45kW tractor with 3 disc mouldboard	4.13	Possibly contract aim to complete by March or April latest mid Oct.
Discing	45kW tractor light disc	3.75	After ploughing aim to complete by end of Oct.

Ridging	45kW tractor single row ridges	3.00	After discing aim to complete by end of Oct.
Fumigating	Handgun	16.85	Not usually done aim to complete 2 weeks before planting.
Fertilizing	Hand	80.90	Usually at planting.
Planting	With rains	170.65	Last 2 weeks of November.
Cultivating and re-ridging	45kW tractor	3.00	Contract immediately after planting and 2-3 weeks later.
Weeding	Hand	140.85	
Tying and suckering	Hand	98.00	During December
Reaping, tying, bam loading(loose leaf)	Hand	354.59	Early January
Reaping, tying, bam loading(stalk cut)	Grade of the stalk	237.16	End of January
Curing		57.35	Early Jan to March
Barn unloading, grading, baling	Grade of the stalk	2246.85	March to May
Other		**37.00**	
Total		**3804.88**	

Summary of other work requirements in hours per annum by activity

Type of work	**Total hours per annum**	**Remarks**
Land clearing	1014.90(for 1.25 ha)	2 month period Jan - Feb.
Ploughing(not allocated) e.g. fire guards etc	60.50	During March and April
Pre planting hand work, e.g. clearing roots etc	24.50	Oct/ Nov

Livestock	From 1106.25(min) to 1607.50 (max)	Usually 1 juvenile daily during the year for herding
Conservation	53.00	Aug – Oct
Buildings and related jobs	110.90	
Cutting grass	18.00	March – May
Garden and trees	146.00	Continuous
Repairs and maintenance of craft work	19.65	Throughout the year
Work on other farms	Nil	
Meetings and business away from farm	19.50	Throughout the year
Miscellaneous	4671.3	Can be reduced if re required

Trenching

- 7.5m^3/labour day for red soil.
- 6.0m^3/labour day for gravely soil.

LABOUR AND EQUIPMENT REQUIREMENTS

Land preparation (Ploughing)

Tractor	Method	Operational labour	Hectare/rate of work/hour	Hours /ha	Litres/ha	Labour days/ha
65kw	3 disc reversible	D	0.43	2.32	27.0	0.29
	3 disc conventional	D	0.37	2.70	29.0	0.34
	3 furrow mould board	D	0.37	2.70	26.0	0.34

	3 disc conv. Plough /trailed	D	0.29	3.45	29.0	0.43
Discing						
65kw	Heavy disc 3m rome Light disc	D D	0.71 0.88	1.41 1.34	9.0 9.5	0.18 0.43
Ridging						
65kw	Ridge, fertilize, fumigate (ant hole)(single row) if EDB applied separately	D+2 (EDB applicator) D	0.51 0.55	2.0 1.9	15.0 8.0	0.74 0.45
Levelling						
65kw	Landplane	D	0.71	1.41	9.0	0.18
Sub soiling and ripping						
65kw	3 tine ripper (after heavy disc) 3 tine ripper	D D	0.90 0.71	1.11 1.41	10.0 10.0	0.14 0.18

Planting and sowing

Tractor	**Method**	**Operational labour**	**Hectare/rates of work/hour**	**Hours/ha**	**Litres/ha**	**Labour days/ha**
65kw	2 row planter	D+3	0.50	2.00	8.0	1.0
	4 row planter	D+4	0.90	0.90	6.5	0.69
	6 row planter	D+6	1.26	1.26	5.0	0.69
	*broadcast spreader	D+1	3.00	3.00	2.0	0.12
		D+1	1.00	1.00	3.0	0.34

	*box type spreader seed drill air	17	25.30	25.30		0.06

Also used for lime and fertilizer application

Re-ridging

Re-ridging	Method	Operational labour	Hectare/rates of work/hour	Hours/ha	Litres/ha	Labour days/ha
	Single ridger	D	0.54	1.9	11.0	0.23
	Double row ridger	D	1.00	1.0	8.0	0.13

Weed control

Alternative to herbicide (per occasion)

Tractor	Method	Operational labour	Hectare/rates of work/hour	Hours/ ha	Litres/ha	Labour days /ha
65kw	Inter row cultivator in row by hand	D	1.73	0.58	6.0	0.07
	Ox-cultivator	2	0.30	3.33	15kg cubes/2ox team/day	2.02 0.83
	Hand weeding					5.97
	Thinning by hand					4.46

Herbicide application (per occasion)

65kw	Boom+light disc Boom(no disc)	D+1 D+2	0.88 1.80	1.13 0.56	9.5 1.5	0.28 0.21
65kw	Air	17	25.30	0.04	1.0	0.06

Pest and disease control (per occasion)

tractor	Method	Operational labour	Hectare/rates of work/hour	Hours/ ha	Litres/ ha	Labour days /ha
65kw	Boom sprayer	D+2	2.0	0.50	1.5	0.19
65kw	Mist blower	D+2	4.0	0.25	1.5	0.09
65kw	Air	17	25.30	0.04	1.0	0.08
	Knapsack	5	1.3	0.77	0.02	0.48
	ULV	5	1.6	0.63	0.02	0.39

Stalk and Stover destruction

65kw	Rotary slasher heavy disc (as for discing)	D	0.83	1.20	7.0	0.15
	Ripper with paravane	D	0.74	1.34	10.0	0.17

Harvesting

Crop	**Method**	**Hectares/hour**	**hours/ha**	**Fuel litres/hectare**	**Labour days/hectare**
Maize	Combine(contract)	1.6	0.63	15.0	
	Transport bang board 12 rows	0.18	5.56	7.0	10.37

	Reaping into sacks and barrows + tractor transport			5.0	5.79
	Shelling by tractor	400bags/day		61/100 bags	1.5
	Shelling by hand				10.24
Cotton	Hand picking	35-40 kg /reaper / day			
Soya beans	Combine (contract) + farm transport (if used)			1.50 5.0	0.75
Tobacco	All methods, tractor transport			20.0	72.0
	All methods, ox transport			15kg cubes/ day/ 2 oxen	78.0
groundnuts	Tractor+ cutter blade to loosen beds Lift and windrow (hand) Digger shaker(D+1) +hand stacking	0.78 - 0.50 -	1.28 2.00	8.0 - 10.0	0.16 2.90 0.50 7.5
	Picking stationary picker	10-15bags pods/ h		301/100bags	1.60
	Combine(D+3)	50-60bags pods/ha		15 +transport 51/ha	0.3
	Hand (beater bars)	Bags/worker day			
Sunflower	Modified combine hand 6 method , similar to maize				

For commuting allow 4 litres per ha as a total for each crop

Trailer loading

Crop	Method	Hectares/hour	Fuel litres/ ha	Labour days /ha
All crops	Elevator			0.10
All crops	Hand			0.17

Transport

Fuel consumption in litres/ tonne / kilometre

Flat land 0.05

Undulating land 0.10

Hilly land 0.15

AGRICULTURAL REGULATIONS

Dairy Act Chapter 18:08

- To consolidate and amend the laws relating to the regulation and control of the dairy industry.
- To ensure that dairy produce is pure, wholesome and unadulterated.
- To provide for matters incidental thereof.

Farmers and Licensing and Levy Act: Chapter 18:10

- To provide for the licensing of farmers.
- To provide for payment and the collection of levies on certain agricultural products.
- To provide for the establishment of levy accounts and appropriation of moneys therein.

Farmers Stop Order Act Chapter 18:11

- To provide for the registration by farmers of stop orders and special stop orders binding their crops and proceeds thereof.

Fertilisers Farm Feeds and Remedies Chapter 18:12

- Provides for the registration of fertilizers, farm feeds, sterilizing plants, and certain remedies.

- To regulate and restrict the importation and sale of fertilizers, farm feeds, and certain remedies and substances of animal origin intended for the manufacture of fertilizers or farm feeds.

Fruit Marketing Chapter 18:13

- Provides for the establishment and use of a national mark in relation to the marketing of specified types of fruit grown in Zimbabwe.
- To prescribe for the standards and requirements for export of specified types of fruit grown in Zimbabwe.

Grain Marketing Act Chapter 18:14

- To provide for the establishment of Grain Marketing Board.
- To regulate and control of prices and marketing of certain agricultural products and their derivatives.

Pig Industry Act Chapter 18: 15

- To provide for the establishment of Pig Industry Board.
- Provides for the imposition and collection of levies on pigs produced in Zimbabwe.
- To provide for the development of the Pig Industry in Zimbabwe.

Seeds Act 40 [1963]

- For the registration of sellers of seeds plus seed testing labs.
- To regulate the importation, exportation and sale of seed: and provide for the testing, certification and inspection of seed.

Plant Breeder Right 53 /1973

- Registration of plant breeding right in respect of certain varieties of plants plus protection of the rights of person who are registered as holder of push rights.

Produce Exports Act Order 4 /1921 Act 37 [1938] Section 3

- Provide for the grading of Agricultural produce plus any seed produced to be exported from Zimbabwe for the purpose of sale for the prohibition of regulation of the methods of processing produce.
- Prohibition plus regulation of the exported much produce.

Sugar Production Control Act 23 / 1964

- Control of regulation of the manufacture of sugar and delivery of sugar cane for manufacture in Zimbabwe and to put the price to be paid for sugarcane.

Fencing Act 20; 06] 1976

- To establish fencing courts and to confer on them certain powers plus functions.
- To regulate the alteration, construction, relocation, repair or replacement for divided fences.
- To create certain affairs in relation to fences.
- To provide for fences incidental to or connected with the forgoing.

Tobacco Marketing and Levy Act

- Provides for the control and regulation of the marketing of tobacco in Zimbabwe.
- Promotion of tobacco exports.
- Imposition of levies.
- Control of use of agricultural remedies on tobacco and tobacco lands.
- Establish the Tobacco Marketing Board.

Tobacco Research Act

- To make provision for the direction and maintenance of research in connection with tobacco.

Bees Act 54 of 1973 **Section 23**

- An Act to provide for the control of disease in bees and the conservation of bees found in the wild-to regulate bee keeping and to provide for matters incidental to or connected with the foregoing.

Locust Control Act Chapter 19 .06

- An act to provide for the control of locusts.
- Provides for: Reporting of appearance of locusts swarms of hopper bands ; Destruction of hopper bands or locust swarms ; provision of materials free of charge.

Noxious Weeds Chapter 19.07

An Act to make provision for the eradication of noxious weeds.

Part 1 Schedule

Avena fatua Wild Oat

Azolafiliculloides	Water lettuce
Cascuta spp	Doddles
Eichmormia Crassipes	Water hyacinth
Lantana Camara	Cherrie Pie
Harrisia Martini	Moonflower Cactus
Opuntia Aurantiana	Jointed Cactus/prikle Pear

Plant Act and Disease Act Chapter 19; 08

- An act to provide for eradication and prevention of the spread of plant pests and diseases in Zimbabwe.
- For the prevention of the introduction into Zimbabwe of plant pests and diseases for matters inducted there to.
- Eradication of Prevention of spread of pests.
- Control of importation of growing media, injurious organisms, invertebrates and plants.

Quelea Control Act

- To provide for the control of quelea birds.

Water Act

- To provide for the planning of the optimum development and utilization of water resources in Zimbabwe and establishment of water development advisory councils.
- The establishment, jurisdiction and composition of a water court.
- For application for the rights to the use of public water.
- For the control thereof by the state in certain circumstances
- For the declaration of public water shortage areas and the consequences thereof.
- For the control of underground water
- For the acquisition of servitudes in respect of water and ancillary thereto.
- For the prevention and control of water pollution.
- For the approval of combined irrigation schemes.
- For the safety of dams and to provide for matters incidental to or connected with the foregoing.

Sericulture Act 25/1989

- Regulate and control the production, breeding, rearing, twilting and marketing of silkworm seed and cocoons and raw silk.

Phyto-sanitary Regulations

- These are regulations, which govern the importation and exportation of plant products.
- Imported or exported plants should be in good health and free of diseases.
- These are governed by the Plants and Diseases Act Chapter 19:08 of 1999 and was implemented by National Plant Quarantine Services (NPQS).

Import procedures

- The regulation states that no person shall import into Zimbabwe any seed / plant material with live insect/ pest or diseases.
- A plant import permit must accompany any seed or plant material that enters the country from NPQS.
- The import permit will be issued where there is a Genetically Modified Organism Certificate verifying the status of the consignment as well as a letter from Grain Marketing Board if it's a seed confirming approval if importation for a controlled seed.
- A bulky import permit is obtained from the Ministry of Agriculture after obtaining a Plant Import Permit usually for those who import in small quantities but for those who import in bulk they are rendered a Bulky Import permit.
- Usually the importing country will send an inspector/ plant inspector in conjunction with ZIMRA officials at any port of entry and will be released after examination, analysis or when they comply with the import requirements.
- The appointed officer/ plant inspector at all reasonable times has the right to inspect any seed/ plant consignment which enters the country through withdrawal of a sample at the port of entry.
- Pre shipment is conducted prior to importation in the country of origin especially for controlled commodities such as maize, groundnuts, and wheat. Inspectors quickly analyse the collected samples and conclude whether they meet the import requirements. Failure to meet the requirements will result in destruction at owner's cost or return of consignment to the country of origin.
- The import permits upon entering any port of entry, should be made available. Failure to produce the permit will lead to a supervised importation with a permit obtained on a higher charge. Failure to pay will lead to detention or returning the consignment to the sender.

Exportation Procedures

- Any person exporting a seed/ plant should get a phyto-sanitary certificate from the NPQS, which complies with the regulations of the importing country. A phyto-sanitary certificate is obtained after inspection of the consignment to be exported.

CONVERSIONS

Metric Conversions

Length

1 metre= 3.28084 feet	1 foot = 0.305 metres
1 metre=3.17603 cape feet	1 cape foot= 0.314858 metres
1 metre= 1.09361 yards	1 yard= 0.914metres
1kilometre= 0.62137miles	1 mile =1.609344kilometres
1 kilometre= 0.539957 nautical mile	1 nautical mile= 1.852 kilometres

Area

1square millimetres= 0.00155square inches	1 square inch=645.16 square millimetres
1 square metre=10.764 square feet	1 square foot = 1.19599 square metres
1 square yard=0.836127 square metres	1 hectare= 2.47105acres
1 acre= 0.404686hectares	1acre=1.167499morgens
1morgen= 0.856532hectares	1 square kilometre =0.38610 square miles
1 square mile=2.58999 square kilometres	

Volume

1cubic metre (m^3)=1000 litres= 35.31467cubic feet= 1.30795 cubic yards =0.000811acre feet= 219.969 gallons (imp)=264.2 gallons (U.S.)

1 acre foot = 1233.48 m^3= 272250 gallons 1 ml = 1.00016 cm^3= 0.035196 fluid ounces

1litre = 1.75980 pints =0.219976 gallons (Imp)= 0.2642 gallons (U.S.)

1 mm^3=0.000061024cubic inches	1 cubic inch =16387,1 mm^3

1cubic foot= 0.028317 m^3	1 cubic yard =0.764555 m^3
1gallon(imp) =0.004546m^3	1 gallon (U.S.)=0.00378m^3
1 fluid ounce =28.412ml	1 pint= 0.568245litre
1 gallon (Imp) =4.54609 litres	1 gallon (U.S.) =3.78 litres

Mass

1gram =0.035274 ounces (avoirdupois)	1 gram =0.032151 ounces (troy)
1 ounce (avoirdupois)= 28.350grams	1 ounce troy = 31.103 grams
1kg= 2.204622 pounds	1pound =0.453592kg
1 tonne = 1.102311 short tonnes	1 tonne = 0.984207 long tonnes
1 short tonne =0.907185tonnes	1 long tonne =1.01605tonnes

Temperature

Celsius (C) to Fahrenheit (F) conversion

$$C = \frac{5\,(F-32)}{9} \qquad F = \frac{9\,C+32}{5}$$

Work Energy

- 1 joule = 0.24 calories 1 calorie = 4.2 joules
- 1 kilo joule = 240 calories

Power

- 1 kilo watt = 1.34 horse power 1 horse power = 0.746 kW

Force

- 1 Newton (N)= 0.225 pounds force 1 kilogram force =9.807 N
- 1 pound force = 4,448 N

Stress

- 1 Newton per m^2 = 1 Pascal (Pa) = 0.000145 pound force per square inch
- 1 pound force per square inch = 0.006895 Pa
- 1 kg per cm^2 = 14.223 pound force per square inch
- 1 pound force per square inch= 0.070307kg/ cm^2

Pressure

- 100 kilopascals = 1 bar = 10 metres head of water = 14.5 pounds per square inch (approx)
- 1 pound per square inch = 0.07 bar (approx) = 0.7 metres head of water 7kPa

Velocity

- 1 metre per second (m/s) = 3.281 feet per second
- 1 foot per second = 0.305 m/ s
- 1 kilometre per hour (km/h) = 0.621371 miles per hour = 0.53961 knots
- 1 m.p.h. =1.609344 km/h 1 knot = 1.85318 km/h

Rate of flow

- 1 cubic metre per second = 35.32 cubic feet per second
- 1 cubic foot per second = 0.028 m^3/s = 29.32 litres/ second

Consumption

- 1 kilometre per litre = 2.8247 mile per gallon
- 1 mpg= 0.354 km/litre

Other useful Metric conversion factors

1 g/litre = 0.160 ounces/gallon (imp)	1 ounce/ gallon = 6.236 g/litre
1 ml/litre =0.160 fluid ounce / gallon	1 fluid ounce/ gallon= 6.250 ml/litre
1 litre /ha= 0.712 pints/ acre	1 pound /acre= 1.121 kg /ha
1 t/ha =0.446 short tonnes/ acre	1 short tonne /acre = 2.242 t/ha
1 kg/km = 1.370 pounds/ mile	1 pound /mile =0.730 kg/km

1 tonne/km=0.685 short tonnes/mile	1 tonne/ km = 0.611 long tonnes per mile
1 short tonne /mile =1.460 t /km	1 long tonne /mile = 1.635t/km

Field Conversions

To convert:

gpm to m^3/ha multiply by 0.27	Gpm to litres/s multiply by0.076
Causes to m^3/h multiply by 0.102	Causes to litres/s multiply by 28.32
M^3/ h to litre /s multiply by 0.28	HP to kW multiply by0.7463

Yields per unit area

180 lb bags

t/ha x 5.242 = bags / ac	Bags/ac x 0.1908 = t /ha

200 lb bags

t/ha x 4,4609 = bags/ ac	Bags/ac x 0.22427 = t /ha

Wire diameters

Comparison of Standard Wire Gauge and International Metric Sizes

SWG	**Diameter**		**Equivalent metric series**
	Inches	**mm**	**mm**
7/0	0.500	12.700	12.50
6/0	0.464	11.786	11.80
5/0	0.432	10.973	11.20
4/0	0.400	10.160	10.00
3/0	0.372	9.449	9.50
2/0	0.348	8.839	9.00

0	0.324	8.230	8.00
1	0.300	7.620	7.50
2	0.276	7.010	7.10
3	0.252	6.401	6.30
4	0.232	5.893	6.00
5	0.212	5.385	5.30
6	0.192	4.877	5.00
7	0.176	4.470	4.50
8	0.160	4.064	4.00
9	0.144	3.658	3.75
10	0.128	3.251	3.35
11	0.116	2.946	3.00
12	0.104	2.642	2.65
13	0.092	2.337	2.36
14	0.080	2.032	2.00
15	0.072	1.829	1.80
16	0.064	1.626	1.60
17	0.056	1.422	1.40
18	0.048	1.219	1.25
19	0.040	1.016	1.00
20	0.036	0.914	0.900
21	0.032	0.813	0.800
22	0.028	0.711	0.710
23	0.024	0.610	0.600

24	0.022	0.559	0.560
25	0.020	0.508	0.500
26	0.018	0.457	0.450
27	0.0164	0.4166	0.425
28	0.0148	0.3759	0.375
29	0.0136	0.3454	0.355
30	0.0124	0.3150	0.315
31	0.0116	0.2946	0.300
32	0.0108	0.2743	0.280
33	0.0100	0.2540	0.250
34	0.0092	0.2337	0.236
35	0.0084	0.2134	0.212
36	0.0076	0.1930	0.190
37	0.0068	0.1727	0.170
38	0.0060	0.1524	0.150
39	0.0052	0.1321	0.132
40	0.0048	0.1219	0.125
41	0.0044	0.1118	0.112
42	0.0040	0.1016	0.100
43	0.0036	0.0914	0.090
44	0.0032	0.0813	0.080
45	0.0028	0.0711	0.070
46	0.0024	0.0610	0.060
47	0.0020	0.0508	0.050

48	0.0016	0.0406	0.040
49	0.0012	0.0305	0.030
50	0.0010	0.0254	0.025

Thickness of sheet

Comparison of Birmingham Gauge sizes and international Metric series

Birmingham Gauge Number	**Thickness**		***Nearest International Metric Series***
	Inches	mm	***mm***
15/0	*1.0000*	*25.40*	*25.0*
14/0	*0.9583*	*24.34*	*25.0*
13/0	*0.9167*	*23.28*	*23.6*
12/0	*0.8750*	*22.22*	*22.4*
11/0	*0.8333*	*21.27*	*21.2*
10/0	*0.7917*	*20.11*	*20.0*
9/0	*0.7500*	*19.05*	*19.0*
8/0	*0.7083*	*17.99*	*18.0*
7/0	*0.6666*	*16.93*	*17.0*
6/0	*0.6250*	*15.88*	*16.0*
5/0	*0.5883*	*14.94*	*15.0*
4/0	*0.5416*	*13.76*	*14.0*
3/0	*0.5000*	*12.70*	*12.5*
2/0	*0.4452*	*11.31*	*11.2*
0	*0.3964*	*10.07*	*10.0*
1	*0.3532*	*8.971*	*9.00*

2	*0.3147*	*7.993*	*8.00*
3	*0.2804*	*7.122*	*7.10*
4	*0.2500*	*6.350*	*6.30*
5	*0.2225*	*5.652*	*5.60*
6	*0.1981*	*5.032*	*5.00*
7	*0.1764*	*4.481*	*4.50*
8	*0.1570*	*3.988*	*4.00*
9	*0.1398*	*3.551*	*3.55*
10	*0.1250*	*3.175*	*3.15*
11	*0.1113*	*2.827*	*2.80*
12	*0.0991*	*2.517*	*2.50*
13	*0.0882*	*2.240*	*2.24*
14	*0.0785*	*1.994*	*2.00*
15	*0.0699*	*1.775*	*1.80*
16	*0.0625*	*1.588*	*1.60*
17	*0.0556*	*1.412*	*1.40*
18	*0.0495*	*1.257*	*1.25*
19	*0.0440*	*1.118*	*1.12*
20	*0.0392*	*0.9957*	*1.00*
21	*0.0349*	*0.8865*	*0.900*
22	*0.03125*	*0.7938*	*0.800*
23	*0.02782*	*0.7066*	*0.710*
24	*0.02476*	*0.6289*	*0.630*
25	*0.02204*	*0.5598*	*0.560*

26	*0.01961*	*0.4981*	*0.500*
27	*0.01745*	*0.4432*	*0.450*
28	*0.01563*	*0.3969*	*0.400*
29	*0.0139*	*0.3531*	*0.355*
30	*0.0123*	*0.3124*	*0.315*
31	*0.0110*	*0.2794*	*0.280*
32	*0.0098*	*0.2489*	*0.250*
33	*0.0087*	*0.2210*	*0.224*
34	*0.0077*	*0.1956*	*0.200*
35	*0.0069*	*0.1753*	*0.180*
36	*0.0061*	*0.1549*	*0.150*
37	*0.0054*	*0.1372*	*0.140*
38	*0.0048*	*0.1219*	*0.125*
39	*0.0043*	*0.1092*	*0.106*
40	*0.00386*	*0.09804*	*0.100*
41	*0.00343*	*0.08712*	*0.090*
42	*0.00306*	*0.07772*	*0.080*
43	*0.00272*	*0.06909*	*0.071*
44	*0.00242*	*0.06147*	*0.060*
45	*0.00215*	*0.05461*	*0.053*
46	*0.00192*	*0.04877*	*0.048*
47	*0.00170*	*0.04318*	*0.042*
48	*0.00152*	*0.03861*	*0.038*
49	*0.00130*	*0.03429*	*0.034*

50	*0.00120*	*0.03048*	*0.030*
51	*0.00107*	*0.02718*	*0.028*
52	*0.00095*	*0.02413*	*0.024*

Sieves (conversions BS mesh number/ inch to nominal aperture size in mm and um. Extract from BS 410).

Mesh number	**Nominal aperture size (mm)**	**Mesh number**	***Nominal aperture size (mm)***
3	5.60	18	*850*
3,5	4.75	22	*710*
4	4.00	25	*600*
5	3.35	30	*500*
6	2.80	36	*425*
7	2.36	44	*355*
8	2.00	52	*300*
10	1.70	60	*250*
12	1.40	72	*212*
14	1.18	85	*180*
16	1.00	100	*150*
		120	*125*
The relationship of mesh number to the actual number of meshes per inch depends on the wire diameter and should be taken as approximation		150	*106*
		170	*90*
		200	*75*
		250	*63*
		300	*53*

	350	*45*
	400	*38*

Other useful metric Conversion Factors

1g/litre = 0.160ounces/gallon	*1 ounces/gallon=6.236 g/litre*
1ml/litre=0.160 fluid ounce	*1fluid/ounce= 6.250 ml/litre*
1litre /ha= 0.712 pints/acre	*1 gallon/acre11.233 litres/ha*

Densities

Average densities of agricultural commodities

(Conversion factor: 1b/cub. Foot * 16 = kg/m^3)

Item	**Density**
Produce compost	160-56-kg/m^3 (depending on moisture content)
Green coffee	560kg/m^3
Washed coffee	300kg/m^3
Unwashed coffee	210kg/m^3
Cotton (lightly pressed)	80-130kg/m^3
Groundnuts (shelled)	640kg/m^3
Hay in stacks	130kg/m^3
Hay baled	130-190kg/m^3
Maize (cobs de-husked)	480kg/m^3 (80-85% grain by mass)
Maize grain	750kg/m^3
Maize (meal)	700kg/m^3
Maize (snapped corn milled to 12mm)	300kg/m^3 (75-81% grain by mass)

Potatoes	640kg/m^3
Silage	560kg/m^3 plus 16kg for every 300mm of depth
Tobacco (baled for sale)	350kg/m^3
Tobacco (loose bales)	190-225kg/m^3
Tobacco (loose in bulk)	160kg/m^3 approximate

Solid Fuels

Item	**Density**
Anthracite	1630kg/m^3
Coal	310kg/m^3
Coke	1000kg/m^3
Cordwood (gums)	400kg/m^3 solid wood under bark at 12% moisture
Cordwood (indigenous)	500kg/m^3 12% moisture

Liquids

- Milk 1.028kg/litre

Standard unit of agricultural commodities (Packed produce-net mass)

Commodity	**Net mass**
Bag of Green coffee	50kg
Bag of washed coffee	43kg
Bag of unwashed coffee	30kg
Bag of groundnuts shelled	50kg
Bag of maize (grain)	50kg

Bag of maize meal	1, 2,5,10,20,50kg
Bag of mhunga	50kg
Bag of sorghum Z	50kg
Bag of soya beans	50kg
Bag of sunflowers	55kg
Bag of sunhemp	50kg
Bag of rice (husked/ unthreshed)	50kg (provisional)
Bag of rice (polished)	50kg (provisional)
Bag of dry peas	50kg
Bag of wheat	50kg
Bag of barley	50kg
Max. bale mass of (Flue cured) tobacco for sale	110kg
Min. bale mass (flue cured)	25kg
Max. bale mass of (burley) tobacco for sale	70kg
Min. bale mass (burley)	10kg
Hay bale	45cm*35cm* variable length (i.e. 45-90cm)
1 sack or bag	$0.144m^3$
Pocket of seed potatoes	30kg
Pocket of table potatoes	15kg
Pocket of big onions	12.5kg
Pocket of green beans	±10kg
Pocket of green peas	8kg
Pocket of oranges	10kg

Pocket of grapefruit	10kg
Pocket of lemons (smooth)	12.5kg

Average densities and standard units of other commodities

Liquids (in bulk)

Item	**Approx. mass/litre**	**Net per 200-litre drum**
Gear oil	0.9kg/litre	180kg
Motor oil	0.9kg/litre	180 kg
Power paraffin	0.81 kg/litre	162 kg
Illuminating paraffin	0.79 kg/litre	158 kg
Cross-power paraffin	0.80 kg/litre	158 kg
Diesel	0.83 kg/litre	166 kg
Super petrol	0.73 kg/litre	146 kg
Regular petrol	0.71 kg/litre	142 kg
Aviation gasoline 100	0.72 kg/litre	144 kg
Molasses	1.75 kg/litre	350 kg
Water	1.00 kg/litre	200 kg

Some approximate heat values

Item	**Heat values**
Butane/propane gas	48 000kj/kg
Coal (Zimbabwean)	30 000kj/kg
Diesoline	34000kj/litre or 960kj/kg

Gumwood (Eucalyptus)	18 300-19-300kjkg solid wood under bark and dry.
Indigenous timber (Brachystegia/Julbernardia)	16 400kj/kg litre or 41 420kj/kg
Power paraffin	33 400j/litre or 41240 kj/kg
Sheller trash	18600kj/kg

Building materials densities

Item	**Density**
Bricks	1600-2000kg/m^3
Cement	1500kg/m^3
Concrete work	1750- 2400kg/m^3
Glass	2600kg/m^3
Gravel	1600-2000kg/m^3
Masonry	1600-2500kg/ m^3
Sand (undisturbed)	1600- 2000kg/ m^3
Stone, crushed (average)	±1600kg/ m^3
Stone, granite (block)	2600kg/ m^3
Stone, granite (chips	1450kg/ m^3Roofing materials in place
Asbestos	15-20kg/ m^3
Iron	6.5-10kg/m^3
Timber (sawn) dry soft woods	450-550kg/ m^3
Timber (sawn) dry hard woods	550-800kg/m^3

Dimensions

Brick	225* 110* 75mm
$1m^2$ of brick work (floor)	=50 bricks laid flat
	=100 bricks laid on edge

Bricks required to build $1m^2$ of wall

Half brick wall	50
One brick wall	100
One and a half brick wall	150
Two brick wall	200

Roofing (corrugated iron)

No. of sheets	Cover in metres	No. of sheets	Cover in metres	No. of sheets	Cover in metres	No. of sheets	Cover in metres
1	.66	39	22.37	77	44.09	115	65.81
2	1.23	40	22.94	78	44.46	116	66.38
3	1.80	41	23.52	79	45.23	117	66.95
4	2.37	42	24.09	80	45.80	118	67.52
5	2.94	43	24.66	81	46.38	119	68.09
6	3.51	44	25.23	82	46.95	120	68.66
7	4.08	45	25.80	83	47.52	121	69.24
8	4.66	46	26.37	84	48.09	122	69.81
9	5.23	47	26.94	85	48.66	123	70.38
10	5.80	48	27.52	86	49.23	124	70.95
11	6.37	49	28.09	87	49.80	125	71.52
12	6.94	50	28.66	88	50.38	126	72.09

13	7.51	51	29.23	89	50.95	127	72.66
14	8.08	52	29.80	90	51.52	128	73.24
15	8.66	53	30.37	91	52.09	129	73.81
16	169.23	54	30.94	92	52.66	130	74.38
17	9.80	55	31.52	93	53.23	131	74.95
18	10.37	56	32.09	94	53.80	132	75.52
19	10.94	57	32.66	95	54.38	133	76.09
20	11.51	58	33.23	96	54.95	134	76.66
21	12.09	59	33.80	97	55.52	135	77.24
22	12.66	60	34.37	98	56.09	136	77.81
23	13.23	61	34.37	99	56.66	137	78.38
24	13.80	62	35.52	100	57.23	138	78.95
25	14.37	63	36.09	101	57.81	139	79.52
26	14.94	64	36.66	102	58.38	140	80.09
27	15.51	65	37.23	103	58.95	141	80.67
28	16.09	66	37.80	104	59.52	142	81.24
29	16.66	67	38.37	105	60.09	143	81.81
30	17.23	68	38.95	106	60.60	144	82.38
31	17.80	69	39.52	107	61.23	145	82.95
32	18.37	70	40.09	108	62.38	146	83.52
33	18.94	71	40.66	109	62.38	147	84.09
34	19.51	72	41.23	110	62.95	148	84.67
35	20.09	73	41.80	111	63.52	149	85.24
36	20.66	74	42.37	112	64.09	150	85.81

37	21.23	75	42.95	113	64.66	151	86.38
38	21.80	76	43.52	114	65.23	152	86.95

Farm Labour Employment Conditions

Points to note for farm labour

- All employment is voluntary and no employee shall be required to perform forced labour.
- Relevant labour legislation in place should be followed, and adhered to.
- Basic health care should be provided for all employees. This should include access to clinic within reasonable walking distance. Advice and training should be available on personal hygiene and food safety, family planning), common diseases related to sanitary conditions, malaria, cholera and other diseases like HIV and AIDS etc.
- Employment of children under the age of fifteen years in a full time capacity is prohibited. Children between 13 and 15 years of age may be employed during school holidays.
- The Hazardous Substances and Articles Act (Chapter 15.05) prohibits any work that exposes a child or young person to hazardous substances. S172 of 1997 prohibits any work that exposes a child to electrically powered hand-tools, cutting or grinding blades; any work that exposes a child to extremes of heat, cold, noise or whole body vibration. These regulations also prohibit any shift work or any work which is likely to jeopardise or interfere with the education of the child or young person.
- On remuneration, the employer shall place each employee (permanent and seasonal) in a grade appropriate to his/her occupation in line with current payment systems.
- Employers should ensure that staff have equal opportunities in terms of selection, and in accordance with their ability to carry out the required duties.
- Accurate and thorough labour records should be kept. These records should include the following:
  - A labour register, which is a detailed record of attendance, non-attendance, leave etc.
  - National Identification number and National Social Security Authority (NSSA) numbers of all employees;
  - Family details for each employee;
  - Signed warnings. Where applicable;
  - Grievance and termination of employment;
  - Regular working hours should be checked or registered for each employee;
  - An over-time register;
  - Vacation leave for all employees;
  - Sickness benefits received by each employee.
  - A Contract of Employment should be signed between the employer and employee, for all classes of workers. The contract shall be in English and/or vernacular depending on the choice of the employee. The contract must include the following: -
    - Name, grade
    - Wage (and when it will be paid)
    - Hours of work

- Details of any bonus or incentive production scheme in operation
- Provisions for accommodation
- Provision for benefits during sickness
- Vacation leave
- Industrial holidays
- The terms of probation and Reference to Code of Conduct

- Any other benefits e.g. Workers' Compensation, access to school/health facilities and services, subsidised food stuffs where applicable.
- The employee must sign and shall receive a copy of the contract.
- The Code of Conduct should be accessible to all employees with translation into local language.
- Disciplinary measures shall not involve physical, verbal or psychological harassment. No woman shall be dismissed solely because she is pregnant. Sexual harassment is an offence in terms of the existing legislation.
- There must be written procedures defining reporting channels to management, witness requirements and where necessary, onward transmission of the complaint to ZRP.
- (Source Agricultural Code of Practice Handbook, HPC, 2002)

Example of Enterprise Gross Margins

Yield levels		kg	18000	25000	30000
Selling price		Usd $/kg	0.50	0.50	0.50
Gross Income		$/ha	9,000	12,500	15,000
Total Variable Costs		**$/ha**	**2,748**	**2,842**	**2,909**
Gross Margin		$/ha	6,252	9,658	12,091
Gross Margin		$/$100TVC	227	340	416
Yield Levels		kg/ha	18,000	25,000	30,000
Variable costs items			**USD $/HA**	**USD $/HA**	**USD $/HA**
Prior to harvesting	**Qty**				
a. Labour,	100	ld/ha	160	160	160

b. Seed,	1800	kg/ha	1,000	1,000	1,000
c. Tractor & equipment,	78	lits	273	273	273
d. Fertilizer and lime (ex-factory)					
Compound S,	1250	kg/ha	750	750	750
Ammonium nitrate	100	kg/ha	60	60	60
Transport to farm ,	1250	kg	5	5	5
e. Pest and disease control					
Mancozeb,	1	kg/ha	10	10	10
Monochrotophos,	2.8	lits	11	11	11
f. Herbicide					
Dual 720EC,	2.50	lits	18	18	18
g. Irrigation,	**5000**	**cubic metres**	**200**	**200**	**200**
Subtotal			**2,427**	**2,427**	**2,427**
Miscellaneous costs, 2%			49	49	49
TVCprior to harvesting			2,475	2,475	2,475
Harvesting and marketing					
a. Labour,	0.7	days/ton	20	28	34
b. Tractor,	9	litres	32	32	32

c. Transport			72	100	120
e. Packing			144	200	240
Subtotal			**268**	**360**	**425**
Miscellaneous, 2%			*5*	*7*	*9*
Total harvest & marketing			**273**	**367**	**434**
Total Variable Costs			**2,748**	**2,842**	**2,909**

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