JENN
Training and Consultancy
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Department of Education
FREE STATE PROVINCE

AGRICULTURAL SCIENCES

GRADE 12

SPRING CLASSES 2026

TEACHER AND LEARNER CONTENT MANUAL



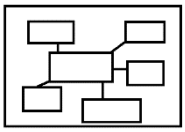
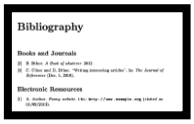
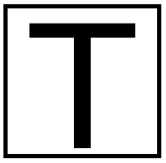
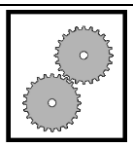
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ICON DESCRIPTION

 **MIND MAP**	 **EXAMINATION GUIDELINE**	 **CONTENTS**	 **ACTIVITIES**
 **BIBLIOGRAPHY**	 **TERMINOLOGY**	 **WORKED EXAMPLES**	 **STEPS**

UNIT 1	AGRI-PRODUCTION FACTORS: LAND



EXAMINATION GUIDELINE

Learning objectives: At the end of this unit the learners should be able to demonstrate knowledge of the following content:
• Identify the functions of land (in economic terms)
• Indicate the economic characteristics of land as a factor of production
• Describe the techniques/methods of increasing land productivity

TERMINOLOGY

DEFINITION	CONCEPTS
A piece of ground that can be used for building or agricultural production	**Land**
If there is an increase of the input in the production process, the output will increase but a point will be reached where further increase in the input will result in the decline of the output.	**Law of diminishing returns**



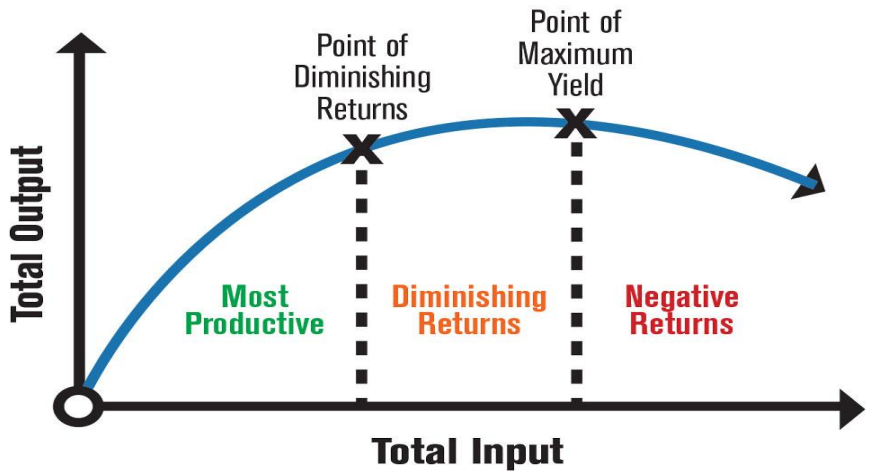
1.1 Economic functions and Economic characteristics of land

Economics functions of land	Economic characteristics of land
• Provides space for/medium of plant growth	• Arable land is limited /scarce
• Serves as collateral	• Land is indestructible but degradable
• Serves as source of raw materials	• Land is restricted for certain types of plants/differs in production potential
• Provides food	• Land is found in a specific environment
	• Subject to the law of diminishing returns
	• Soil is durable
	• Land appreciates in value

1.2 Law of diminishing returns

The yield capacity of land is mainly determined by the physical characteristics of the soil. It can be increased to a certain limit by increasing capital and labour inputs per unit or by means of improved technology. A point will be reached where production no longer increases with increased units of input. The graph below shows that a point is reached where the yield per added factor of production will start to decline.

Figure 1. Law of Diminishing Incremental Yield



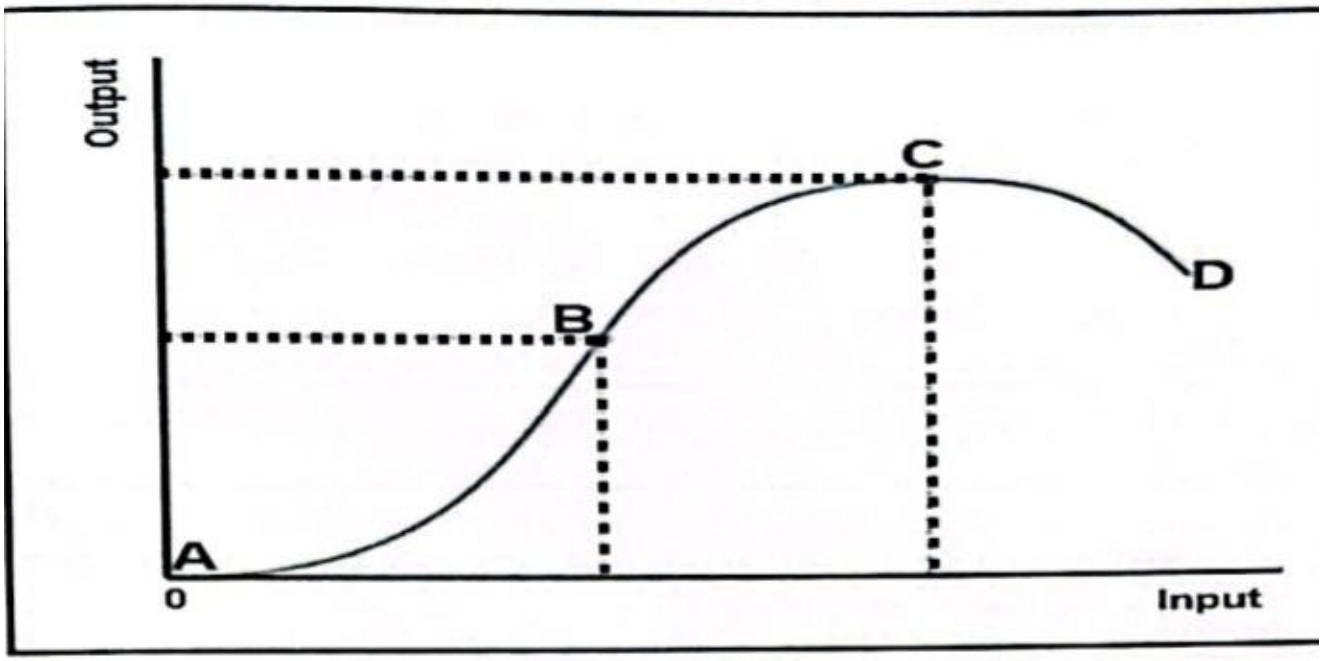
1.3 Techniques/methods of increasing land productivity

- ❖ Adaptation of production systems to scientific farming methods using modern technology, data, and improved biological materials. These practices boost crop yields, protect soil health, and use water and fertilizers efficiently to grow more food on the same amount of land.
- ❖ Improving the fertility of the land/addition of chemical fertilizer/organic manure
- ❖ Restore land potential directly revives soil fertility, captures vital carbon, protects scarce water resources, and boosts agricultural yields
- ❖ Optimise water management / Water provision /supply water/irrigation/build dams Effective water management maximizes crop yields in South Africa by reducing dry-land stress during dry spells, cutting high evaporation losses, and building long-term soil health.
- ❖ Consolidation of uneconomical farm units enables mechanisation.. Land consolidation
- ❖ improves the efficiency and cost effectiveness of investments in transportation communication networks, utilities and irrigation systems
- ❖ Utilisation of improved agricultural technology/precision farming
- ❖ Provide extension services/education to farmers through transferring critical technical knowledge, distributing vital physical inputs like seeds and manure, and introducing. climate-smart farming techniques to smallholder and rural farmers.
- ❖Reduce tillage/practice crop rotation

ACTIVITIES

ACTIVITY 1

1.1 The grapgh below illustrates the Law of Diminishing returns.



1.1.1 Identify the range from **A** to **D** where EACH of the following occurs:

(a) Diminishing returns (1)
(b) Negative returns (1)
(c) Increasing returns (1)

1.1.2 Identify the letter (A-D) that represents a point of maximum production (1)

1.1.3 State ONE method to improve the productivity of land (1)

1.1.4 Name the economic characteristic of land associated with EACH of the following statements below:

(a) A road expansion into a wheat field (1)
(b) An empty piece of land was bought for R 150000 in 2015. Now, in 2026, the same piece of land is valued at R350000. (1)

1.2 The table below represents two groups of farmers with different ways of farming.

GROUP A	GROUP B
• 20 small pieces of land • Average size of 1 ha per farmer • 2 small tractors, others use oxen • 1 hand sprayer • Grows different crops per growth season • Harvests by hand • Combined harvest is 1 ton per hectare	• 576 ha arable land • 1 big tractor, a boom sprayer and a combine harvester • Grows maize practising a monoculture system • Produces 5 tons per hectare

1.2.1 Indicate the land factor described in EACH of the two scenarios. (1)

1.2.2 State TWO benefits of the practices by the farmers in GROUP B that may have contributed to the higher production per hectare. (2)

1.2.3 Suggest TWO techniques applicable to the farmers in GROUP A that can improve their production per hectare. (2)

1.2.4 Identify an economic characteristic of land that will be negatively affected by monoculture and continuous cultivation. (1)

1.2.5 State TWO functions of land as a production factor. (2)

[11]

ACTIVITY 2

2.1 Explain the meaning of each of the following economic characteristics of land:

a) Urban development (1)

b) Land is limited (1)

c) Land is subject to the law of diminishing returns (1)

2.2 The table below shows the amount of fertiliser applied and quantity of maize produced on a piece of land.

FERTILISERS (kg)	MAIZE (bags)
5	10
10	25
15	35
20	40
25	40

2.2.1 Draw a line graph using the information in the table above. (6)

2.2.2 Identify the economic characteristic of the land depicted in the table above. (1)

2.2.3 Deduce the function of the land reflected in the table above. (1)

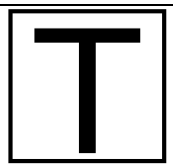
2.2.4 Suggest TWO methods of increasing the productivity of the land other than the one in the table (2)

UNIT 2	AGRI – PRODUCTION FACTORS: LABOUR



EXAMINATION GUIDELINE

Learning objectives: At the end of this unit the learners should be able to demonstrate knowledge of the following content:
• Define the term labour
• Describe the different types of labour in agriculture (with relevant examples)
• Identify and describe the problems associated with labour in agriculture
• Indicate the methods for increasing labour productivity
• Identify the labour legislation (Acts) affecting farmworkers in South Africa (LRA, BCEA, OHSA, COIDA and SDA)
• Describe the standard format and layout (components) of a labour/farmworker contract



TERMINOLOGY

DEFINITION	**CONCEPTS**
Labour that works less than 24 hours per month	**Casual labour**
A formal and legal binding agreement between the employer and the employee.	**Contract**
It is the type of insurance where workers are insured against disability or sickness.	**Health and disability Insurance**
Physical or mental process which is applied in the workplace with the expectation of being paid or remunerated a wage or a salary.	**Labour**

This takes place when the skill is lost due to death, disability, divorce, illness etc.	**People/human risks**
A labour whose job is there throughout the year and are full time workers.	**Permanent labour**
A process that involves deciding what to do, when to it how to do it and who is going to do it	**Planning**
Remuneration for skilled workers who are permanent workers	**Salary**
Labour that knows how to do the job, they may be permanent or temporary	**Skilled labour**
Labour that works less than 24 hours per month	**Casual labour**



2.1 DIFFERENT TYPES OF LABOUR IN AGRICULTURE

- **Casua**l – work less than 24 hrs p/m, doing none- repetitive work.
- **Part-time** - work fewer than standard hours e.g. two days a week/ afternoons only)
- **Seasonal** – work during peak periods such as harvesting or shearing sheep.
- **Temporary** – stand in for other e.g. permanent worker on sick/maternity leave.
- **Permanent** – works on full-time basis (work ordinary hours), signs a contract.

2.2 LABOUR CATEGORISED ACCORDING TO SKILLS

- **Skilled labour** - Workers who can offer special services, meaning they have been trained in a particular skill or skills. e.g., farmers with tertiary qualifications, economists and agricultural economists.

- **Semi-Skilled labour** - they have a certain level of training, often such workers have formal education e.g., unqualified mechanics, drivers of agricultural vehicles.

- **Unskilled labour** - workers who have no formal skills or training. e.g. sheep shearing, herders, shepherds, cleaners etc.



Skilled – for example the veterinarian above.



Semi –skilled- tractor driver without a driving licence.



Potato pickers are examples of **unskilled labour**.

2.3 PROBLEMS ASSOCIATED WITH LABOUR

- **Shortage/scarcity of labour** - In South Africa, workers migrate from rural areas to cities in search of better opportunities

- **Industrial competition** – workers think jobs in industry are much more rewarding than farm jobs as well as working conditions.

- **Lack of skills** - Many farm workers are not skilled.
- **Ineffective labour management**- some farmers lack labour management skills resulting in frictions between the farmer and employees**.**
- **HIV /AIDS /COVID** - Days may be lost due to farm workers being ill and absent from work because of numerous diseases.

2.3.1 IMPACT OF HIV/ AIDS /COVID ON LABOUR PRODUCTIVITY

- Absenteeism of workers which leads to decline in productivity.
- Difficult to plan due to absenteeism.
- Loss of skills and experience.
- Agricultural operations cannot be completed on time due to labour shortages.

2.3.1.1 HOW TO ADDRESS HIV & AIDS

- Education awareness and training of workers.
- Provide access to free condoms for all workers.
- Supplying medication like anti-retroviral drugs for infected workers.
- Discouraging multiple sexual partners.
- Have support groups for supporting the infected and affected workers.
- Provide treatment for sexual transmitted diseases.



Provision of free condoms.



HIV awareness campaign.

2.4 METHODS OF INCREASING LABOUR PRODUCTIVITY

- **Increasing economic conditions of worker**s - provision of incentives, bonuses, good salaries, medical aid etc**.**
- **Improving educational conditions** – by means of trainings and workshops to make workers more efficient leading to increased productivity.
- **Addressing HIV/AIDS** - by awareness campaigns, access to condoms, encourage good values, establish support groups for affected workers.
- **Improving environmental conditions -** provide better housing, adequate leaves, free transport, water and food, protective clothing.
- **Managing labour –** dealing with grievances, delegating tasks, being fair.
- **Physical farm planning -** of the farm and its activities to obtain ideal productivity of farm labourers
- **Mechanisation.** More work is completed within a short space of time working more efficient
- eliminates fatigue
-

2.5 LABOUR LEGISLATION

- **Labour Relations Act** 66 of 1995- aims to promote economic development, social justice,the right to joing labour unions, peace and democracy at workplace.

- **Basic Conditions of Employment Act** 75 and Amendments of 1997 - The Law applies to all employers and employees. Act regulates leave, working hours, employment contracts, payslips, etc.

- **Occupational Health and Safety Act** 85 of 1993 – provides safety and health of workers at work and for the health and safety of persons in connection with machines and plants.

- **Compensation for Occupational Injuries and Diseases Act** 130 of 1993- seeks to provide and regulate health and safety at work for all workers.

- **Skills Development Act** 97 of 1997 of 1998 -act aims to provide for the financing of skill, providing training for workers as well as bursaries through development by means of a levy-grant scheme and a National Skills Fund; to provide and regulate employment services.

Labour Equity Act of 1995 – ensures that there is no workplace discrimination based on gender, age, disability, race, sexuality etc.

Unemployment Insurance Act – intends to establish the UIF which gives short term relief on workers who are retrenched.



Farm workers demonstrate for workers rights..

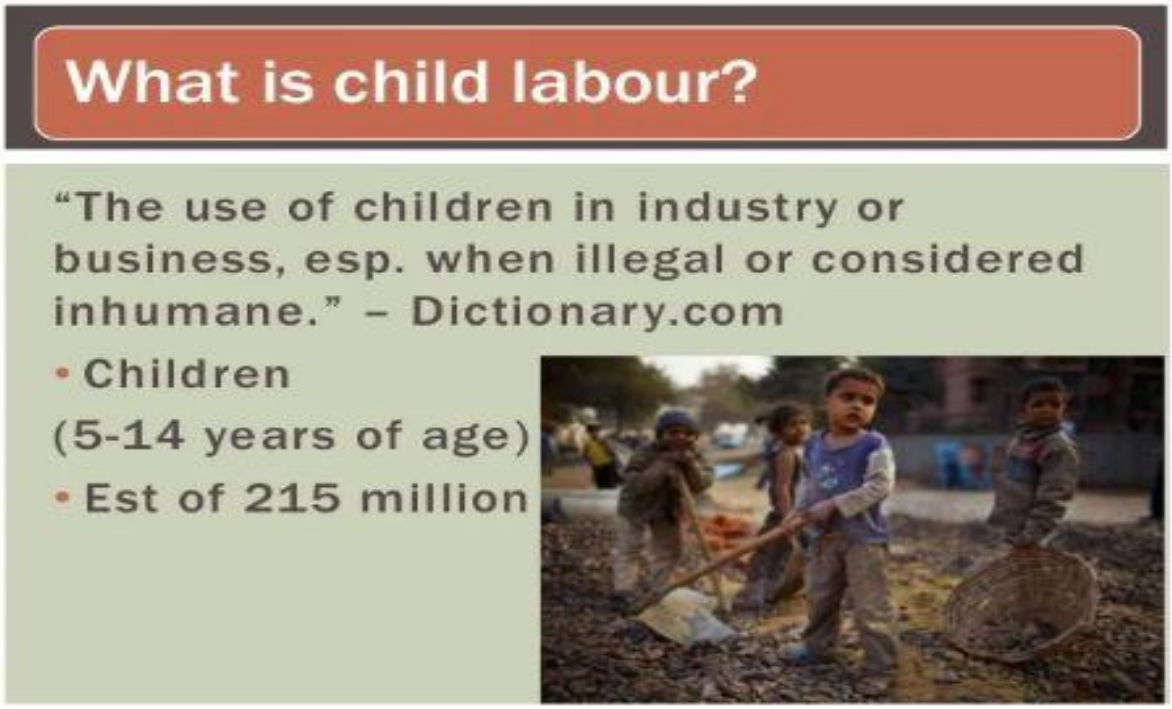
2.6 LABOUR CONTRACTS

A typical labour contract will have the following information:

- Employer & employee details.
- Place of work, duties/job description and job title.
- Conditions for termination
- Wages, allowances, leave and other benefits.
- Working hours and meal intervals.
- Signatures for both parties.
- Medical benefits
- Mode of payment
- Period/ duration of employment eg twelve months fixed contract.

2.7 ILLEGAL PRACTICES ENCOUNTERED ON FARM

- **Farm evictions** – illegal and forceful removal of people from farms where they have been residing.
- **Child labour** - illegal employment of children under 15 years of age.
- **Failure to adhere to legislation by employers** – employer depriving workers a right to strike or belonging to a union of their choice.



ACTIVITIES

ACTIVITY 3

3.1 Below are different types of labour employed to perform various tasks in a sheep production enterprise:

- Seasonal
- Permanent
- Casual

3.1.1 Identify from the above the type of labour that is employed to perform the following tasks:

(a) Feeding stud rams (1)

(b) Shearing sheep (1)

(c) Installation of water troughs on the farm (1)

3.1.2 Name TWO ways in which the farmer can improve the living conditions of farm labourers in this farming enterprise. (2)

3.2 A legal binding document between the farmer and the farm worker must be signed on employment as per the requirement of labour legislation. Other legislation addresses the conditions of employment of farm workers, as listed below.

A. Entitlement to tea, lunch breaks and leaves of absence
B. Affiliation rights to labour unions
C. Provision of protective gear when working with hazardous chemicals
D. Compensation for injuries while on duty

3.2.1 Identify the letter (A–D) associated with the conditions above that is addressed by EACH of the following Acts:

(a) Labour Relations Act, 1995 (Act 66 of 1995) (1)

(b) Occupational Health and Safety Act, 1993 (Act 85 of 1993) (1)

(c) Basic Conditions of Employment Act, 1997 (Act 75 of 1997) (1)

3.2.2 Name the legal document that needs to be signed between the farmer and the farm worker. (1)

[9]

ACTIVITY 4

4.1 HIV/Aids have a negative impact on the productivity of farm workers.

4.1.1 Indicate TWO implications of HIV/Aids for the agricultural sector. (2)

4.1.2 Name ONE measure farmers can take to address the problem of HIV/Aids on the farm. (1)

4. 2

The following personnel are employed on the farm:

- A dairy foreman
- Two general workers
- A brick-layer
- An electronic feeding machine operator

4.2.1 Identify, in the list of personnel above, an example of each of the following:

(a) Casual worker (1)

(b) Manager (1)

(c) Unskilled worker (1}

(d) Skilled worker (1)

4.3 The table below shows duties performed by two different workers on the farm.

WORKER 1	WORKER 2
• Building a dam • Erecting a fence • Painting farm buildings	• Shearing sheep • Picking avocadoes • Harvesting grapes

4.3.1 Identify the type of temporary worker represented by EACH of the following:

(a) WORKER 1 (1)

(b) WORKER 2 (1)

4.3.2 Give a reason for the answer to QUESTION 4.3.1(b). (1)

4.3.3 State TWO ways to increase labour productivity in agriculture. (2)

[12]

UNIT 3	AGRI – PRODUCTION FACTORS: CAPITAL



EXAMINATION GUIDELINE

Learning objectives:

At the end of this unit the learners should be able to demonstrate knowledge of the following content:

- Define the following terms: capital, assets, cash flow, budgets
- Identify and describe the types of capital (with relevant examples)
- List the methods of creating capital
- Identify and describe the sources of finance/credit (long-term, medium-term and short-term credit)
- Indicate the problems associated with capital as a factor of production

• Identify and describe the capital/financial management systems, including financial records, farm asset records and farm budgets
• Indicate the differences between an enterprise budget and a whole farm budget (example of farm budget)
• Distinguish between the main aspects which are included in a Cash Flow Budget Statement
• Define the concepts of farm Management/Management, strategic farm risk management
• Identify and explain the principles/components of management
• Indicate the general management skills needed to manage a farm business
• Identify and describe the internal and external forces which affect/influence farming businesses
• Discuss the primary sources of risk in farming business
• Identify and discuss the main risk management strategies/techniques (diversification strategies, risk-sharing strategies)
• Discuss the law of diminishing returns as applicable to all factors of production – interpretation of graph
• List the methods of creating capital

CAPITAL AS A PRODUCTION FACTOR



TERMINOLOGY

DEFINITION	CONCEPTS
Money or assets used in the production process	**Assets**
It is a sheet that summarises the assets and liabilities of a business	**Balance sheet**
An estimate/projection of costs, revenue (income and expenditure) regarding foreseeable situations/ financial that shows how income will be generated and how it will be spent.	**Budget**
Money or equipment that are used for production purposes./ Wealth accumulated through savings that is employed in the production process	**Capital**
type of a book used to record money coming to the farm and money going out of the farm	**Cash analysis book**
It is the movement of money/cash in or outside the business enterprise	**Cash flow**
A financial plan that predicts the exact cash coming into and going out of a busin.	**Cash flow budget statement**
It includes receipts and payments over a specific period.	**Cash flow statement**

It is the amount remaining in an account at the end of the accounting period.	**Closing balance**
A loan made from a financial institution e.g. bank.	**Credit**
Is the budget that is intended for a particular farm enterprise	**Enterprise budget**
Payment made for goods and services	**Expenditure**
The risks that take place when the manager is unable to pay the debt on time.	**Financial risks**
Are assets that are of a long term in nature such as land and buildings and cannot be easily changed into cash.	**Fixed assets**
Type of capital invested over a long period e.g. buildings, land, dam etc.	**Fixed Capital**
Structural improvements to fixed assts such fixed assets such as dams, silos and buildings	**Fixed improvements**
Money that an individual or business receives in exchange of the sale of goods or exchange of for providing a good or service	**Income**
It is a summary of all income and expenditure in a financial statement over a fixed period in time.	**Income statement**
It is a record keeping system where assets are recorded.	**Inventory**
It is the farm /company's financial debt, or money owned.	**Liabilities**
A credit in which the repayment takes a longer period and is used to purchase land and fixed improvements.	**Long term credit**
Credit in which the repayment takes place over a short time and used to buy for movable assets.	**Medium Term credit**
Type of capital goods invested for a medium term like livestock and machinery that are used in the production processes	**Movable capital**
It is defined as assets minus the liabilities.	**Net worth**
It is the amount of money in a bank account when it is opened/ **the** amount of money that is available in the bank when starting a month or a year.	**Opening balance**
Is defined as income minus the expenses/ difference between income and expenditure	**Profit or loss**
Type of income not spent and has accumulated and is invested in fixed improvement or new equipment	**Savings**
A credit which is repaid back over a short period of time	**Short term credit**

It is the budget for the whole farm and all the enterprises in the farm.	**Whole farm budget**
Capital goods invested for a short term like seeds, fuel and fertilizers and is used for production processes	**Working/floating/production capital**

3.1 TYPES OF CAPITAL AND METHODS OF CREATING CAPITAL

3.1.1 TYPES OF CAPITAL:

There are three types of capital namely fixed capital, movable capital and working capital.

Fixed capital: Type of capital invested over a long period e.g. buildings, land, dam etc.



A garin silo

Movable capital: Type of capital goods invested in durable assets for a medium likelivestock and machinery that are used in the production processes.



Livestock

- **Working capital:/floating/production capital** Type of capital goods invested for a short term like seeds, feeds, fuel and fertilizers and is used for production processes.



Feed for livestock

3.1.2 METHODS OF CREATING CAPITAL

Capital can be created by:

- **Production**: Type of profit invested which comes from farming operation or farming enterprises. The profit can be invested for the following season/s.
- **Savings:** Type of income not spent and has accumulated and is invested in fixed improvement or new equipment.
- **Credit:** A loan made from a financial institution e.g. bank.

TYPES OF CREDIT IN AGRICULTURE

- **Long term credit:** A credit in which the repayment takes a longer period and is used to purchase land and fixed improvements. Repayment is longer than 10 years and can be 20 to 30 years.
- **Medium term credit:** A credit in which the repayment takes place over a short time and used to buy for movable assets e.g. livestock, tractors and repayment is for a period of 1-5 years and may extend up to 10 years.

- **Short term credit:** A credit which is repaid back over a short period of time. Repayment may be up to one year. It is used for production goods like feed, fuel and seeds within one production season.

- **TYPES OF COSTS IN AGRTICULTURE**

- **Fixed costs-**These are costs that are based on time rather than the quantity produced or sols by businesses. Examples include rent and lease costs, salaries, utility bills, insurance and loan repayments.

- **Variable costs -**These are costs that change as the volume of production changes. Examples are raw materials, production costs, delivery costs, packaging supplies etc

3.2 PROBLEMS ASSOCIATED WITH CAPITAL IN AGRICULTURE

Under-capitalisation -Not investing enough capital for to optimise production **Over-capitalisation** Too much capital is invested in the farming business **Subject to high risk.**Farming is dependent on risk factors such as drought, pest incidence and floos	• **Depreciation -**Capital assts such as machinery lose value over time • **Scarcity of capital** Lack of capital may prevent a farmer from purshacing farm inputs **Interest rates may be high** Some farmers borrow capital and pay more interest if interest rates become high

3.3 FINANCIAL MANGEMENT SYSTEMS

Financial records: These are records that show money that is coming in and money that is spent in a business over a period. A financial record can be used to calculate the return on investments

Assets: These are resources that have economic / financial value that the farmer owns. e.g. Livestock, plantations and machinery.

Inventory: It is a record keeping system where assets are recorded.

Fixed improvements: These are immovable assets such as dams, silos and buildings.

Fixed assets: These are assets that are of a long term in nature like such as land

and buildings and cannot be easily changed into cash.

3.3.1 **Financial management systems make the farmer to do the following**::

- ❖ Put sound management on the farm capital keep an inventory of assets
- ❖ Draw up a sound budget/preparing budgets
- ❖ Do analysis and compare financial results/keep a cash analysis book
- ❖ Put a sound plan regarding the future of the business
- ❖ Preparing key financial statements, balance sheets, income Statement, cash flow statement

Whole farm budget: It is the budget for the **whole** farm and **all** the enterprises in the farm. Eg maize, tomatoes, sheep enterprises combined together.

Enterprise budget: It is the budget that is intended for a particular farm enterprise(eg budget for maize production only

Cash analysis book: This type of a book used to record money coming to the farm and money going out of the farm. (i.e. receipts and payments)

3.4

Cash Analysis Book for Talanyane Farmimg for January 2025

Cash Inflow					**Cash Outflow**				
Date	**Transaction Details**	**Invoice Amount**	**Discount 5%**	**Amount**	**Date**	**Transaction Details**	**Invoice Amount**	**Discount**	**Amount**
1/1/2025	Opening Balance			R25000	1/5/2025	Fertilizer	R15 000	R1500	R13 500
1/2/2025	Cash Sale	R5 000	R250.00	R4750	1/15/2025	Seeds	R5000		R5000
1/2/2025	Thabo Friuts and vegs	R10 000	R500.00	R9 500	1/20/2025				

3.5 Balance sheet: It is reflects / summarises the assets and liabilities of a business.

Components of a Balance Sheet Statement

Assets **What the business owns**	**Liabilities** What the business owes	**Net Worth / Owner's Equity** Assets minus liabilities
Examples: • **Land and buildings** • **Machinery and equipment** • **Livestock** • **Cash in bank** • **Debtors**	**Examples:** • Loans • Overdrafts • Creditors • Accounts payable • Outstanding expenses	**Formula:** **Net Worth = Assets − Liabilities** This indicates the owner's financial interest in the business.

Liabilities: It is the farm /company's **financial debt** (money that farm /company **owes**.

Net worth: It is defined as **assets** minus the **liabilities**.

Income statement: It is a summary of all in**come** and **expenditure** in a financial statement.

Profit*:* It is defined as **income** minus the **expenses**

3.6 Components of cash flow statement

- **Income:** Money that an individual or business **receives** in exchange of the sale of goods or exchange of for providing a good or service.
- **Expenditure:** Payment made for goods and services (e.g. salaries, wages and inputs)
- **Profit or loss:** It is defined as **income** minus the **expenses**/ difference between income and expenditure. **Profit/Loss = Income -Expenditure**
- **Opening balance:** It is the amount of money in a bank account when it is **opened**/ the amount of money that is available in the bank when starting **a month or a year.**
- **Closing balance***:* It is the amount remaining in an account at the **end of the accounting period.**

3.5 Main aspects which are included in a cash flow budget statement

Cash Flow Budget Statement

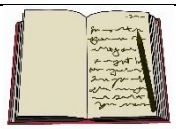
↓		
Cash Receipts / Inflow **Money expected to come into the farm/business**	**Cash Payments / Outflow** Money expected to be paid out by the farm/business	**Balances** Cash available at the beginning and end of the period
↓	↓	↓
Examples: • **Opening balance** • **Cash sales** • **Receipts from debtors** • **Loans received** • **Other farm income**	**Examples:** • Seeds, feed and fertiliser • Wages and salaries • Fuel and repairs • Loan repayments • Other operating expenses	**Key calculations:** **Net Cash Flow = Cash Inflow – Cash Outflow** **Closing Balance = Opening Balance + Net Cash Flow**

3.7 **Income statement**

lists total farm revenue, operating expenses, and inventory changes over a specific period (usually one year) to calculate **Net Farm Income**.

Components of an Income Statement

Income / Revenue **Money received by the farm/business**	**Expenditure / Expenses** Money spent by the farm/business	**Profit or Loss** Difference between income and expenses
Examples: • **Sale of crops** • **Sale of livestock** • **Sale of livestock products** • **Government payments** • **Other farm income**	**Examples:** • Seeds • Fertiliser • Feeds • Wages and salaries • Fuel, repairs and services	**Formula:** **Profit / Loss = Income − Expenses** If income is more than expenses, the business makes a profit. If expenses are more than income, the business makes a loss.



ACTIVITIES

ACTIVITY 5

4.1 The table below shows a financial record showing the expected expenditure and income of a horticultural farming enterprise.

EXPECTED EXPENDITURE		EXPECTED INCOME	
ITEM	**AMOUNT (R)**	**ITEM**	**AMOUNT (R)**
Irrigation	10 300	Flowers (shop)	150 000
Manure	22 400	Flowers (nursery)	40 000
Fuel	13 300	Compost	7 500
Labour	24 500		
Potting soil	8 800		
Vegetative material	45 500		
Chemicals	18 700		
TOTAL EXPENDITURE		**TOTAL INCOME**	

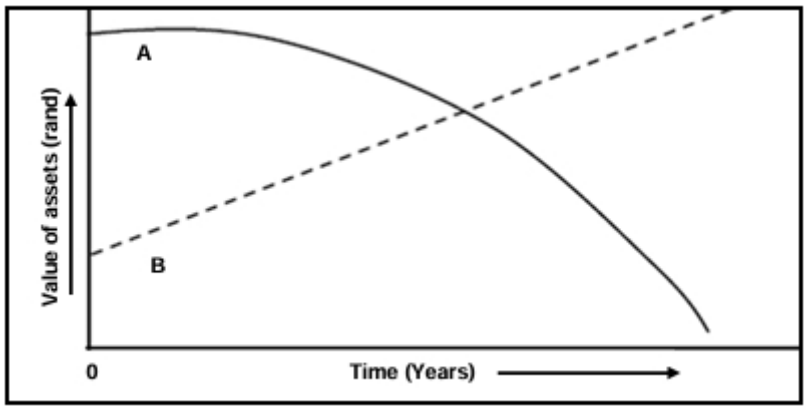
5.1.1 Identify the type of financial record represented in the table above. (1)

5.1.2 Use a formula to calculate the profit or loss of this enterprise. (Show ALL calculations.) (4)

5.1.3 Indicate whether the farmer should continue or not with the enterprise. (1)

5.1.4 Give a reason for the answer to QUESTION 4.1.3. (1)

5.2 The table below shows a financial record showing the expected expenditure and income of a horticultural farming enterprise.



5.2.1 Identify the curve (A or B) that represents the following:

(a) Movable capital assets (1)

(b) Fixed capital assets (1)

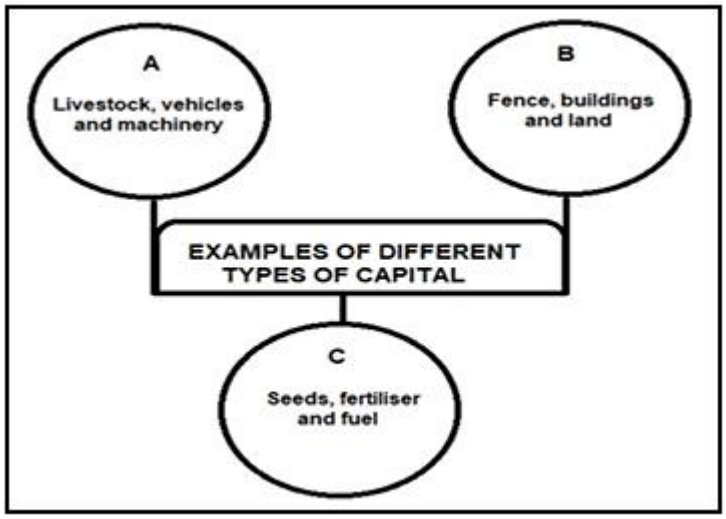
5.2.2 Give a reason to support the answer to QUESTION 4.2.1(b). (1)

5.2.3 State TWO problems of capital as a production factor. (2)

[12]

ACTIVITY 6

6.1 The diagram below shows examples of different types of capital commonly used in farming.



6.1.1 Identify the type of capital represented by A, B and C in the diagram above. (3)

6.1.2 State TWO methods of creating capital. (2)

6.2 The table below represents a financial record in a farming enterprise.

MONTHS OF THE THIRD QUARTER	OCTOBER	NOVEMBER	DECEMBER
OPENING BALANCE	**R500**	**R10 150**	**R13 538**
Income (Receipts):			
Livestock sales	R3 500	R3 500	R2 000
Sales from crops	R4 300		
Capital	R5 500	R4 500	R2 200
TOTAL INCOME (RECEIPTS)	**R13 300**	**R8 000**	**R4 200**
Expenses (Payments):			
Transport	R2 800	R3 700	R4 600
Interest on amount owed	R350	R412	R674
Wages for labourers	R500	R500	R3 500
TOTAL EXPENSES (PAYMENTS)	**R3 650**	**R4 612**	**R8 774**
PROFIT/LOSS	**R9 650**	**R3 388**	**A**
CLOSING BALANCE	**B**	**R13 538**	

6.2.1 Identify the financial record in the table above. (1)

6.2.2 Give ONE reason for the answer to QUESTION 1.2.1 by referring to the table. (1)

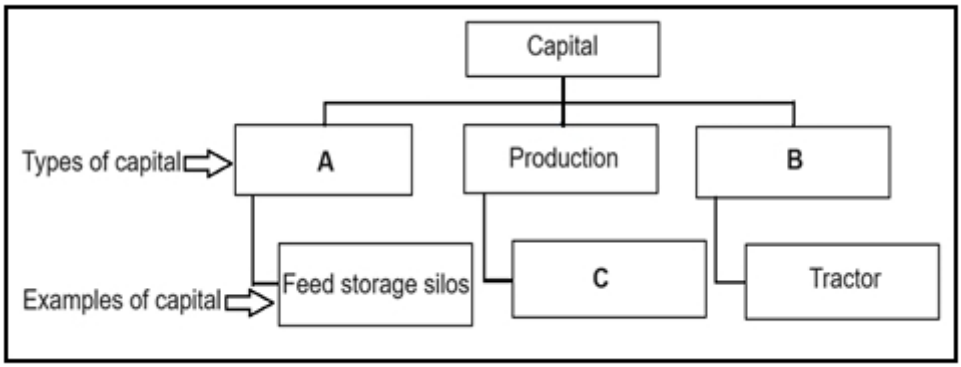
6.2.3 Calculate the profit or loss for December represented by A in the table above. Include the formula and show ALL calculations. (3)

6.2.4 Calculate the closing balance represented by B in the table above. Show **ALL** calculations. (2)

[12]

ACTIVITY 7

7.1 The schematic representation below shows types of capital with examples.



7.1.1 Identify the types of capital represented by A and B in the schematic representation above. (2)

7.1.2 Give ONE example of a capital item represented by C. (1)

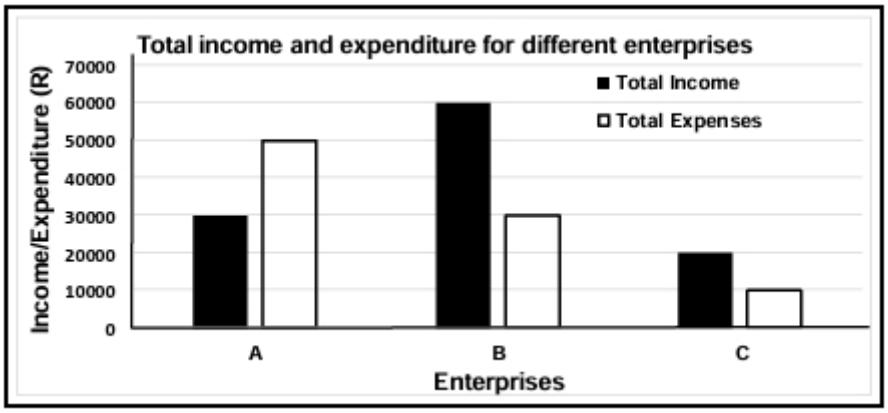
7.1.3 Suggest the type of credit that can be sourced from a financial institution to acquire the following types of capital:

(a) A (1)

(b) C (1)

7.1.4 Name ONE method of creating capital. (1)

7.2 The graph below shows income and expenditure for different farming enterprises for the 2023/24 financial year.



7.2.1 Identify the enterprise in the graph above with the:

(a) Highest income (1)

(b) Lowest expenses (1)

7.2.2 Name the financial record that shows the information in the data above. (1)

7.2.3 Calculate the profit or loss for enterprise A. Show ALL the calculations, including the formula. (3)

7.3 State the problem associated with capital that is applicable to EACH of the following statements:

7.3.1 The farmer does not have enough capital to buy equipment to run the farming enterprise. (1)

7.3.2 Too much capital is invested in the enterprise in relation to available land and labour. (1)

[14]

UNIT 4	AGRI – PRODUCTION FACTORS: MANAGEMENT/ENTREPRENEUSRHIP



EXAMINATION GUIDELINE

Learning objectives: At the end of this unit the learners should be able to demonstrate knowledge of the following content:
• Identify and explain the principles/components of management
• Indicate the general management skills needed to manage a farm business
• Identify and describe the internal and external forces which affect/influence farming businesses
• Discuss the primary sources of risk in farming business
• Identify and discuss the main risk management strategies/techniques (diversification strategies, risk-sharing strategies)
• Discuss the law of diminishing returns as applicable to all factors of production – interpretation of graph

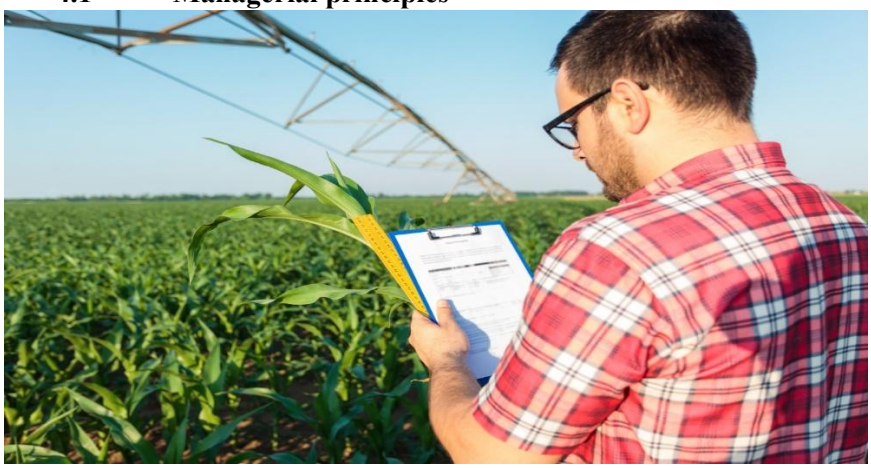
TERMINOLOGY

DEFINITION	CONCEPTS
This will involve short term and long- term planning.	**Business management skills**
The skills of communication which is good for all the workers on the farm.	**Communication skills**
Involves checking and verification of the results of the decision making.	**Control**
Are forces that the manager has little or no control over them	**External forces**
Farm management involves a day-to-day organization and coordination of resources	**Farm Management**

The skills wherein the manager is well vested on financial matters regarding borrowing, investing and full understanding regarding taxation so as to regard against financial losses	**Financial Management skills**
These are forces that originate on the farm itself.	**Internal forces**
A piece of ground that can be used for building or agricultural production	**Land**
If there is an increase of the input in the production process, the output will increase but a point will be reached where further increase in the input will result in the decline of the output.	**Law of diminishing returns**
Involves giving direction, guidance and setting the plan to motion	**Leading**
The types of risks when the manger is taken to court for having ignored some regulatory standard on the farm.	**Legal risks**
A law or set of laws made by the government.	**Legislation**
Involves organisation and coordination of activities (human, and financial) of a business.	**Management**
It is a risk which gives rise to an oversupply or undersupply of a product in the market.	**Market risks**
Involves ringing together physical, human and financial resources to achieve objectives	**Organisation and coordination**
The skills to be able to manage problems when they arise or to prevent them from arising.	**Problem management skills**
Profit invested which comes from farming operation or farming enterprises.	**Production**
These are risks that may come due to breakdown of machinery, weather or pests that may damage the crops.	**Production risks**
It is an insurance that insures the property, machinery against things like storms, hail damage, injury of the visitor etc.	**Property and liability insurance**
Belonging to different farming associations/cooperatives or farming organizations	**Risk sharing**

CONTENTS

4.1 Managerial principles





- **Planning:** It involves deciding what to do, when to it how to do it and who is going to do it. It involves financial planning, farm activity planning and market planning.

- **Implementation** : It. Involves the process of getting the plan in action. A farm manager resources the plan coordinating and organising various activities to meet the objectives of the business.

- **Leading:** It involves giving direction, guidance and setting the plan to motion.

  Control: It involves monitoring performance, comparing actual results to planned objectives, and taking corrective actions. Control can be delegated and must be economical .

4.2 General management skills needed to manage a farming business

- **Business management skills**. This will involve short term and long-term planning. The staff must know what is to be done on a day-to-day basis (i.e. daily operations)

- **Financial management skills**. The manager must be well vested in financial matters regarding borrowing, investing and full understanding regarding taxation to guard against financial losses.

- **Communication skills:** Communication is a two-way process. Both stakeholders including the manager must understand one another.

- **Problem solving skills:** In any given institution where people are, challenges/problems will be there. The manager must be a person who can solve the problems. He must as well be a good listener.

- **Production and operational skills:** The manager must have good knowledge of production of a farming enterprise and the operational skills of that farming enterprise e.g. crop farming, poultry farming, piggery etc.

4.3 The internal and external forces that affect/influencing farming business.

Internal forces:

These arise from **within** the business and a farmer has control over these forces; also known as microenvironment. Internal forces are factors or conditions within a business.

Six key internal factors can affect a business:

• **Resource availability** land, water, and work force	• **Organogram**(**organisational structure)** and culture . Good structures enhance communication and enhance worker motivation
• **Financial standing** -the amount of debt owed and cash flow situation	• **Management** and administration systems in place
• **Availability competencies**, of management team and labour, marketing and fiscal management	• **Research**- whether the farm is involved in research and development which has the potential in making farming operations much more efficient.
• **Production techniques,** produce quality and cost, packaging and dispatch methods.	• **Business image and reputation** • A good farm business image can help bring in customers

External forces: from outside of the business; a farmer has **no or limited** control over these forces; also known as the market and macro environments. External forces are factors outside the business that a farmer has little or no control over.

Table 1 External forces on a business

• **Competition** from other producers may lead to oversupply of agricultural produce and impact on profitability if new entrants produce much more efficiently.	• **Politics-**impact factors such as which type of farmers receive subsidies and land acquisition policies
• **Economic**s -changes in the macro-economic environment such as high inflation rates and how much money consumers have to spend.as well as taxation, interest rates and Rand /Dollar exchange rates affects business	• **Technology**-improved technology and its availability, whether locally sourced or imported affects fam business. Imported technology tends to be expensive
• **Ethical considerations**. Green/sustainable marketing, can impact on the buying behaviour of consumers.	• **Socio-cultural**-communal land tenure systems limit productivity
• **Legal forces** Legislation related to labour working conditions, can have an impact on far business.	• P**opulation** demographics, education levels, culture and religion all impact on farming business. Education levels for example can affect labour availability on a farm.
• **Environmen**t-water scarcity, flooding and soil degradation can have an impact on farming profitability .	

4.4 The primary sources of risk in farming business.

- **Production risks**: These are risks that may come due to breakdown of machinery, weather or pests that may damage the crops e.g. army worm which recently damaged maize crop in South Africa, Zambia, Zimbabwe, Namibia, Mozambique and Uganda.
- **Marketing risk:** If there is an oversupply of a product in the market, price will fall.
- **Financial risk:** These may take place when the manager is unable to pay the debt/loan on time.
- **Legal risks**: This takes place when the manger is taken to court for having ignored some regulatory standard which resulted in the death of a labourer/worker.
- **People /Human risk:** This takes place when the skill is lost due to death, disability, divorce, illness etc. This affects production negatively.

4..5 Risk management strategies/techniques

- **Minimise safety risks**: Avoid short cuts and make workers have proper protective clothing (Proper protective gear). Working machinery or equipment's must be well serviced.
- **Crop insurance .**It covers losses against against hail, wind, transit goods, fire, extreme rain and frost good agricultural farming practices:

- **Hedging .** Use of financial uinstuments like futures contract, forward contracts to lock in sales for crops or livestock before harvest.
- **Specialisation .** Policies are custom bulit for specific farming sectors like viniculture,dairy and grains. Sanlam Agriculture and Hollard tailor risk assessment for the farming enterprise . The farmer is primarily dependent on a single source of income. E.g. crops, cattle, dairy, poultry .
- **On farm processing** . Processing help reduce over supply of agricultural produce. It also ensures stable income for a farmer and reduce loss.
- **Flexibility in farming business.** It allows the farmer to adapt quickly to unpredictable weather conditions, shifting market prices and supply chain shocks**.** A farmer should be flexible enough to switch enterprise should the need arise
- **Good cooperation and support for farmers with their neighbours:** This will include sharing of labour and skills that will minimize costs on outsourcing.
- **Attention to business management:** A farm manager must always analyse the impact of decisions on the financial performance before a new practice is implemented.
- **Making use of free assistance:** The States Departments do give free assistance and advice or warning on certain occurrences e.g. the army worm invasion.
- **Health and disability insurance for workers:** If workers are insured, production will be good because they will be able to get good health services.
- **Property and liability insurance:** It is good to insure the property, machinery against things like storms, hail damage, injury of the visitor etc.
- **Diversification of risks:** There is a saying that you cannot put all your eggs in one bucket. **The following can be done to diversify the risks.**
    - Planting of different crops (i.e. mixed farming)
    - A farmer can spread his/her investment over several enterprises (pig farming, poultry farming cattle farming etc.)
    - Geographical diversification (have different land types wherein there are different soil types and different climatic conditions.
- **Risk sharing:** a practice where agricultural producers, financial institutions, and supply chain partners spread potential financial and production uncertainties among themselves.
- **Safety risk advice:** Food poisoning chemicals must never be put on food containers (e.g. Putting poisonous chemicals on a coca cola bottle).



ACTIVITIES

Activity 8

8.1 A group of farmers started farming with different crops and citrus fruits. They began experiencing a drop in citrus production due to insect infestations. They had to substitute citrus with avocado and banana plants.

8.1.1 Identify TWO risk management strategies that will benefit the farmers in the scenario above. (2)

8.1.2 Give a reason for EACH risk management strategy identified in QUESTION 7..1. (2)

8.1.3 Indicate the primary source of risk in the scenario above. (1)

8.2 Indicate the type of force that influences the farming business represented by EACH of the following statements:

(a) Money available to spend by consumers (1)

(b) Equipment and workforce available on a farm (1)

8.3 A farming enterprise can be influenced by different forces.

8.3.1 Identify the external force represented by EACH of the following:

(a) An increase in the VAT on commodities (1)

(b) New emerging markets for farm products (1)

8.4 Indicate the source of risk linked to the following:

(a) QUESTION 7.3. 1(a) (1)

(b) QUESTION 7.3.1(b) (1)

8.4.1 Name TWO general management skills needed to manage a farming business. (2)

8.5 Below are THREE management principles that farmers should explore when managing a business.

implementation; planning; control

8.5.1 Choose the management principle above that matches EACH of the statements below:

(a) Monitoring results and comparing them with performance standards (1)

(b) The process of putting plans in motion (1)

8.5.2 State TWO external forces that affect a farming business. (2)

8.6

8.6.The farmer took the opportunity of having an orchard to start a business making jam and dried and canned fruit. The business was growing until the machinery broke down, resulting in a drop in sales. The farmer then introduced a piggery, poultry, sheep farming and sold manure to other farmers and community members.

8.6.1 Identify TWO sources of risks in the scenario above. (2)

8.6.2 Justify EACH source of risk identified in QUESTION 7.6.1 based on the scenario. (2)

8.6.3 Identify the risk management strategy used by the farmer to deal with the risks identified in QUESTION 8.6.1. (1)

8.6.3 State ONE applicable management principle that would assist the farmer to manage the risks. (1)

Activity 9

9.1 The following are the economic characteristics of land as a production factor:

availability; appreciation; law of diminishing return; collateral; specific environment

9.1.1 Match the following statements with EACH of the economic characteristics listed above:

(a) The price of land tends to increase over time. (1)

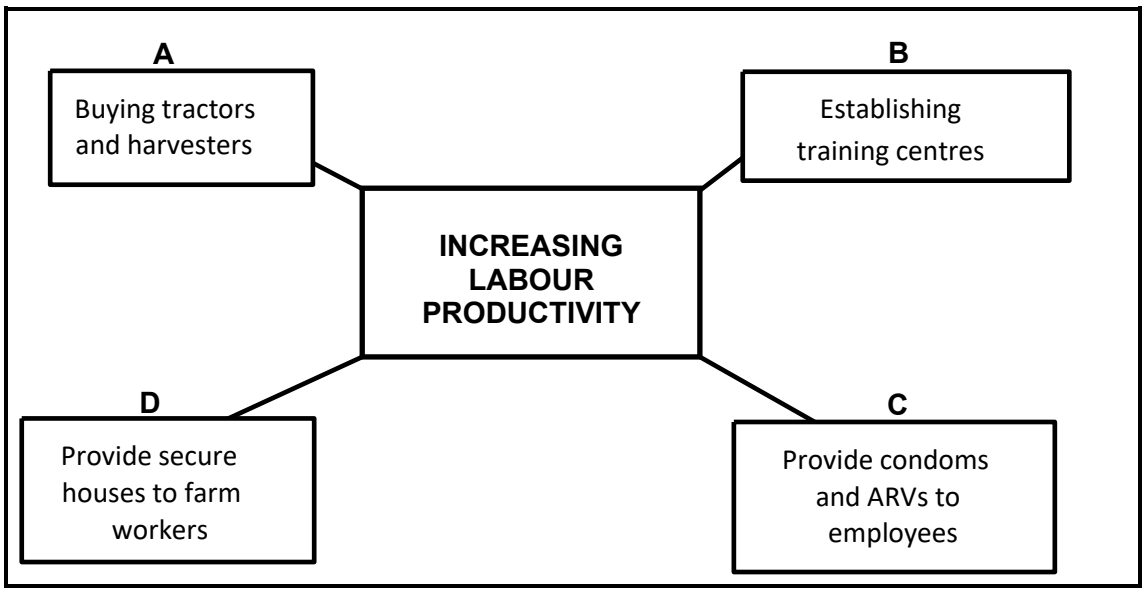
(b) Land is a valuable asset that farmers may use as security for a loan. (1)

9.1.2 Explain how EACH of the following farming methods may be used to increase land productivity:

(a) Use of scientific methods (2)

(b) Consolidation of small uneconomical land units (2)

9.2 The flow chart below shows different methods a farmer used to increase labour productivity.



9.2.1 Define the concept labour productivity. (2)

9.2.2 Deduce the labour problem that is addressed by the farmer in:

(a) B (1)

(b) C (1)

(c) D (1)

9.2.3 Indicate how the measure in **A** can increase labour productivity. (1)

9.3 Below is an extract of the components and the items from a contract signed between the farm worker and the farmer.

COMPONENT	ITEM
1. **…**	4 October 2020 to retirement
2. **JOB TITLE**	Spray operator
3. **LEAVE**	One month paid leave per year
4. **…**	07:00–17:00 daily
5. **…**	Monthly salary/wage
6. **PROTECTIVE GEAR**	Overall, mask and gloves

9.3.1 Indicate the component of a contract that is represented by:

1 - Termination of employment (1)
4- Working hours (1)
5- Mode/method of payment (1)

9.3.2 Name the labour legislation that addresses leave benefits. (1)

9.3.3 Identify the items that address compliance to the Occupational Health and Safety (Act 85 of 1993). (1)

ACTIVITY 10

10.1 The picture below shows sheep raised on a piece of land.



10.1.1 State TWO functions of land as depicted in the picture above. (2)

10.1.2 State THREE economic characteristics of land. (3)

10.1.3 Labour is a huge expenditure in a farming enterprise.

10 .2.1 State TWO components of a contract between a farmer and a farm worker. (2)

10.2.2 Indicate TWO labour problems resulting from farm workers moving to other industries. (2)

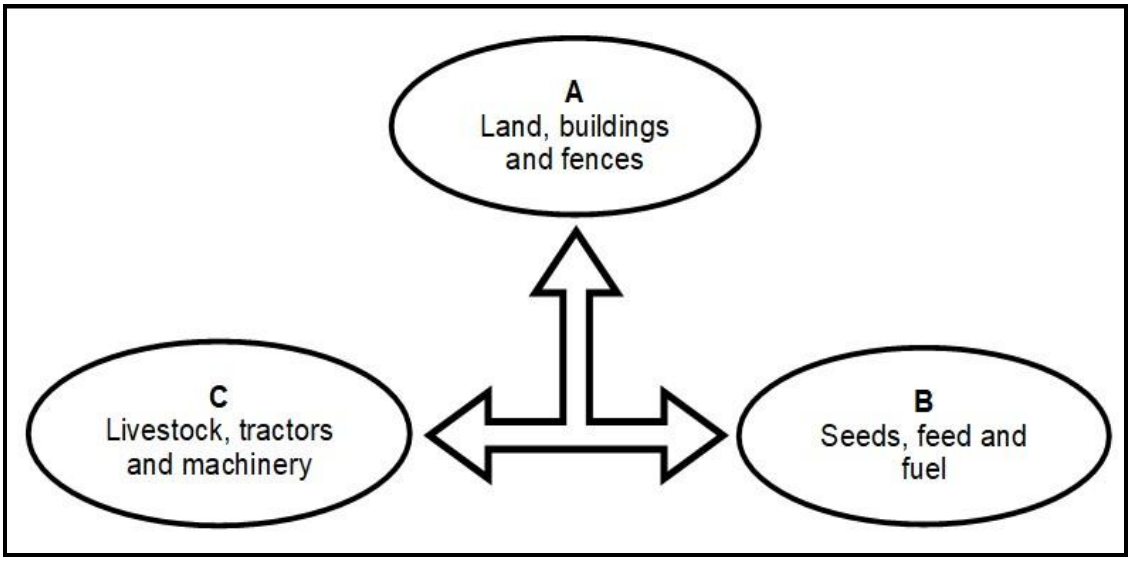
10.2.3 Suggest TWO ways in which a farmer can retain farm workers. (2)

10.2.4 Indicate the implication of EACH of the following labour Acts on the working conditions of farm workers:

(a) Basic Conditions of Employment Act, 1997 (Act 95 of 1997) (1)

(b) Occupational Health and Safety Act, 1993 (Act 85 of 1993) (1)

10.3 The schematic representation below shows different capital items found on a farm.



10.3.1 Indicate the type of capital represented by EACH of the following:

(a) B (1)

(b) C (1)

(c) A (1)

10.3.2 Suggest TWO methods of creating capital in a farming business. (2)

10.3.3 Identify the problem of capital the farmer is likely to encounter with regard to EACH of the following statements:

(a) Aging, wear and tear of farm machinery and vehicles (1)

(b) Inability to acquire capital items such as machinery, land, buildings and livestock 1

(c)Theft, occurrence of diseases among livestock, incidences of droughts and pests (1)

UNIT 5 ANIMAL REPRODUCTION

:5.1 SYNCHRONISATION OF OESTRUS AND MATING

EXAMINATION GUIDELINE AND OUTCOME



- Define the concept of the synchronisation of oestrus/heat
- Briefly describe the various techniques/methods of synchronisation of oestrus/heat
- Advantages and disadvantages of synchronisation of oestrus
- Describe the basic factors causing sterility and infertility in females (cows)
- Define mating/copulation and ejaculation
- Describe natural mating by referring to male sexual display/courtship behaviour/pattern, factors that regulate
- mating behaviour among bulls and the five main stages of mating/copulation

IMPORTANT TERMS AND DEFITIONS	T
the process of using hormonal or management techniques to coordinate the oestrus cycles of a group of female animals so that they come into oestrus (heat) simultaneously or within a controlled timeframe	Oestrus Synchronisation

1 Synchronisation of Oestrus (Heat)

The synchronisation of oestrus is a reproductive management practice in livestock where hormonal treatments are used to induce and synchronise the oestrous cycles of a group of animals, ensuring they all come into heat (oestrus) at the same time ,within a predictable and short timeframe.

1.1 Techniques/methods of synchronisation of oestrus/heat

The synchronization of oestrus in livestock involves several techniques or methods, each using specific hormonal treatments to regulate the reproductive cycle. Here's a brief description of the most common methods:

1.1.1.Injection of Prostaglandin-Based Protocols

Prostaglandin are administered to induce luteolysis (regression of the corpus luteum), leading to the onset of oestrus. It is effective only in animals with a functional corpus luteum. Heat occurs 2–5 days after treatment. Common use includes single or double injection protocols spaced 11–14 days apart.

1.1.2 Progesterone-Based Protocols

Progesterone is administered via intravaginal devices (e.g., CIDR or PRID) or oral medication to mimic the luteal phase and suppress heat. Progesterone prevents ovulation while in place when

administered . Removal triggers oestrus within 2–3 days. Example: Controlled Internal Drug Release (CIDR) devices.

1.1.3.Injection of GnRH-Based Protocols (Ovulation Synchronization)

Gonadotropin-releasing hormone (GnRH) is injected to synchronize ovulation. GnRH induces follicular development and ovulation. Common Use: Fixed-time artificial insemination (FTAI) protocols.

1.1.4. Melengestrol Acetate (MGA) Protocol which is mixed with feed.

An oral progestogen fed to animals for a set period to suppress heat. Progestogen feeding is stopped, allowing synchronized heat to occur. It is more common in beef cattle than dairy.

1.2 Advantages and disadvantages of synchronisation of oestrus

The synchronisation of oestrus is beneficial for improving reproductive efficiency, especially in large-scale operations, but it requires careful management and may not be suitable for all farm systems.

Advantages	Disadvantages
• Improved breeding efficiency and more predictable calving	• High cost of hormonal treatments
• Reduced need for heat detection and labor costs	• Requires expertise and veterinary support
• Timed artificial insemination (TAI) for better conception rates	• Inconsistent results in some cows
• Improved fertility management and reduced breeding errors	• Potential health risks if not properly managed
• Better control of calving intervals	• Limited flexibility for spontaneous breeding
• Cost-effective in large herds	• Reduced natural mating behavior in some systems
• Disease control through reduced bull exposure	• Dependency on external resources (hormonal treatments, vet support)

:5.2 OESTRUS AND OESTRUS CYCLE

EXAMINATION GUIDELINE AND OUTCOME



- Define oestrus or the heat period
- Identify and describe the female sex hormones and their respective functions
- Indicate and describe the periods/stages/phases of the oestrus cycle in cows
- Noticeable signs/characteristics of oestrus in cows
- Describe the practical methods dairy farmers can adopt to assist with the identifying of cows on heat

IMPORTANT TERMS AND DEFITIONS



Physiological and behavioral state in female mammals, during which they are sexually receptive and capable of conceiving	Oestrus
The physical act of sexual reproduction between two individuals, typically involving the transfer of male gametes (sperm) to the female reproductive system	Mating/Copulation

1 Oestrus and oestrus cycle

Oestrus (also spelled estrus) or the heat period is a phase in the reproductive cycle of female mammals during which they become sexually receptive and capable of conceiving. This period is characterized by behavioral, hormonal, and physiological changes that signal fertility and readiness to mate.

1.1 Female sex hormones and their functions

The female reproductive system is regulated by several key hormones, each playing a vital role in sexual development, reproductive processes, and overall hormonal balance. The primary female sex hormones are oestrogen, progesterone, and follicle-stimulating hormone (FSH), luteinizing hormone (LH), and oxytocin.

1.1.1 Oestrogen - produced by the Graafian follicle within the ovary.

· Promotes the development of female secondary sexual characteristics.

· Regulates oestrous behavior, making females receptive to mating (e.g., standing heat).

· Stimulates growth and maintenance of the uterine lining in preparation for pregnancy.

1.1.2. Progesterone -Secreted by the corpus luteum after ovulation and by the placenta during pregnancy (in species where the placenta takes over this function).

- Maintains pregnancy by inhibiting uterine contractions and preparing the uterus for embryo implantation.

- Suppresses oestrous behavior during pregnancy.

-Prepares mammary glands for milk production.

1.1.3. Follicle-Stimulating Hormone (FSH) -Produced by the anterior pituitary gland.

- Stimulates the growth and development of ovarian follicles, which contain the oocytes (eggs).

- Promotes oestrogen production in the follicles.

1.1.4. Luteinizing Hormone (LH) - Also produced by the anterior pituitary gland.

-Triggers ovulation by causing the dominant follicle to release its egg.

-Stimulates the formation of the corpus luteum, which secretes progesterone.

-Essential for the transition from the follicular to the luteal phase of the oestrous cycle.

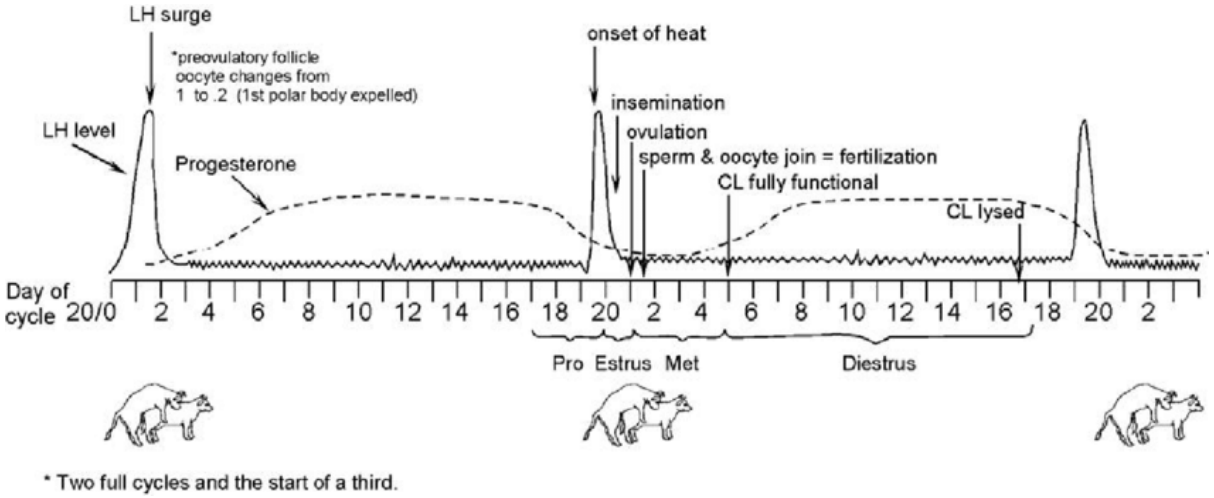
1.1.5. Oxytocin - Synthesized in the hypothalamus and released by the posterior pituitary gland.

Induces uterine contractions during labour.

Stimulates milk let-down during lactation.

1.2 Oestrus cycle

The **oestrous cycle** in cows is a repetitive cycle of physiological changes that prepare the animal for reproduction. It lasts approximately 21 days (ranges from 18 to 24 days) and is divided into four main stages or phases: proestrus, oestrus, metestrus, and dioestrus. Each phase is characterized by specific hormonal, behavioral, and physiological changes.



* Two full cycles and the start of a third.

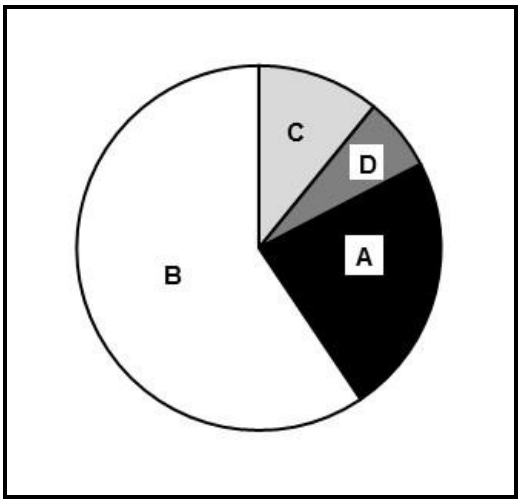
1.2.1 Stages/Phases of the Oestrus Cycle in Cows

Stage/Phase	Duration	Hormonal Changes	Characteristics
1. Proestrus	3-4 days	Increase in oestrogen	- The follicle develops on the ovary. - The oestrogen level rises, preparing the uterus for oestrus. - Physical Signs: Slight swelling of the vulva, increased vaginal mucus,
2. Oestrus (Heat)	12-18 hours	Peak oestrogen	-Physical Signs: The cow becomes very receptive to the bull, stands to be mounted, exhibits restlessness, frequent urination, and clear vaginal discharge. - The cow is in heat, and this is the time for mating or artificial insemination.
3. Metestrus	3-5 days	Rapid rise in progesterone	- Ovulation occurs at the end of oestrus (release of the egg). - Progesterone levels begin to rise, preparing the uterus for pregnancy. - The cow may show a brief period of resistance to mounting after oestrus. - Physical Signs: Decreased vaginal discharge, the cow may appear less restless.
4. Dioestrus	10-14 days	High progesterone	- The corpus luteum (CL) forms on the ovary after ovulation. - Progesterone is at its highest level, and prevents further oestrus.

Stage/Phase	Duration	Hormonal Changes	Characteristics
			- Physical Signs: The cow is not in heat and shows no signs of oestrus behaviour. If the cow is pregnant, the corpus luteum remains active. If not pregnant, the corpus luteum regresses, and the cycle begins again.
5. Anoestrus (optional phase)	Variable (depends on conditions)	Low levels of hormones	- The cow is not cycling due to factors like pregnancy, lactation, stress, or poor nutrition. - The cow is inactive in terms of oestrus, and no reproductive events occur.

ACTIVITY 11

11.1 The pie chart below illustrates different stages of the oestrus cycle in cows.



11.1.1 State the duration of the above cycle in cows. (1)

11.1.2 Indicate the stage of the oestrus cycle represented by each of the following letters:

(a) B (1)

(b) D (1)

11.1.3 In the pie chart above, identify the part that represents the stage of high FSH secretion. Write down only the letter (**A**–**D**). (1)

11.1.4 Name TWO practical methods used by dairy farmers to identify the cows in heat. (2)

11.1.5 Indicate what happens to the corpus luteum if the cow becomes pregnant. (1)

11.2 Mating behaviour in bulls is regulated by certain factors.

11.2.1 Give TWO factors that regulate mating behaviour in bulls. (2)

11.2 .2 Name a chemical substance found in the urine of cows in oestrus that stimulates libido in bulls.

6. BASIC AGRICULTURAL GENETICS

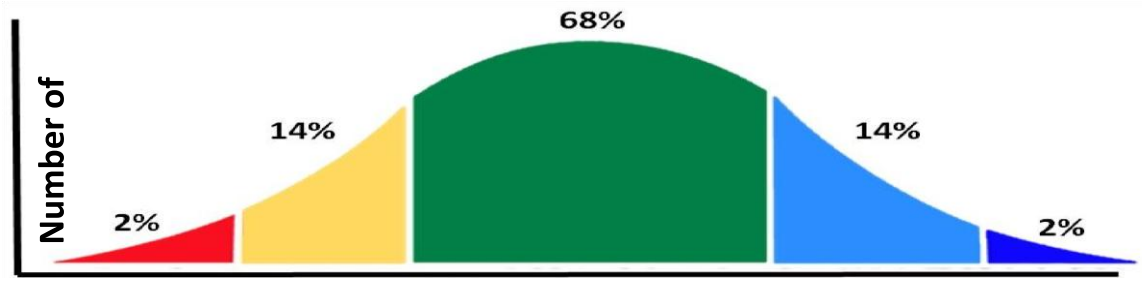
6.1 Selection and Breeding

Indicate the general principles of selection, like biometrics, heritability and estimated breeding values (EBVs), and compare natural and artificial selection
Indicate the selection methods used by plants and animal breeders (mass, pedigree, family and progeny selection) and breeding values.
Identify and describe inbreeding, linebreeding with relevant examples, cross breeding, upgrading, species crossing, out-crossing and the advantages and disadvantages of these different breeding systems

The degree to which a characteristic/trait is determined by genes	Heritability
This gives an estimate of how much better or worse than an average the offspring of an individual will be for a particular characteristic	Estimated breeding value(EBV)
The study of measurable biological characteristic by using computer technology	Biometrics

6.2 Importance of variation in selection

Selection is based on the observable differences between individual of the same species. For example, if offsprings of two parents show a variation in characteristics such as growth rate, resistance to extreme weather condition and egg production, the variation of each of character will have a normal distribution curve(bell-shaped) curve



A greater number of the population falls in the average (individuals meeting the average) whilst lowest numbers are found in the extremes of the curve.

- Characteristics that are caused by genetic factors are passed from parents to offspring.
- Characteristics that are caused by the environment are not passed to offspring
- It is crucial that the farmer identifies characteristics that are **genetically** controlled when choosing individual plants or animals from breeding

6.3 Heritability

It refers to the degree to which a characteristic is determined by genetics as against environmental factors. It is calculated by comparing the similarity between connected individuals under similar environment conditions. Heritability is expressed on a scale of 1% to 100% or 0 to 1.

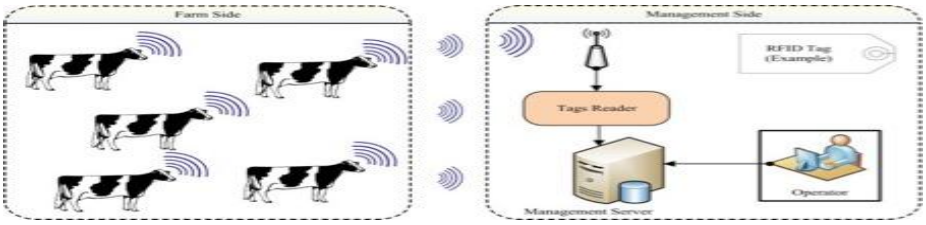
Heritability values of over 50% for a particular characteristic is considered high and more influenced by gene rather than by environment**.**

6.4 Estimated Breeding Values (EBVs)

EBV is used to predict the genetic potential of an animal as a parent. They help breeders make informed decisions to improve traits in livestock such as milk yield, growth rate, fertility and disease resistance.

6.5 Biometrics

In animal breeding, it refers to the application of statistical methods and mathematical models to analyse biological data related to animal traits, genetics and breeding performance. It plays a crucial role in selection breeding programmes, and genetic evaluation.



Factors to consider when selecting breeding stock.

1. Age	6. Quality of products
2. Level of performance	7. Mothering Ability
3. Physical Fitness	8. Adaptability
4. Health Body Conformation	10.Prolificacy
5. Temperament or Behaviour	

The degree to which a characteristic/trait is determined by genes	Heritability
This gives an estimate of how much better or worse than an average the offspring of an individual will be for a particular characteristic	Estimated breeding value(EBV)
The study of measurable biological characteristic by using computer technology	Biometrics

6.6 TYPES OF SELECTION

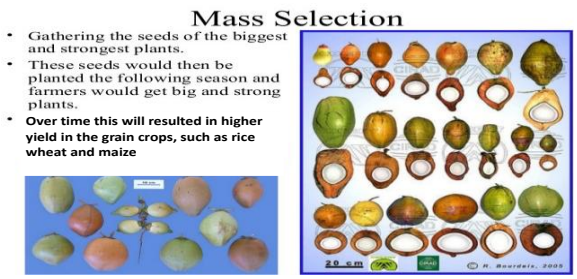
1. **Natural selection** - the process where organisms with traits best suited to their environment survive and have more offspring

2 Artificial selection - an evolutionary process where humans consciously choose which plants or animals reproduce based on desirable traits

Selection methods used by plant and animal breeders

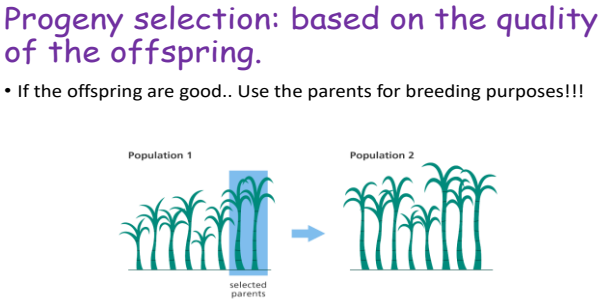
1.Mass selection

It refers to the practice of selecting individuals from a population based on their phenotype (desirable traits). The seeds from these selected plants are mixed and used to grow the next generation. Over successive generations, this process helps to improve the overall performance



2.Pure line/ Progeny Selection

Plant and animal selection method where selection is based on the performance of the offspring(progeny). Examples include selecting plants that produce offspring with higher grain yields. In animas, an example is selecting cattle whose offspring show superior milk production.

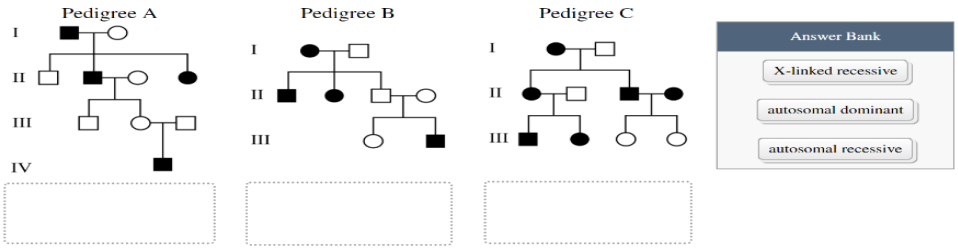


3.Pedigree Selection

Individual plants and animals are selected based on their own performance and the known performance of their ancestors

Pedigree selection: based on the quality of the ancestors:

Determine all the possible modes of inheritance for the pedigrees.



Family selection

A breeding method where entire families are selected based on the average performance of the family, rather selecting individual plants and animals. Selected individuals could be siblings or half siblings.

Family selection:

- Based of the quality of the relatives of the same generation (siblings). – Sugar Cane: Most often used in plants that use vegetative propagation



Using Heritability and Estimated Breeding Values(EBVs) in breeding.

Farmers and animal breeders can use heritability and EBVs to predict and follow the progress of a breeding programme. The greater the EBV of the parents and the higher the heritability of the characteristics, the greater the chance of improving performance by selection and breeding

Breeding systems

T

Process of producing plants or animals by sexual reproduction	Breeding
The crossing of two plants or animals that are closely related	Inbreeding
The breeding of two plants or animals that are not closely related/Mating of two purebreds of different animals	Cross breeding
Breeding of animals that share common ancestors but not closely related	Line breeding

The mating of individual animals of different species	Species crossing
Increase in the performance of the hybrid	Hybrid vigour or Heterosis
Mating of unrelated animals or of animals that are not closely related	Outcrossing
The repeated mating of thoroughbred (purebred) male animals with inferior female animals.	Upgrading

Breeding types

1. Inbreeding

The crossing of two plants or animals that are closely related.
E.g. Father and daughter, mother and son, brother and sister.

2. Line Breeding

This is a form of selective breeding where animals that are related, but not as closely as inbreeding are mated to preserve desirable traits from a specific ancestor.

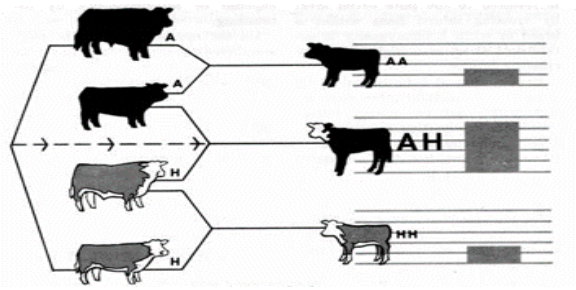
An example of line breeding is when a bull is selected to mate with a distant relative (granddaughters) rather than with a close relative (his daughters).

A **common ancestor** is an individual that appears on both the **sire** and **dam** sides of the pedigree.

1.Cross Breeding

Involves the crossing of two or more different animal breeds or plant varieties. The result is a hybrid animal/plant with enhanced traits from both parents, which is called hybrid vigour or heterosis.

E.g. Afrikaner bull X Aberdeen Angus cow.

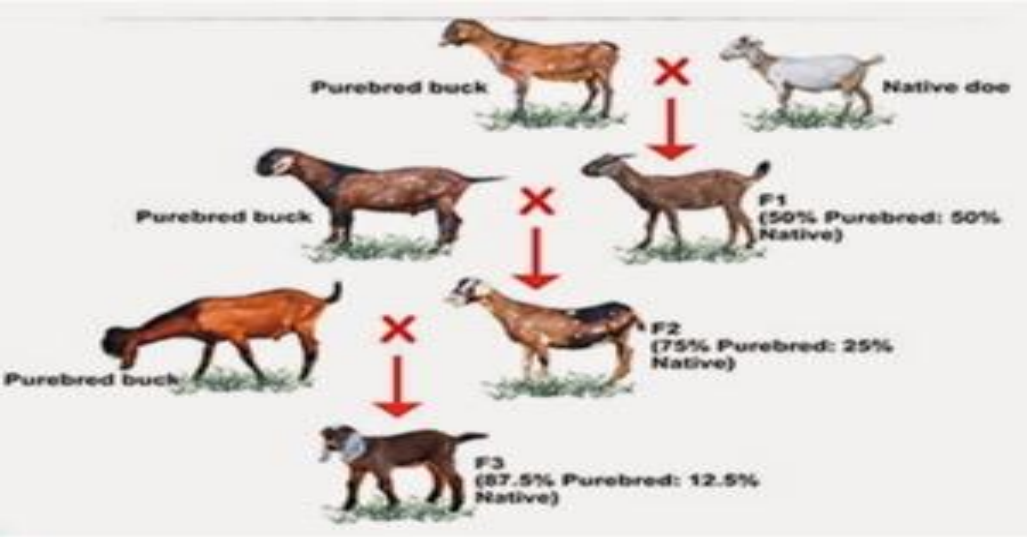


2. Outcrossing

This method introduces new characteristics to inbred animals. A distantly related relative of the same breed with desirable characteristics is brought in to cross breed with inbred animals.

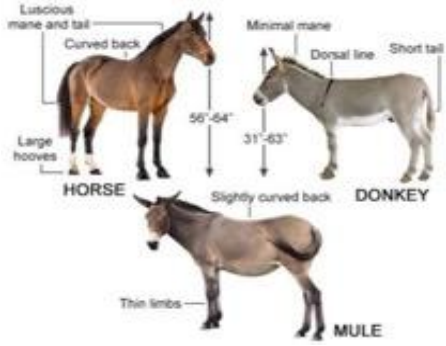
3.Upgrading

It is the repeated mating of thoroughbred (purebred) male animals with inferior female animals to improve poor quality herd. Excellent pure-bred males of a specific breed are mated generation after generation with females of inferior quality. This is done by mating a good sire with females of inferior quality or using semen of good quality animals to inseminate these females.



4.Species-crossing

Is the mating of individuals of two different species/the crossing of two different animal species usually producing non-fertile offspring because each species is unique.





e.g. A horse mated with a donkey produces a mule.

or Donkey stallion X horse mare = mule

Uses of the mule

- Used as draught animals for pulling implements/ploughing/working.
- To carry loads/transport of goods

Advantages and disadvantages of breeding systems

Breeding system	Advantages	Disadvantages
Inbreeding	• Produces uniform animals/plants • Used to create pure lines or strains • Helps in preservation of rare traits withing a population	• It lowers the variability of the gene • Reduction in vigour • May give rise to defective animals
Line-breeding	• Produces uniform animals and less defects than inbreeding	• Less hybrid vigour than cross breeding • May give rise to defective animals
Outcrossing	• Brings desired characteristics into pure breeds • Increases genetic diversity • Reduced inbreeding depression • Greater adaptability	• Less hybrid vigour than cross breeding • Leads to unpredictable offspring • Loss of desired traits
Cross breeding	• Gives rise to hybrid vigour/heterosis • Introduces new desirable traits • Offsprings are more fertile	• F1 hybrids have maximum effect after which hybrid vigour declines • Loss of pure-bred traits • May lead to Unpredictable traits
Upgrading	• Improves poor quality animals quickly • It improves productivity • It is cost effective	• Effect slows down after a few generations • Leads to loss of indigenous traits • It mainly dependent on exotic breeds
Species-crossing	Produces new plant/animal species	Animal species offspring are infertile

Activity 12

11.1 Choose the correct answer and write only the letter **(A–D)** next to the question number.

12.1.1 Which of the following breeding systems is most suitable for a farmer wanting to maximize hybrid vigour (heterosis) in commercial beef production?

A) Inbreeding
B) Crossbreeding
C) Linebreeding
D) Species hybridization

12.1.2 An advantage of using Estimated Breeding Values (EBVs) during selection is that they:

A Measure only the environmental effects on an animal's performance.
B Guarantee that every offspring will outperform its parents.
C Predict the genetic merit of an animal for specific traits.
D Are based entirely on the visual appearance of the animal.

12.1.3 A lethal genetic defect caused by a recessive allele will manifest physically in an animal only when the animal is:

A Heterozygous
B Homozygous dominant
C Homozygous recessive
D Outbred

12.2 Read the case study below and answer the questions that follow.

A communal cattle farmer in the Eastern Cape notices that the average weaning weight of his herd has dropped significantly over the past five years. To fix this, he buys a high-quality Bonsmara bull from a stud farm. The new bull has an excellent Estimated Breeding Value (EBV) for weaning weight. The farmer decides to mate this bull only with his top-performing cows, while culling the cows with poor milk production and low fertility.

12.2.1 Define the term *selection* in the context of animal breeding. *(2)*

12.2.2 Identify **two** selection methods or tools the farmer used in the case study. *(2)*

12.2.3 Explain the economic importance of selecting animals with high fertility. *(2)*

12.2.4 Name **two** environmental factors that could prevent the offspring of the new bull from reaching their full genetic potential for weaning weight. *(2)*

12.2.3 Study the schematic diagram below representing two different breeding systems and answer the questions.

- **System A:** Hereford Bull × Hereford Cow (Both share a common grandfather) → Offspring
- **System B:** Brahman Bull × Angus Cow → F1 Crossbred Offspring

12.2.1 Identify the specific breeding systems represented by **System A** and **System B**. *(2)*

12.2.2 State **one** major disadvantage associated with **System A**. (1)

12.3.2 Describe **two** phenotypic benefits the farmer will observe in the F1 crossbred offspring in **System B** due to heterosis. (2*)*

12.3 The table below shows the heritability percentages (%) for different traits in dairy cattle**.**

Trait	Heritability (%)
Milk Yield	25%
Butterfat Content	50%
Calving Interval (Fertility)	5%
Mastitis Resistance	10%

12.3.1 Differentiate between high heritability and low heritability traits. (2)

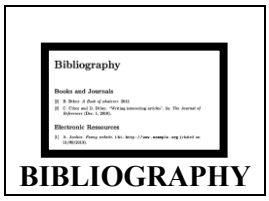
12.3.2 Identify the trait from the table that will show the fastest genetic progress through direct selection. Give a reason for your answer. (2*)*

12.3.3 Explain why a farmer should focus on improved management practices (like nutrition and housing) rather than selection to improve the "Calving Interval" trait. (3*)*

12.4 Upgrading is a specific breeding system used by farmers.

12.4.1 Briefly explain how the process of upgrading is carried out over several generations. (3)

11.4.2 State TWO primary reasons why a subsistence farmer would choose upgrading over buying a purebred herd. (2*)*



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