**TOPIC 1 - SOIL DEGRADTION**

**What is soil degradation?**

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| * Soil degradation is the process by which soil loses its quality and productivity. It is caused by improper use usually for agricultural, pastoral, industrial or urban purposes. * It is also defined as a loss in the value and quality of soil. |

**Describe forms of soil degradation.**

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| **Physical degradation**   * It is a form of degradation when the structure of the soil is destroyed by rain or machines and the broken particles are then eroded through wind or rainwater. * This is the physical or mechanical damage to soil making it less productive. It is brought about by agents such as water, moving air and more oftenly, human activities. * This form of soil degradation leads to destruction of soil structure making the soil having poor porosity, reduced water holding capacity, poor capillarity and poor drainage. * It also leads to formation of deep gullies making the land unsuitable for cultivation of crops.   **Chemical degradation**  This is the form of soil degradation that leads to changes in the chemical composition of the soil. Excessive use of agro-chemicals such as fertilizers, pesticides and herbicides result in the chemical; degradation of the soil, |

**State two forms of soil degradation.**

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| **Physical degradation**   * It is a form of degradation when the structure of the soil is destroyed by rain or machines and the broken particles are then eroded through wind or rainwater * In other words, it is the physical or mechanical damage to soil making it less productive. It is brought about by agents such as water, moving air and more oftenly, human activities.   **Chemical degradation**   * it is the form of soil degradation that leads to changes in the chemical composition of the soil. Excessive use of agro-chemicals such as fertilizers, pesticides and herbicides result in the chemical; degradation of the soil, |

**Differentiate between physical and chemical degradation.**

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| **Physical degradation**   * It is the physical or mechanical damage to soil making it less productive. It is brought about by agents such as water, moving air and more oftenly, human activities. In other words, * This form of soil degradation leads to destruction of soil structure making the soil having poor porosity, reduced water holding capacity, poor capillarity and poor drainage. * It also leads to formation of deep gullies making the land unsuitable for cultivation of crops.   **Chemical degradation**  This is the form of soil degradation that leads to changes in the chemical composition of the soil. |

**State two causes of physical land degradation.**

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| 1. **Soil erosion**   This is the detachment, transportation and deposition of soil particles from one place to another mainly by wind or water   1. **Human activities**   These activities include deforestation and clearing of vegetation leaves the ground - base area, Burning of crop kills soil organisms. poor cultivation methods, overgrazing and monocropping6 going up etc |

**Outline the major causes of soil degradation.**

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| 1. **Soil erosion**  * This is the detachment, transportation and deposition of soil particles from one place to another mainly by wind or water. * The top soil which is rich in organic matter is carried away by wind or water. When the top soil is removed and carried away, the soil left has less organic matter and hence low fertility. Such soil is not good for cultivation of crops.  1. **Salinisation**   This is the accumulation of soluble mineral salts.  The two types of salinisation include   1. **Dry land salinity**  * This occurs in low rainfall areas where the rate of infiltration of water is lower than the rate of evaporation. Hence, there is no adequate water to wash down the soluble salts. * It can also be aggravated by soils with poor water infiltration capacity leading to water logging.  1. **Irrigation induced salinity**  * This occurs when the soil receives more water by irrigation than the dispersal ability of underground aquifers and drainage systems. This makes the water table with dissolved salts to rise up to rise up to the root zones of the crops. * It also occurs where surface irrigation is used, salts may be brought into the crop field by irrigation, and salts may be brought into the crop field by irrigation water. When this water evaporates, the concentration of salts in the field increases impairing crop growth.  1. **Soil acidification**   Soil acifidification is the gradual alteration of the degree of acidity or alkalinity. T is brought about continuous use of acidic or basic fertility.  Acidic salts may also accumulate in the soil lowering the soil pH.   1. **leaching**  * **L**eaching refers to the loss of water soluble plant nutrients to the deeper soil horizons. The loss of food nutrients is facilitated by excess water in the soil either from rain or irrigation. * If nutrients play are lost, the physical appearance and chemical compensation.  1. **Compaction of soil**  * Soil compaction is the physical of the soil by an applied mechanical force. The force destroys the soil.  1. **Human activities/deforestation**   These activities include deforestation and clearing of vegetation leaves the ground - base area, Burning of crop kills soil organisms. poor cultivation methods, overgrazing and monocropping going up etc.   1. **High human population growth**. This creates a greater pressure on the available land resources. 2. **Irrigation and soil drainage** can cause acidification and salinations while the use of chemical fertilizers results in little upward movement of water. 3. **Overgrazing** due to overstocking depletes the vegetation cover making the soils vulnerable to erosion. |

**What is salinisation of soil?**

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| This is the accumulation of soluble mineral salts. |

**State two causes of soil salinification.**

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| 1. **Dry land salinity**  * This occurs in low rainfall areas where the rate of infiltration of water is lower than the rate of evaporation. Hence, there is no adequate water to wash down the soluble salts. It can also be aggravated by soils with poor water infiltration capacity leading to water logging.  1. **Irrigation induced salinity**  * This occurs when the soil receives more water by irrigation than the dispersal ability of underground aquifers and drainage systems. This makes the water table with dissolved salts to rise up to rise up to the root zones of the crops. |

**In which way does salinisation cause soil degradation?**

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| **Dry land salinity**   * This occurs in low rainfall areas where the rate of infiltration of water is lower than the rate of evaporation. Hence, there is no adequate water to wash down the soluble salts. * It can also be aggravated by soils with poor water infiltration capacity leading to water logging.   **Irrigation induced salinity**   * This occurs when the soil receives more water by irrigation than the dispersal ability of underground aquifers and drainage systems. This makes the water table with dissolved salts to rise up to rise up to the root zones of the crops. * It also occurs where surface irrigation is used, salts may be brought into the crop field by irrigation, and salts may be brought into the crop field by irrigation water. When this water evaporates, the concentration of salts in the field increases impairing crop growth. |

**Explain five human activities which may cause soil land degradation.**

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| 1. Deforestation and clearing of vegetation leaves the ground bare. This exposes the soil to agents of soil erosion which may disorganize the soil particle arrangement or carry away fertile top soil. 2. Burning of crop remains kills soil organisms which are responsible for the decomposition of soil organic matter and improvement of soil fertility. 3. Poor cultivation such as ploughing up and down the slope. This increases the degree of soil erosion. 4. Overgrazing reduces vegetation cover. The top soil can easily be brown away. 5. Monocropping limits the verity of nutrients in the soil reducing soil fertility. |

**Explain the bad farming practices that cause soil degradation.**

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| 1. Continuous cropping which exhausts the soil because it has no time to rest and makes it prone to soil erosion. 2. Cultivating steep slopes and river banks which encourages erosion. 3. Constructing ridges along the slope, this accelerates rill and gully erosion. 4. Cultivating the soil when it is too dry or too wet. This destroys the soil structure. 5. Using heavy machinery, which destroys the soil structure. |

**What is soil acidification?**

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| Soil acifidification is the gradual alteration of the degree of acidity or alkalinity. T is brought about continuous use of acidic or basic fertility. Acidic salts may also accumulate in the soil lowering the soil pH. |

**State three ways how the change of soil pH influences crop production.**

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| 1. It determines the most appropriate crop to be grown in the soil. 2. It influences the availability of some plant minerals. 3. It influences the activity of soil micro-organisms. |

**What is soil compaction?**

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| Soil compaction is the physical of the soil by an applied mechanical force. The force destroys the soil. |

**Explain four causes of soil compaction.**

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| 1. Use of heavy machinery on wet soil. This pushes the soil aggregates together making the soil more dense. This high density makes the soil less porous. 2. Ploughing the land at the same depth season after season. This likely to cause soil compaction when a mouldbouard plough is used. 3. Secondary tillage operations decrease the soil aggregate stability making it more prone to compaction. 4. Animal movement especially when used to carry out field practices may also compact the soil with their hooves. |

**List the effects of land or soil degradation or describe the effects of soil degradation on crop production.**

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| 1. **Loss of soil fertility-** When soil erosion occurs, plant nutrients found in the top soil and micro-organisms are carried away. 2. **Reduction of arable land-** Soil erosion leaves the land crusty and less useful for crop production. 3. **Spread of water-borne diseases-** Flood water may carry with it disease causing organisms that human beings and livestock may contract. Diseases caused by the parasites reduce the ability of the farmer to actively participate in farm activities related to crop production**.** 4. **Spread of weed seeds-** Flood water may carry weed seeds from one farm to another. Weeds reduce crop yield by competing with the crops for nutrients. 5. **Siltation of water bodies-** This is the deposition of soil in water bodies such as rivers, dams and lakes. Siltation reduces the capacity of such reservoirs hence decrease in water resources. 6. **Pollution of ware resources-** Flood water may carry agrochemicals such as pesticides, fungicides and fertilizers into water bodies thereby polluting the water. 7. **Flooding**- This refers to the flow of water in excessively large quantities over the earth’s surface. Flood water can result into damage of crops in the field and destruction of farm structures. |

**Describe the relationship between population growth and soil degradation.**

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| The population growth causes soil degradation due to the following reasons   1. The need for more food to cater for the growing population 2. Demand for wood fuel 3. Need for shelter and furniture 4. Demand for fibre such as cotton and sisal   **These scenarios will lead to**:   1. Clearing of more land under natural under natural perennial vegetation to replace it with annual crop crops which are not so good in combating soil degradation. 2. Cutting down of trees. This results into bare land, which is less productive. The land is also exposed to soil erosion agents. 3. Keeping more animals on small pieces of land, hence, overstocking leading to overgrazing and erosion. 4. Humans encroaching into arid and semi-arid areas which do not have a stable ecosystem. |

**Describe two effects of high population on land.**

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| **These scenarios will lead to**:   1. Clearing of more land under natural under natural perennial vegetation to replace it with annual crop crops which are not so good in combating soil degradation. 2. Cutting down of trees. This results into bare land, which is less productive. The land is also exposed to soil erosion agents. 3. Keeping more animals on small pieces of land, hence, overstocking leading to overgrazing and erosion. 4. Humans encroaching into arid and semi-arid areas which do not have a stable ecosystem. |

**Explain the biological measures of controlling soil degradation.**

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| Biological measures for controlling soil degradation   1. **Planting grass strips/filter strips-**  * These are strips of permanent grass or legumes grown between crops to reduce the speed of flowing water and filter out soil.  1. **Planting cover crops or applying green mulch.** 2. This reduces the impact of rain drops on the soil, 3. Encourages higher water infiltration and minimizes the volume of surface run-off. When the leaves of the cover crops fall, they decay and stabilize the soil by improving the soil structure thus reducing erodability of soil. 4. The cover crops also reduce excessive heating of the soil for both physical and chemical forms of land degradation. 5. **Grassed waters - channels planted with grass at their bases** 6. They lead water from the farm to safer grounds 7. Vegetation helps reduce the speed of water and traps soil 8. **Contour farming and strip cropping**  * In strip cropping, different crops are planted in strips along the contours and harvested at different times so that there is a strip of crops in the field at any given time. Stones may also be lined across a slope to reduce speed of run-off water down the slope. The figure below shows contour farming and strip cropping.  1. **Mulching**  * This is the covering of the soil surface with dry vegetation or plastic materials such as polythene sheets. * **Uses of mulches in controlling soil degradation:**  1. Preventing splash erosion and loss of soil moisture through evaporation. 2. Maintaining the soil structure by preventing strong hitting of soil particles by the rain drops or irrigation water. 3. Encouraging high water infiltration as speed of surface run-off is reduced by the mulch. 4. **Planting trees**   **Afforestation** is the planting of trees in areas where there have been none while **re-afforestation** refers to planting trees where forests have been cleared.  Importance of trees in controlling soil degradation   * They act as wind breaks thus reducing ability of wind to carry away top soil * Their leaves intercept raindrops hence reducing their impact on the soil resulting in less splash erosion. * Trees create a suitable microclimate for rainfall formation. * Trees reduce the speed and volume of run-off water by encouraging water infiltration.  1. Small family size. This reduces the pressure exerted on land and soil resources. 2. Conserving grazing lands. This is done by fencing and practicing rotational grazing. |

**Explain the physical measures of controlling soil degradation.**

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| **Physical measures for controlling soil degradation**   1. **Constructing storm water drains** which divert water from upland into a natural water way or specially constructed water way or diversion ditches. 2. **Gabions/porous dams/check dams**  * These are boxes of galvanized wire mesh filled with stones and built across slopes and gullies.   **Uses of gabions**   1. They resist the strong force of fast running waters in gullies or streams 2. They slow down the speed of run-off water 3. They trap the soil being washed down the stream 4. **Thrash lines-** These are heaps of crop residues made along the contours.   **Uses**   1. They help trap soil and reduce the speed of run-off water down the slop facilitating water infiltration into the soil. 2. Thrash lines can be made of maize stalks, wheat straw or grass which also add nutrients into the soil when they decompose. 3. **Bunds-** These are banks of earth built along the contours that reduce water run -off. 4. **Ridging-** This involves making raised heaps of soil along contours to conserve soil and water**.** 5. **Construct contour bands across the slope following the contour.** This is done to catch and encourage water to sink into the soil. 6. **Cut-off drains/diversion ditches’**   These are channels made to drain water out of the farm before it causes damage by erosion.   1. **Terraces**  * It is a ridge of soil constructed across a slope to control water-run off and minimize soil erosion. * The main function of a terrace is to decrease the length of slope.   The following are the types of terraces   1. **Bench terraces-** These are constructed on steep slopes of 35% to 55% slope gradient where value crops are grown. 2. **Broad-based terraces-** These terraces which are wide at the base and are about two-thirds of a metre high. They are constructed on slight slopes with between 2-12% slope gradient where soils are deep and widely spaced. 3. **Narrow-based terraces-** They are terraces which have narrow bases and are made in areas with a 12-20% slope gradient. They are usually constructed by hand along the contours. 4. **Level terraces-** They are constructed for the purpose of retaining water for long periods of time. They have no outlet channels but act as retention channels. They are suitable for areas where there is scarcity of water. 5. **Graded terraces-** These are constructed in such a way that they direct excess water out of the farm at a low speed to areas with vegetation. They are designed to ensure a slow flow of water out of the farm. They are commonly found in high rainfall areas. |

**TOPIC 2: AGRICULTURE AND CLIMATE CHANGE**

**Describe the ways of dealing with climate change in agriculture.**

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| 1. **Practising conservation agriculture/conservation farming.**   This is an approach in farming that strives to attain high and sustained crop production levels while at the same time minimizing the disruption of the soil’s structure, composition and natural biodiversity.  Conservation agriculture is based on three principles   1. **Minimum soil disturbance** - This helps to maintain the soil structure making it less prone to soil erosion. 2. **Permanent soil cover**.-This provides the following benefits  * Improved infiltration of water hence reduced surface run-off and soil erosion. * Reduced evaporation of water from the soil hence less severe crop water stress. * Increased organic matter and humans’ content hence good soil structure that is less prone to erosion. * Increased microbial activity due to availability of food and shelter which improves soil porosity.  1. **Crop rotation**   Crop rotation is the practice of growing different types of crops on the same piece of land following a definite order.  **Benefits of crop rotation include**   * Ensures maximum utilization of soil nutrients since different crops require different nutrients and different crops have varying root depth. * Deep rooted crops recycle leached nutrients by bringing them back to the to top soil thus they can be used by shallow rooted crops. * It helps in controlling crop-specific pests as these pests die due to starvation upon changing the crop. * Reduced weed infestation as some weeds are crop-specific and other crops are able to smother the weeds. * Increased nitrogen level due to the association of micro organisms and root nodules of leguminous plants that have the ability to convert atmospheric nitrogen into nitrates and fix it in the soil. * There is a higher diversity of crops just in case of failure of one.  1. **Practising agroforestry.**  * Agroaforestry is an integrated approach in farming that involves the simultaneous cultivation of farm crops, pastures and trees on the same piece of land. * **The following are the environmental and economic benefits of agro forestry**  1. Improve water infiltration into the soil as the speed of surface run-off is reduced. 2. Control soil erosion both splash, sheet and rill erosion 3. Organic matter from trees improve the soil structure and hence soil water holding capacity. 4. Tree canopy protect the soil from wind erosion 5. Tree cover conserves soil moisture by reducing the rate of evaporation. 6. **Reafforestation**   This is the practice of planting trees where they have already been harvested. This will decrease the amount of carbon stored on the land.   1. **Practising integrated forest, crops, livestock and fish farming.**   Integrated forest, crops, livestock and fish farmingis a system made up of a range of resource saving practices that aim at achieving high production levels while preserving the environment.  In other words, the aim is to establish an ecosystem in which there is symbiotic relationship so that productions costs can be reduced while at the same time conserve the environment.   1. **Water harvesting**   It is the practice of trapping and accumulating rain water for future use. The three main components of water harvesting include   1. **Catchment-** This is any surface from which rain water can be collected. These may include foot paths, road drains and rock catchment and roof top catchment 2. **Conveyance**- It is the means by which water moves from the catchment area into the storage structure. 3. **Storage-** These may include water tanks, dam water and ponds. |

**Explain how the following assist in mitigating climatic change. Or how each of the following measure can deal with climatic change.**

1. **Rainwater harvesting**

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| Rain water harvesting is the accumulation and deposition of rainwater for reuse on site, rather than allowing it to run off.  Uses include water for garden; water for livestock; water for irrigation; water for domestic use with proper treatment and in door heating for houses. |

1. **Re-afforestation**

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| This is the practice of planting trees where they have already been harvested. This will decrease the amount of carbon stored on the land. |

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1. **Alley cropping**

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| With alley cropping, crop strips alternate with rows of closely spaced tree or hedge species. Normally, the trees are pruned before planting the crop. The cut leafy material is spread over the crop area to provide nutrients for the crop. In addition to nutrients, the hedges serve as windbreaks and eliminate soil erosion. |

1. **Parkland**

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| Parkland is defined by the presence of trees widely scattered over a large agricultural plot or pasture. The tresses are usually of a single species with clear regional favourites**.**  **The benefits of parkland include**   * The trees offer shade to grazing animals * Protect crops against strong wind bursts * Provide tree prunings for firewood * Is roost for insect or rodent -eating birds. |

1. **Strip cropping**

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| In strip cropping, the trees alternate with crops and the trees or shrubs are planted in wide strip. The purpose is to provide nutrients, in leaf form, to the crop. They also provide protection to the nearby crops against soil erosion and harmful winds. |

1. **Agro-forestry**

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| * Agro forestry is an integrated approach in farming that involves the simultaneous cultivation of farm crops, pastures and trees on the same piece of land. * **The following are the environmental and economic benefits of agro forestry**  1. Improve water infiltration into the soil as the speed of surface run-off is reduced. 2. Control soil erosion both splash, sheet and rill erosion 3. Organic matter from trees improve the soil structure and hence soil water holding capacity. 4. Tree canopy protect the soil from wind erosion 5. Tree cover conserves soil moisture by reducing the rate of evaporation. |

1. **Conservation agriculture**

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| This is an approach in farming that strives to attain high and sustained crop production levels while at the same time minimizing the disruption of the soil’s structure, composition and natural biodiversity.  Conservation agriculture is based on three principles   1. **Minimum soil disturbance** - This helps to maintain the soil structure making it less prone to soil erosion. 2. **Permanent soil cover**.-This provides the following benefits  * Improved infiltration of water hence reduced surface run-off and soil erosion. * Reduced evaporation of water from the soil hence less severe crop water stress. * Increased organic matter and humans’ content hence good soil structure that is less prone to erosion. * Increased microbial activity due to availability of food and shelter which improves soil porosity.  1. **Crop rotation**   Crop rotation is the practice of growing different types of crops on the same piece of land following a definite order.  **Some of the benefits of crop rotation include**   * Ensures maximum utilization of soil nutrients since different crops require different nutrients and different crops have varying root depth. * Deep rooted crops recycle leached nutrients by bringing them back to top soil thus they can be used by shallow rooted crops. |

**Explain the principles of ago-forestry which can assist in mitigating climatic change in agriculture.**

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**TOPIC 3: LAND DRAINAGE**

**Define the term land drainage.**

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| Land drainage is the removal of superfluous water from the soil when the water table in the soil is high or when excess surface water is unable to percolate into the soil**.**  In other words, land drainage is the practice of removing excess water from the soil to make it suitable for crop production. |

**Explain the importance of land drainage or why is drainage vital to the production of crops.**

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| 1. It is crucial to reduce the impact of water into the soil and to increase the rate at which water is removed after infiltrating the soil. It avoids the soil becoming waterlogged. 2. It improves soil aeration as the pores occupied by water will hold air. 3. Raises the soil temperature as there is reduced cooling effect by evaporating water. 4. It increases microbial activities due to high aeration and high temperatures. 5. It reduces soil erosion as much water will be able to infiltrate into the soil reducing surface run off. 6. It controls water-borne parasite such as mosquitoes and snails that are intermediate hosts of malaria and bilharzias, |

**Explain the reasons why it is important draining a waterlogged soil.**

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| 1. It facilitates entry and circulation of air in the soil.   Soil air is important because   1. Air provides oxygen for root respiration 2. Air provides oxygen necessary for seed germination 3. The soil contains a wide variety of soil macro -organisms such as decomposers which need oxygen for their cell respiration. 4. The soil becomes easy to work with. 5. It helps to reclaim land and increase farmable land. 6. It helps to prevent flooding. |

**Describe three methods of land drainage.**

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| 1. **Surface drainage**   It is used to remove excess water from natural rainfall and irrigation.  Under this method, ditches are constructed to carry the excess water by gravity to the natural water way such as stream or river. Water from the soil surrounding the ditch flows into it thus draining excess water from the land.  The diagram below shows surface drainage.  **C:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\Furrow_irrigated_Sugar.JPG**  **C:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\surface irrigation.jpg**  **Surface drainage takes the forms of**   1. **Open ditches-** this is widely used method of removing excess water from a field where U or V -shaped open ditches are constructed   **Advantages of open ditches drainage**   * Large quantities of water can easily drained * It is cheaper to use   **Disadvantages of open ditches**   * It has maintenance costs * It interferes with the agricultural mechanization of certain operations. * It reduces arable land * It leads to soil erosion if not well designed.  1. **Cambered beds-** This is created by making large heaps of soil in form of big and broad ridges or mounds on which crops are grown. Water collects into the spaces between the mounds allowing crops on the mounds to grow well on the aerated soils. The figure below shows cambered bed   **C:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\download.jpgC:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\images.jpg**  **Advantages of cambered bed**   * It intercepts water that flows laterally down the slopes * Excess water is discharged from the land making it unsuitable for crop growing * It is the easiest and cheapest method of reclaiming a swampy area.   **Disadvantages of cambered bed**   * High maintenance cost due to constant repairs * It can form a breeding place for mosquitoes * Perennial weeds establish themselves in the drains * It causes some difficulties in using farm machinery * Farm animals can injure themselves in the open ditches  1. **Pumping-** It is the costly method of drainage. It is recommended as a method when all other methods have failed and it involves the use of pumps to conduct water to areas where it may be needed. 2. **Sub-surface drainage**   This method uses underground porous pipes or ceramic tiles which remove excess underground water which is lead to a canal or river. The sub-surface drainage is aimed at lowering the level of underground water to prevent the development of water logging caused by seepage.  The diagram below shows a porous pipe drain  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\images (1).jpgC:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\subsurface-irrigation-info2.jpg  **Advantages of subsurface drainage**   * It is not prone to gully erosion * It does not occupy useful land * It does not interfere with mechanical tillage operations. * It does not inconvenience animal movements on the field**.**   **Disadvantage of subsurface drainage**   * It is costly to construct underground drains and they require proper maintenance. * The efficiency of this system can be impaired by blockage due to weed growth, silting up and farm waste. * The pipes or drains can be damage by roots of trees or tillage machines.  1. **Biodrainage**   This is a method that relies on the use of biological agent to remove excess water of which the agent to remove the water is plants or trees. The roots of the plants penetrate deep in the soil creating waterways for water to seep through. The trees also take up a lot of water which is then lost through transpiration.  Common trees used in the drainage include Eucalyptus spp, Casuarinas pp etc  **Benefits of biodrainage compared to conventional drainage.**   * Trees act as wind breaks and shelter belts in agro forestry * Some trees may give useful by products such as fodder and wood products. * Trees help to purify the atmosphere by taking in carbon dioxide and releasing oxygen into the atmosphere. * Trees reduce the problem of climatic change by increasing the forest cover. * Trees help to moderate the temperature of the surrounding area * It is cheaper to maintain. |

**TOPIC FOUR- FARM MECHANISATION**

**Define the term ‘mechanisation’**

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| Farm mechanization refers to the use of power and animal driven machinery to carry out certain farming activities in agricultural production.  In other words, farm mechanization involves the use of farm machinery for farming operations to increase farm output and farm worker productivity. |

**Explain the factors to consider when mechanising the farm.**

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| 1. **Availability of capital-** A farmer needs high initial capital since the machines are expensive to install and maintain. Money may also be needed for spare parts. 2. **Size of farm land-** Mechanization is economical in large tracts of land. 3. **Availability of technical skills-** It requires skilled and qualified personnel to operate and maintain most machines. 4. **Topography of the land-** Mechanisation is easier on flat ground**.** 5. **Environmental assessment-** Mechanization leads to environmental pollution, deforestation and erosion. Therefore, it is needed to make environmental assessment before mechanizing the farm. 6. **Availability of fuels and oils.** For proper operations and maintenance, fuels and oils should be accessible and affordable. 7. **Availability of labour.** There is need to have sufficient labour to perfect the work done the machines. 8. **Employment opportunities-** Mechanization increases productivity and more people will be employed to market the products**.** 9. **Topography-** Mechanization can easily be applied on fairly gentle slopes to relatively flat land. 10. **Land for livestock feed.** There must sufficient land for pasture production**.** 11. **Accessibility of the land-** The land should be accessible for ease of movement of machines, that is, the roads should be passable. 12. **Value of crops-** The crop to be grown under mechanization should be of high value in order to recover the cost of mechanization**.** 13. **Support services**  * Spare parts should be easily available for maintenance of the machines. * Fueling points should be within easy reach. * Machine experts should be easily available in operating the machines.  1. **Improved infrastructure and social amenities-** Farm mechanization requires well distributed road networks, widespread electrification and water systems. 2. **Market demand.** There should be high demand for the crops that are to be planted under mechanization. 3. **Farmer’s altitude-** Farmers should have a positive attitude towards mechanization. |

**Describe the advantages of farm mechanization.**

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| 1. Increases crop yield. 2. Farm operations can be done on time. 3. Improved production efficiency by reducing cost per unit of product. 4. It makes work easy and enjoyable. 5. Farmers benefit from economies of scale by large scale production. 6. Crop quality is maintained especially during harvesting and processing. 7. Operations are done more efficiently**.** 8. It substitutes expensive farm labour. 9. It compensates for labour peak periods. 10. It releases farmer’s time for other activities |

**Describe the limitations/disadvantages of farm mechanization.**

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| 1. Unskilled farm labour is not required hence many cases of unemployment. 2. Inadequate capital to purchase machines. 3. Small land holdings make mechanization uneconomical. 4. Requires skilled and qualified personnel to operate most machines. 5. Highly skilled operators require higher wages. 6. If a machine breaks down, there is delay in agricultural operations. Maintenance and repairing facilities may not be readily available in rural areas. 7. Machines require energy to operate but fuel prices are always increasing. This may become costly to the farmer. 8. Foreign currency is lost in importing spare parts. 9. Mechanisation requires larger farm holdings. |

**List two main types of machinery.**

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| 1. **Tractor drawn machinery.** 2. **Animal drawn machinery** |

**TRACTOR-DRAWN MACHINERY**

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| These are machines attached to a tractor to carry out various operations. The following are the tractor -drawn machines: trailers, ploughs, planters and mowers. |

**Explain three ways of attaching an implement to a tractor.**

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| 1. **Single point hitch (draw bar)**   The attached machine has its own wheels for support and is sometimes called the pulled type of hitching. Hitch pins on the machines are used to fit the machines onto the tractor through drilled holes or eyes on the draw bar of the tractor.   1. **Three point hitch (hydraulic system)**   The machines are attached at the two side links and at the top link. They are also referred to as the fully mounted or integral types. Such machines do not need other support. They are lifted from the ground by the hydraulic system.   1. **Power take off (P.T.O)**   These are machines driven by power take off shaft or belt and pully which are in rotary motion. The implements are attached at the rear end of the tractor and are driven by engine. The P.T.O may be used to operate reciprocating mowers, rotavators and sprayers |

**EXAMPLES OF TRACTOR-DRAWN IMPLEMENTS**

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| 1. **Tractor trailer**   This is a container which is pulled by a tractor and used to carry various farm produce and inputs to and from the farm.  **Maintenance of tractor trailer**   1. Check tyre pressure and adjust accordingly before each day’s work 2. Avoid overloading the tractor trailer 3. Clean the trailer regularly 4. Keep under a shade for long storage. 5. Checks bolts and nuts. Tighten loose nuts or bolts. 6. Repair damaged parts.   **Safety measures when using a tractor trailer**   1. Ensure that the load is properly distributed to prevent the trailer from swaying. 2. Observe traffic rulers when driving the tractor-trailer. 3. **Tractor drawn ploughs**   These are machines used for cultivation purposes. The most common tractor -drawn ploughs include disc plough, the mould board ploughs and subsoiler.  **Disc plough**  The disc plough is more suitable in stony places or in places with stumps and a lot of roots. This is because discs roll over hidden obstructions like stones and are not easily blocked by vegetation during ploughing.  Disc plough can also work easily in hard soils where it is difficult to use a mould board plough.  **Maintenance of disc plough**   1. Clean the plough after use 2. Tighten loose nuts and bolts 3. Apply old engine oil on the plough for long storage. 4. Lubricate the moving parts 5. Store in a dry place. 6. Replace lost or worn out parts**.** 7. Sharpen discs by hammering the edges.   **Advantages of using a disc plough**   1. It requires less power to pull as the discs have the ability to roll. 2. It is very effective on stony land. 3. It is very suitable in dry land 4. It requires relatively low maintenance cost since the discs last long. 5. It requires less skill to operate than a mould board plough.   **Disadvantages of disc ploughs**   1. A high tractor speed on a piece of land leaves a rough seedbed which needs more secondary tillage operations. This may be costly. 2. Depth of ploughing is uneven as penetration depends on the hardness of the soil or presence of obstacles.   **MOULD BOARD PLOUGH**  **Advantages of the mouldbord ploughs**   1. It achieves uniform depth of plough 2. It produces a relatively good and clean seedbed in one operation**.**   **Disadvantages of mouldboard ploughs**   1. It is prone to damage by hidden obstacles 2. It cannot plough dry and hard soils effectively. 3. It can easily create a soil hard plan as it follows the same depth throughout. 4. Higher maintenance costs are incurred due to frequent replacement of shares. 5. It requires higher pulling power   **SUBSOILER**  It is the strongest and heaviest machine of all the ploughs. It requires high power to pull.  **Advantages of using subsoiler**   1. It is preferred in cultivation of compacted soils 2. It is used to break up the hardpan within the subsoils   **Safety measures when using tractor drawn ploughs**   1. Read and follow safety procedures in the manufacturer’s manual. 2. Keep children away from tractors and machinery 3. Remove starter keys when tractors are not in use. 4. Always implements to the draw bar or the mounting points provided by the manufacturer. 5. **Harrows rotary tiller**   **Uses-** These are machines which are used for secondary tillage operations.  The main uses include   1. Leveling of seedbeds 2. Breaking large soil clods 3. Mixing up soil 4. Destroying weeds 5. Covering broadcasted weeds   **Types of Harrows**   1. Disc harrows 2. Spring tined harrows 3. Rigid spike tooth harrows 4. Zig-zag harrows   **Maintenance of harrows**   1. Clean after use 2. Check and tighten the loose nuts and bolts. 3. Replace worn out discs and tines, tighten the loose ones. 4. Lubricate moving parts 5. Apply old engine oil for long storage   **Safety measures when using harrows**   1. Read and follow safety procedures in the manufacturer’s manuals 2. Do not sharp turns with blades down and at high speeds 3. Never clean or lubricate the harrow while it is in motion. 4. Reduce implement to narrowest possible width while on roads or highways. 5. **Mowers planters and seeders**   **Use-** These are implements which are used for planting.  **Common types of planters and seeders**  These include seed drills and precision planters.  **Maintenance of planters**   1. Lubricate moving parts 2. Remove all seeds from the seed hopper after sowing. 3. Remove any seed stuck in the seed slots 4. Fit the desired belt. 5. Dismantle the unit after use.   **Safety measures of planters and seeders**   1. Before filling the seed hopper, ensure the drill is properly attached to the tractor. 2. Use a jack to support the drill until is properly attached to the tractor. 3. **Cultivators or weeders**   **Use-** These machines are used in tilling the soil after the emergency of the crop.  **The common types of cultivators**  **These include**   1. Shovel type 2. Disc cultivator 3. Rotary cultivator 4. Sprine time cultivator   **Maintenance of cultivators or weeders**   1. Lubricate moving parts 2. Sharpen the cultivator points if blunt 3. Apply oil for long storage 4. Store properly 5. **Sprayers**   **Use-** They are used for spray water soluble chemicals in crop fields. A sprayer  achieveuniform spraying  The figure below shows a hand sprayer  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\images.jpgC:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\images (1).jpgC:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\knapsack-manual-sprayer-250x250.jpg  **Maintenance of sprayers**   1. At the end of the day’s work, empty the tank and wash the sprayer thoroughly. 2. Lubricate moving parts 3. Replace filters and nozzles when necessary 4. At the end of the season, remove the nozzles and store separately. 5. The sprayers should be kept under cover when not in use**.**   **Safety measures when using sprayers**   1. Keep proper records of all chemical applications 2. Store chemicals in a safe of place out of reach of children and away from food. 3. Do not wash in any water source. 4. Wash you’re your thoroughly and change clothing. 5. Never spray against the wind direction to avoid drift to unintended areas**.** |

**HARVESTING MACHINES**

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| **Name of the machine** | **Use/function** |
| **Combine harvester** | * Cutting the crop and ramming the grains * Threshing of grains * Cleaning or winnowing the grains * Packing the grains |
| **Maize shellers** | These are stationary machines used to remove grains from maize cobs**.** |
| **Potato lifters** | These are machines used in harvesting root crops such as Irish potatoes and Sweet potatoes. They lift the tubers from the soil and help in collecting them |
| **Forage harvesters** | They harvest forage crops such as maize, millet, sorghum and Napier grass |

**Maintenance of harvesting machines**

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| 1. Tighten loose nuts and bolts 2. Lubricate moving parts 3. Store under a shade 4. Remove foreign materials stuck in the machines at the end of the day’s work. 5. Replace worn out parts 6. Apply oil for long storage etc |

**Safety measures when using harvesting machines**

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| 1. Do not wear loose clothing such as necktie when operating the machines 2. Ensure that all cutting tools and blades are clear, sharp and in good working condition so that they cut freely. 3. Ensure that all belts are in proper condition. |

**ANIMAL DRAWN MACHINES**

The following are the animal drawn implements

1. **Ox- ploughs**

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| * This is a mouldboard plough, only that it has one mouldboard hence it is lighter than a tractor drawn mouldboard. * It is drawn by draught animals such as oxen and donkeys. * The figure below shows an ox-plough   C:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\Parts-of-the-ox-drawn-plough.png |

**State the uses of the ox-plough.**

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| * It is used for ploughing, weeding and opening furrow in which seeds are placed during planting. * **It may also be used for harvesting crops such as groundnuts.** * **The figure below shows hence stage** |

**Describe four daily maintenance practices carried out on an ox-plough,**

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| * Lubricate land wheel hub. * Clean after use * Straighten shed * Replace out parts success gas hooks etc * Store properly * Paint the handles, beam and braces to prevent running. |

**Describe the safety measures when using an ox-plough.**

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| * Put protective * Take animals to be used should be well feds and in good health. * The distance measures when using an ox- plough * Replace worn out parts such as hooks, draw bar assembly and share. * Check and tighten loose nuts and bolts before the day’s work. * Oil the shinny metallic parts such as mouldboards during long storage. * Paint the handles beam and braces to prevent rusting. * Store properly in equipment shed**.** |

1. **Carts**

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| An ox-cart has two rear wheels and is mostly pulled by two animals. The animals are harnessed by the use of a yoke. |

**State two uses of an ox-cart**

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| 1. Carts are used in the transportation of farm produce from the farm to the store or to the mark. 2. Carts are used to transport manure, water and other farm inputs. |

**Describe four daily maintenance practices carried out on an ox-cart.**

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| --- |
| 1. Grease moving parts of the wheel. 2. Ensure the yoke is properly padded for proper harnessing of the animals. 3. Replace broken parts. 4. Check tyre pressure before each day’s work and adjust accordingly. |

**Describe the safety measures when using carts.**

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| 1. Do not operate carts on roadways 2. Do not operate carts inside or through buildings |

1. **Ridger**

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| **Tit has two mould boards fixed opposite each other on the main beam. When pulled, the mould boards make two soil heaps and single furrow. A return pass completes the ridge making.**  **The figure below shows parts of the ridger.**  **C:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\2208.400x400.png** |

**State the use of a ridger.**

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| It is used for making ridges on the farm |

**State two safety measures when using a ridger.**

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| 1. The animals should be in proper health 2. The animal should not walk for a long distance to the field where the operation is to be carried out. |

**Explain four advantages of animal drawn machines.**

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| 1. The initial cost of purchasing such as implements is low. 2. Requires less skill to operate. 3. Can be used in almost all types of topography 4. It has low maintenance costs. |

**TOPIC FIVE: FARM POWER**

**State the common sources of power in the farm**

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| 1. Human power 2. Animal power 3. Wind power 4. Water power 5. Mechanical power 6. Biogas power 7. Solar power |

**Describe the uses of human power.**

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| Human power refers to the use of human beings to do work in the farms.  Human power can be used for the following operations   1. slashing 2. cutting down trees 3. Tilling 4. Weeding 5. Harvesting crops such as maize, tea etc   Human power is used to operate small tools such as machetes, axes, slashers, hoes, chaff cutters and simple pulleys. |

**Describe the advantages of human power.**

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| 1. It can be motivated to increase productivity. 2. There is no fuel consumption 3. It is cheap and easily available 4. It does not require the presence of the farmer during operation. |

**Describe the limitations/disadvantages of human power.**

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| 1. It is slow hence takes a lot of time to complete a task. 2. Low work output 3. It is unreliable since it depends on the health of the worker. 4. It relies on the level of skill of the worker. 5. Less motivation can reduce productivity. |

**State three ways of improving output from human power**

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| 1. Proper training 2. Use of efficient machinery 3. Proper motivation 4. Assignment of duties according to expertise |

**Suggest the uses of animal power.**

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| Animal power refers to the use of animals to carry out activities in the farm. |

**Mention the farm operations which are powered by animal.**

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| Animal power can be used for the following operations   * Cultivation using ox-ploughs and cultivators * Transportation by pulling carts or carrying loads directly on their backs. * Planting and weeding. |

**Explain how to enhance animal power.**

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| * **Harnessing of the animal-** Proper harnessed animals will be more efficient than those that are improperly harnessed. * **Training of the animal-** Well trained animals give out more power and are very active. * **Be mature and in good health-** this makes the animal to be more effective. * **Proper feeding.** Eating food that provides energy necessary for work. |

**Describe the advantages and limitations of animal power.**

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| **Advantages of animal power**   1. It is relatively cheap to buy and maintain draught animals 2. It results into higher work output than that of human power. 3. It does not use of highly skilled personnel. 4. It can be used where land is not accessible by tractors. 5. It can be used where pieces of land are irregularly shaped. 6. It can be used where other sources of power are not available. 7. It can be used on small pieces of land 8. It can be used on very steep slopes   **Disadvantages of animal power**   1. Animals are likely to fall sick and may take longer to recover. 2. Animals get tired easily 3. Animals require adequate feeding in order to work well. 4. More land is required for pasture production. 5. Some animals may be aggressive resulting into injuries. |

**Mention three farm operations which are powered by wind.**

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| 1. Pumping water from boreholes 2. Generating electricity 3. Winnowing crops such as beans, millet and rice soon after threshing. |

**WIND POWER**

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| Moving air has kinetic energy. When wind moves, the kinetic energy is produced makes the blades of the wind mill to rotate. Rotation of a wind mill produces wind power. |

**Describe the advantages and disadvantages of wind power.**

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| **Advantages of wind power**   1. It is inexhaustible. 2. Equipment used in harnessing wind power has low maintenance costs. 3. It is an environmental friendly source.   **Disadvantages of wind power**   1. Wind power is unreliable 2. Its direction cannot be controlled 3. High initial costs in setting up a windmill, 4. It is limited to areas where |

**Explain two ways of improving out from wind power.**

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| * Increasing the size of the rotors used on wind turbines * Ensuring that wind turbines are operational and available. |

**WATER POWER**

**Suggest the uses of water power.**

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| Moving water has kinetic energy. This energy is used to   1. Drive water mills which are in grinding of cereal crops 2. Transport or ferry logs in navigable river. 3. Operate a hydro pump to draw water for domestic use |

**Describe the advantages and disadvantages of water power.**

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| **Advantages of water power**   1. It is cheap 2. It has low initial investment 3. It is a renewable source of power   **Disadvantages of water power**   1. Most rivers are seasonal and have low volumes during dry seasons. This lowers the power generation potential. 2. Rivers flowing in relatively flat areas have low power generation. |

**Describe the ways of improving output from water power.**

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| 1. Construction of dams which can hold a large volume of water. 2. Use of modern efficient turbines. |

**BIOGAS**

**What is a biogas?**

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| It is a flammable gas produced when organic matter is decomposed by microorganisms within a certain range of temperatures, moisture and acidic conditions.  The raw materials |

**Explain the formation of the biogas.**

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| The structure used to generate Biogas is known as a **biogas digester. This is shown by the diagram below:**  **C:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\Simple-schematic-of-a-biogas-plant.jpg**  **BIOGAS PRODUCTION**  Organic materials are first mixed and diluted with water, then pushed down the inlet pipe into the digester. After some, fermentation takes place, gas bubbles come out into the gas holder which is fitted with a pipe to convey the gas to the to the kitchen. It is then pushed out through the outlet pipe into slurry drying pans where it is collected and used for making manure. |

**Identify the main components of biogas**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| The main component of biogas is methane (60-79%) which burns with blue flames.  Other constituents of Biogas are :   |  |  | | --- | --- | | Carbon dioxide | 29% | | Nitrogen | 1% | | Carbon monoxide | 0.1% | | Minute amount of hydrogen sulphide |  | |

**State the use of biogas?**

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| Biogas is commonly used for heating, cooking and lighting. |

**State the advantages and disadvantages of biogas.**

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| **Advantages of biogas**   1. It is environmental friendly since it uses waste products. 2. It is cheap to generate once the biogas digester is installed. 3. The slurry is also used as manure. 4. It has low maintenance costs.   **Disadvantages of biogas**   1. High level skills are required for its installation. 2. It is most appropriate where animals are reared under zero grazing 3. It is labour intensive 4. It requires large quantities of raw materials. 5. It requires relatively high installation costs. 6. It is limited to a few farm operations. |

**Explain two ways of improving output from biogas production.**

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| 1. Feeding the biodigester with manure which is high in solids. Microorganisms need these solids to produce the gas. 2. Use of well maintained biodisgester. |

**Explain four forms of mechanical forms of target.**

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| 1. **Hydro-power**   This is electrical energy generated from flowing water in a dam or reservoir. The falling water rotates turbines which are connected to a generator to produce electricity.  Examples of electricity generating stations include Kapichira, Nkula, Nkula B, Tedzani 11, Tedzani III power stations all at Shire river and Worvwe power station at Worvwe river. They are run by ESCOM.   1. **Geothermal power**   This power is generated by super heated water coming from the earth’s core to the surface. This normally occurs in geysers where stream is continuously emitted under high pressure from enclosed cavities. The steam is harnessed and used to run turbines which generate electricity   1. **Nuclear energy/atomic energy**   Nuclear power generation involves use of nuclear reactors with uranium used to produce heat. The heat is enernomous and is used to generate electricity.   1. **Storage battery**   This is stored electrical energy which is later used for lighting, cooking and driving small motors. It can be used in electric fence. |

**Explain two ways of improving out from mechanical power.**

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| 1. Use of well serviced machines. 2. Ensuring that the input is high. For example, for a hydro-power to be effective, the amount of the water should be adequate. |

**SOLAR ENERGY**

**Name the equipment required in harnessing solar energy.**

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| Solar energy is harnessed from the sun using solar panels. |

**Explain two forms of solar energy.**

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| 1. **Heat energy**   This may be used to dry crops such as cereal grains and pyrethrum. It is also used for cooking and heating. Special equipments are used to trap heat energy.   1. **Light energy**   Solar panels are used to trap solar rays and convert them to electrical energy. The stored electrical energy may be used for pumping water, heating water for domestic use, cooking and lighting. |

**Outline the advantages and disadvantages of solar power.**

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| **Advantages of solar energy**   1. It is inexhaustible 2. It is relatively expensive to install. 3. It is environmental friendly.   **Limitations of solar power**   1. It is unreliable. During cloudy days or days of low sunlight intensity, it is not possible to harness adequate solar power. 2. It is relatively expensive to install. 3. It requires special skills to install and maintain. 4. It cannot be used directly in most farm operations; light energy has to be converted into electrical energy before use. |

**Explain three ways of improving output from solar energy.**

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| 1. Use of high voltage solar panels. 2. Protecting the solar cells from rain, snow, hail or bird droppings. 3. Placing the solar panel perpendicular to the sun’s rays. |

**TOPIC 6: GENDER AND AGRICULTURAL TECHNOLOGY**

**Define the term ‘gender bias’.**

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| Gender bias is the preference towards one gender over the over. It results from socialization into a male and a female role. |

**Give the reasons why men are favoured technologically than women.**

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| 1. **Land tenure is in favour of men.** Our tradition allows men to own land leaving women landless. 2. **Men should work with machines.** It is normal for men to work with and repair machines. 3. **Lack of access to loans.** Women are sidelined when it comes to loans and collateral. 4. **Lack of confidence.** Women do not want to take risks for fear of unknown**.** 5. **Lack of education.** Most women drop out of school before they acquire enough skills to them through life. 6. **Lack of proper role model.** Most girls do not see many women performers to emulate. 7. **Female headed house.** They are disadvantaged despite them having to look after big families. |

**Explain causes of gender biases in agricultural technology.**

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| 1. **Lack of appropriate equipment and farming tools.** Owing to their physical nature women have difficulties carrying out the activities usually done by men without appropriate equipment and tools. 2. **Lack of appropriate science-based technology and information.** Women in remote areas have limited access to science-based technology and information and their ways to deal with the problems are mainly based on their indigenous technology and passed on while working together with other women or visiting relatives in other villagers or through the informal knowledge and 3. **Limited contact with agricultural extension.**   The lack of science -based technology and information partially results from women farmer’s limited contacts with extensionists, and their limited opportunities for training. Extensionists tend to work with men rather women. It is a common scene that when government officials and extensionists come to visits, it is the husband or elder son or even grandfather who comes to talk with them rather than the women, the key cultivator.   1. **Men are favoured with techmological information.** Our culture favours free mobility of males. As a result males can seek information on technology from various sources easily. 2. **There are discriminatory attitudes and gender stereotypes.** Technology is not cheap. Money lenders are more comfortable transacting business with male farmers. Males can acquire and use improved technology. 3. People believe that men are risk takers. 4. There is prejudice against females in the use of various types of farm technology. We expect and accept men to drive the tractor plough than women. 5. Men generally look more confident with technological items. |

**Examine the effects of gender bias in agricultural technology.**

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| 1. **Declining yields/low agricultural production**   Most men leave farmlands and migrate to urban centres in search of white collar jobs. Agricultural production declines because the operations which were mechanically done will be manually done by women.   1. **Labour shortage**   With most of the operations being done manually, the work becomes too much for the farmer. Gender bias encourages reliance on one gender to perform certain operations on the farm. The work may be too much hence little output.   1. **Increased poverty**   Little mechanization of operations results in less farm output and increases poverty. With increased poverty, women farmers left in the rural areas also seek paid employment in the neighborhoods and hence spend less time in their farms.   1. Rise in poverty level leads to loss of tax by the government. 2. It leads to food insecurity, starvation and low energy output. |

**Describe ways of dealing with gender bias in agricultural technology.**

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| 1. Improving access to finance to finance such that both men and women can become entrepreneurs who can have access to credit. 2. Improving access to technology, training and infrastructure. This will ease the burden of women’s agricultural and domestic activities and encourage participation in farming. 3. Increasing employment opportunities for women. Women who earn a formal wage are capable of purchasing and using advanced machinery which increases agricultural production. 4. Allowing control over resources especially in the household. This will encourage women to make sound decisions relating to proper farming practices 5. Improving access to markets by developing proper road and communication network. This will allow both men and women in rural areas to travel to urban areas to sell their produce therefore earning a proper income. 6. Improving access to education opportunities for both men and women without discrimination against certain gender. This reduces illiteracy levels. 7. Allowing access to land by both men and women in rural and urban areas. This will increase input in terms of labour and use of machinery hence an increase in productivity. 8. Increasing representation of women in power structures and decision-making in their communities will politically empower them. 9. Invest land or capital in women to improve their economic base. 10. Enlighten the community on the contribution women can make in agricultural development and view them as partners and not as subordinates. 11. Review land and property ownership. This will ensure women own land and property. 12. Empowering women culturally. This should include giving equal power to female farmers to contribute to decision-making. |

**List any two factors that limit the involvement of female farmers in decision-making.**

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| 1. Poverty among women 2. High illiteracy amongst women. 3. They are not empowered economically. |

**State any four ways of improving the involvement of female farmers in decision-making for agricultural development.**

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| 1. Improving access to education opportunities for both men and women without discrimination against certain gender. This reduces illiteracy levels. 2. Allowing access to land by both men and women in rural and urban areas. This will increase input in terms of labour and use of machinery hence an increase in productivity. 3. Increasing representation of women in power structures and decision-making in their communities will politically empower them. 4. Invest land or capital in women to improve their economic base. 5. Enlighten the community on the contribution women can make in agricultural development and view them as partners and not as subordinates. 6. Review land and property ownership. This will ensure women own land and property. 7. Empowering women culturally. This should include giving equal power to female farmers to contribute to decision-making. |

**TOPIC 7: IMPROVED FARMING TECHNOLOGY**

**Explain the meaning of the term improved farming technology.**

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| It is the use of practices and innovations that increase crop and livestock production at the same time protecting the environment. |

**Explain how do the following practices and innovations help to increase agricultural production?**

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| 1. **Use of sensors**   A sensor is a service that detects or measures a physical property and records.  Examples of sensors which are used in agriculture to enhance farming activities include   1. **Air and soil sensors-** They enable a real time understanding of current farm, forest or body of water conditions 2. **Equipment telematics-** Allows mechanical devices such as tractors to warn mechanics that a failure is likely to occur soon. 3. **Livestock biometrics -** They can automatically identify and relay vital information about the livestock in real time. 4. **Crop sensors**- High-resolution crop sensors inform application equipment of correct amounts of field fertilization before application**.** 5. **Genetically designed food**   This is the creation of entirely new strains of food animals and plants in order to better address biological and physiological needs.   1. **Agricultural robots/agbots**   These are used to automate agricultural processes such as harvesting, fruit picking, ploughing, soil maintenance, weeding, planting, irrigation etc.   1. **Closed ecological systems**   They theoretically transform waste products into oxygen, food and water in order to support life-forms inhabitating the system.   1. **Vertical farming**   Vertical farms could augment natural light using energy-efficient lighting. The advantages include year -round crop production, protection from weather, support urban food autonomy and reduced transport costs. |

**Explain how improved technologies increase food supply.**

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| 1. Cultivating large land holdings 2. Having good land husbandly so that land is not subjected to land degradation. 3. The use of seed technology ensures that farmers produce more yields than the use of local varieties. 4. Use of conservation agriculture makes it possible for crops to survive even when there is a dry spell which under normal circumstances a crop can wither and die. 5. Use of fertilizes boosts crop growth and yielding 6. Good livestock management**.** This involves providing animals with proper feeding, housing and medication so that they should produce highly for the benefit of the farmer. 7. **Irrigation technology-** This ensures that farmers that farmers can produce crops more than once in a year. It also ensures that farmers can still grow and produce crops in times of low or no rainfall.Proper crop processing and storage. This ensures continued food supply from time of harvesting to the next. 8. **Use of genetically modified organisms (GMO).** This is an organism whose genetic material has been altered using genetic engineering techniques. |

**Explain how do the following improved farming technology increase food supply or Explain how each of the following increases food supply.**

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| 1. **Use of high yielding crops**   This has been achieved through plant breeding where high yielding seeds have been developed. This will increase food production because the hybrids developed are   * Drought and low moisture tolerance * Disease resistant * High nutrient content * Herbicide tolerance   Examples of hybrid varieties that contribute to high food production include Bt cotton, Bt rice and Bt maize.   1. **Use of improved livestock breeds and high breeds**   These improved livestock breeds and hybrids have characteristics which make them to   * Have increased heat tolerance * Have resistance to tropical diseases * Have high tolerance to infestation by both internal and external parasites * Have high prolificacy or produces more products**.**  1. **Use of advanced irrigation systems**   This is done to supplement rain where it is not adequate or is unreliable. Irrigation enables growing of crops throughout the year and in ecological zones where the crops would not have survived or produced enough yields**.**   1. **Crop protection**   This entails proper management practices of the crop to protect it against damage by pests, diseases and weeds. Proper management practices such as the use of pesticides and herbicides should be applied to prevent damage and ensure that good quality crop yields are consumed.   1. **Use of animals to provide power on the farm or use of draught animals**   The use of animals such as donkey and oxen can be cheap source of power especially where the farmer cannot afford to buy or hire a tractor. The use of animal power can also be used in hilly terrains where a tractor may not cope. They are also appropriate and economical on small land that may also be irregular in shape. Therefore, food production is increased since land is expansively cultivated.   1. **Legume seed inoculation**   This is the process of introducing commercially prepared sources of rhizobia into the soil to promote nitrogen fixation. Rhizobia bacteria fix atmospheric nitrogen into the soil while on the root nodules of legumes. This practice increases soil fertility hence high yields.   1. **Enhanced control of parasites and diseases in livestock industry**   The following parasite and diseases control practices help to improve the quality and quantity of products produced by livestock: routine vaccination; use of preventive medicine(prophylactic); carrying out quarantine for animals exposed to a contagious disease ;and ensuring that animal houses are well spaced and kept clean.   1. **Improved means of communication**   Communication is the means of sending and receiving information. Better communication such as the use of some television and radio programmes educate farmers on proper farming practices which help in increasing crop yields and animal production.   1. **Processing technology**   Processing of agricultural produce (raw materials) adds value to the produce and consequently, higher market price hence more benefits for the farmer**.**   1. **Use of greenhouses**   A green house is a building in which plants are grown. Various conditions can be altered in the green house to suit the crop in question. Some of these conditions include Temperature; relative humidity; carbon dioxide concentration; and light duration. These enable farmers to grow crops outside their ecological zones. In addition, the greenhouse also protects the crops against infestation by pests, weeds, and attack by diseases. Farmers are able to grow crops throughout all seasons.   1. **Use of more efficient machine**   The use of more efficient machines help to reduce the cost of production in agriculture because:   1. They are more efficient in handling the produce during harvesting hence has less wastage or damage 2. They are more efficient in fuel consumption 3. They are more efficient in fertilizer application by applying just the right amount for optimum yields. 4. They are global positioning system aided machines that reduces tillage, seeds and pesticide input up to 10% per acre. |

**Describe the role of irrigation in improving food security.**

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| Irrigation supplements rain where it is not adequate or is unreliable. Irrigation enables growing of crops throughout the year and in ecological zones where the crops would not have survived or produced enough yields**.** |

**What environmental conditions can be controlled in a green house?**

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| A green house is a building in which plants are grown. The conditions can be altered in the green house to suit the crop in question. Some of these conditions include Temperature; relative humidity; carbon dioxide concentration; and light duration. |

**Outline three characteristics of improved livestock breeds.**

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| The improved livestock breeds and hybrids have the following characteristics   1. Have increased heat tolerance 2. Have resistance to tropical diseases 3. Have high tolerance to infestation by both internal and external parasites 4. Have high prolificacy or produces more products**.** |

**Explain the ways in which improved farming technology affects food security.**

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| 1. It leads to increased food production and a wider diversity hence a balanced diet. This helps to eliminate hunger and malnutrition, increasing labour productivity and better lives. 2. Safeguards on the encroachment of fragile land and forests as it ensures high production per unit area. 3. Reduces human wildlife conflicts as pressure on grasslands and forested areas is greatly reduced. 4. Greatly reduces post-harvest losses due to advanced crop handling facilities and processing technology. 5. Reduction of greenhouse gas emission as fewer machinery are used to till the land. This safeguards on climate change and hence more food production. 6. Agricultural research processes produce stronger seeds and effective fertilizer so that more food is produced. 7. Development of agricultural markets and expansion of trade enables farmers to sell what they grow at a profit. 8. Availability of capital for farmers provides them with an opportunity to expand their farms and buy proper equipment. 9. Provision of extension services to farmers helps them to learn the best techniques of growing and storing crops. Food affordability is improved through optical production processes. 10. Educating farmers on sustainable agriculture provides them with knowledge on suitable methods that can be used to increase crop production without depleting the natural resources. This enhances sustainable farming where high production is coupled with environmental protection. |

**TOPIC 8: AGRICULTURAL MARKETING AND TRADING**

**Distinguish between marketing and trading.**

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| Marketing refers to all processes involved in the transformation and flow of goods and services from the producer to the consumer while trading refers to buying commodities and then selling them at a profit.  In other words, marketing is the transfer of goods and services from the point of production to the point of consumption. |

**State four differences between marketing and trading**

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| **Marketing** | **Trading** |
| Concerned mainly with the satisfaction of the consumer | Concerned mainly with the total sales |
| Involves numerous processes hence very wide | Involves only buying and selling hence not wide |
| Produces after thorough research to determine what the consumer wants | Uses resources to buy and then sell at a profit |
| Produces to the market demand and makes some profit | Aims at making profit by disposing any surplus commodity. |

**Define the term ‘marketing channel’.**

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| A marketing channel is the pathway followed by goods from the producer until it reaches the ultimate consumer and it is made up of individuals or firms that are involved in the process of making a product available for use by the consumer. |

**Explain four basic types of marketing channels.**

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| 1. **Direct marketing**   This is where the producer (the farmer) deals directly with the ultimate consumer with no intermediaries involved. Example is a situation where a farmer sells a few tomatoes or cabbages to the neighbours. In this case the farmer deals with consumer directly.  **Producer Consumer**   1. **Indirect marketing**   This is a marketing channel where intermediaries are involved to link the producer and the ultimate consumer. The intermediaries involved perform different channel functions**.**  Producer Assemblies Processors Wholesalers  Retailers Consumer   1. **Dual distribution**   Dual distribution describes a wide variety of marketing arrangements by which the manufacture or wholesaler uses more than one channel simultaneously to reach the end user. They may sell directly to the end users as well as sell to other companies for resale. Using two or more channels to attract the same target market can sometimes lead to channel conflict.   1. **Reverse channel**   This is a marketing channel which makes products to move from the consumer to intermediary to beneficiary rather the usual room the producer to the ultimate consumer**.**   1. **Electronic marketing channel.**   This is a marketing channel which makes use of internet to provide services for use by the consumers. |

**Explain the roles of marketing channels in marketing strategies.**

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| 1. It links producers to buyers 2. Influences the firm’s pricing strategies. 3. Affecting product strategy through branding, policies, willingness to stock. 4. Customises profits, install, maintain, offer credit. |

**Explain the roles of each of the following in the marketing channels**

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| 1. **Producer**  * Prepares commodities for the consumer to buy.  1. **Assembler**  * Stores commodities in warehouses for sale later on to processors  1. **Processors**  * Changes the state of the produce into a more acceptable or usable form. * They grade the produce.  1. **Distributors**  * Wholesaler buy commodities from the processors * The wholesalers carry out packaging of the produce. * The wholesalers advertise the product. * Retailers buy commodities from wholesalers and sell them to the consumers. * Brokers who are agents employed by the processors assist in buying commodities from the producers or in distributing commodities to the consumers. They act on behalf of the processor. * Middlemen buy commodities from the producers and sell them to the consumers who may be far away from the producers. |

**Define the term “marketing agencies”**

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| These are individuals or firms that are involved in the flow of goods from the producer and the farmer to the ultimate consumer. They are intermediaries who link the farmer to the ultimate consumer, |

**Outline the examples of the marketing agencies and their roles in marketing channels.**

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| 1. **Retailers**  * Retailers buy commodities from wholesalers and sell them to the consumers. * They stock small quantities of the commodities they sell. * Sell the goods in any quantities to the final consumers. * Store the commodities in their warehouses * Provide information to consumers about the commodity prices, impending scarcity of the commodity. * They provide a stop where consumers can get a wide range of commodities.  1. **Wholesalers**  * They buy commodities in large quantities from the farmers or the processors and sell them to the retailers. * They have large warehouses in which they can store large quantities of products to maintain its steady supply. * They sell their commodities in bulk but at a lower profit because they take advantage of economies of scale. * They carry out market research which middlemen can use as they link with the consumer.  1. **Processors**  * They obtain agricultural produce, process them into finished products and sell the products to the wholesalers.  1. **Marketing Companies like AMARC and Farmers World**  * They buy commodities from farmers, itinerant traders, processors or middlemen and sell them to consumers or wholsalers. * They have large warehouses where they can store large commodities to maintain supply * They provide transport ad supply the commodities far and wide so that customers are reached  1. **Brokers**  * They are marketing agents who assists in selling or buying produce on behalf of producers or buyers at a fee.  1. **Middlemen**  * **T**hey buy produce from farmers and sell them to the ultimate consumer. * They provide producers with information about customer demand. * They provide a ready market for the commodities. * They provide the farmers with grading facilities so that the commodities cannot be rejected but sold at a high price. * They provide transport facilities so that the commdityy can reach the market in good times. |

**MARKETING COSTS AND MARKETING MARGINS**

**Define the following terms**

1. **Marketing costs `**

Marketing costs are the costs that are incurred when the commodities move from the farm to the final market, whether are moved by farmers, intermediaries, cooperatives, marketing boards, wholesalers, retailers or exporters.

Examples of marketing costs include

* Labour
* Transport
* Packaging
* Containers
* Rent
* Utilities- water and electricity
* Advertising expenses
* Depreciation allowances

Interest charges

1. **Marketing margin**

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| A marketing margin is the percentage of the final weighted average selling price taken by each stage of the marketing chain.  A market margin indicates the charge which a marketing agent imposes for providing the particular marketing service.  Marketing margin describes how much more consumers have to pay after a commodity leaves the production point. The longer the marketing channel, the higher consumers are going to pay for a commodity. |

1. **Farm gate price**

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| It is the price paid by the farmer when producing the goods**.** |

1. **Retail price**

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| It is the price of the product paid by the consumer |

1. **Farmer’s share**

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| Farmer’s share = x 100 |

1. **Total gross margin**

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| Total gross margin = Retail Price x 100 |

**Total Mark-Up**

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| Total Mark-Up = Retail Price x 100 |

**EXAMPLE**

A farmer in Kasungu sells 5,000 kg of maize to Mr. Banda at K100.00 per kg.

1. Mr. Banda incurs the following costs
2. He buys 100 hessian sacks at K50.00 each.
3. He pays actellic at K5,000.000
4. He transports the maize to Lilongwe at K50,000
5. He pays labourers who apply actellic dust for K10,000.00
6. Sells the maize at a profit of K15,000.00
7. Rab Processors
8. Process the maize into flour at K10.00 per kg
9. Pack the flour in 100 sacks at K50.00 EACH
10. Transports the flour to Salima at K30,000
11. Sells the flour to Chipiku shop in Salima at a profit of k15.00 per kg.
12. Chipiku Store
13. Pays K4.00 per kg for storage of the maize
14. Pays commission of K2.00 per kg.
15. Sells the flour to consumers at a profit of K25.00 per kg.

Required

Calculate

1. The price paid by the final consumer from Chipuku store.
2. The marketing cost in incurred by every marketing agent.

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| --- | --- | --- | --- | --- |
| Level of marketing channel | Charges( K) | Marketing cost | Price paid | % share |
| 1. Farmer   Price of maize in Kasungu |  | 500,000.00 | 500,000 | 48.3% |
| 1. Mr. Banda (Kasungu) 2. Hessian sacks 3. Actellic dust 4. Cost of labour 5. Transport Cost 6. Profit   Total Cost | 5,000.00  5,000.00  10,000,00  50,000,00  150,000,00  220,000,00 | 220,000.00 | 720,000,00 | 21.25% |
| 1. Rab Processors 2. Processing cost 3. Costs of sacks 4. Transport cost 5. Profit   Total cost | 50,000.00  5,000.00  30,000.00  75,000.00  160,000.00 | 160,000.00 | 880,000.00 | 15.45% |
| Chipiku Store   1. Storage costs 2. Commission 3. Profit   Total cost | 20,000.00  10,000.00  125,000.00  155,000.00 | 155,000.00 | 1,035,000.00 | 14.989% |
| Price paid by the final consumer is K1,035,000.00  Marketing costs   1. Mr. Banda K220,000 2. Rab Processors K160,000 3. Chipiku Stores k155,000   Marketing Margin = Retail Price - Farm gate Price  = K1,035,000 - K50,000  = K5,35,000.00 | | | | |

**Describe the effects of population distribution on marketing.**

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| 1. **Age-** There is age between 0 to 5 years, 6 to 17 years and 18 to 45 years and 46 or above. In marketing each age group needs to be targeted with its needs for each group has its own fashion**.** 2. **Gender-** Malawi has more females than males. If a marketer wants to make the best from marketing, the best would be to target the large majority because it would make a bigger composite demand than males. 3. **Occupation -** Malawi’s population is largely made b up of the youth than elderly. The elderly have an occupation which brings money for consumption.Demand is likely to be low because of the few cannot make enough income for the many who want to consume. 4. **Education**   Education changes people’s mindset towards different products. The types of foodstuffs the uneducated go for are very different from those for the educated. This affects marketing.   1. **Location** - People in Malawi are spaced out according to tribes and therefore have different traditional foodstuffs they eat. A marketer needs to make these available in those areas in order to sell. |

**TRADING OF AGRICULTURAL COMMODITIES**

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| Trading of agricultural commodities can be carried out at different levels namely   1. Community 2. National 3. Foreign or International |

**Explain the benefits of trading of agricultural produce at community level.**

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| 1. Provides an outlet for excess produce from farm holdings in the community. 2. Promotes efficient division of labour within the community. 3. Encourages members of the community to engage in enterprises that are rewarding to them. 4. Members of the community can buy more goods from the income they earn. 5. Increases productivity of the community 6. Promotes specialization. 7. Improves the living standards of the community members. |

**Describe four ways of improving trading of agricultural produce at community level.**

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| * Ensure rural roads are passable even during the rainy season. This creates easy and quick access to the agricultural communities produced in that area. * Promote the development of rural growth centres that act as trading centres for a particular area. * Promote peaceful and harmonious co-existence among the neighbouring communities. * Promote communication facilities for example radio, television and telephones especially mobile telephones. This eases access to valuable market information. |

**Explain the benefits of trading of agricultural produce at national level.**

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| * It ensures availability of a variety of commodities in the country. * A region is able to get commodities that it does not produce. * It creates and promotes understanding among various communities in the country. * It promotes specialization. * It enables the producers to dispose surplus produce. * It ensures steady supply of various agricultural commodities. * It creates employment opportunities. * It enables urban population to get food. * It promotes agricultural allied industries such as agro-chemical manufacturers, farm tools and equipment dealers and processors dealing with agricultural commodities. |

**Describe four ways of improving trading of agricultural produce at national level.**

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| * Improve transport infrastructures for example roads, railways, airways and water ways. This will ease and fasten transport of agricultural commodities. * Improve communication facilities. * Promote political stability to ensure peace and tranquility. This allows citizens to go about their daily business without fear. * Provide adequate market information on major agricultural commodities. * Establish buffer stocks in case of overproduction and then release it in time of scarcity. This helps to reduce price fluctuation. * Harmonise taxation. This ensures that the traders are not overtaxed. |

**Explain the benefits of trading of agricultural produce at international level.**

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| * A country is able to get agricultural commodities that it does not produce. * A country is able to export her surplus produce. * The country earns foreign exchange. * It improves international relations. * It widens the market for the country’s agricultural commodities. * It has higher chances of getting humanitarian aid from the trade partners in the case of a calamity. * It improves the country’s transportation and communication facilities. * It improves the living standards of the citizens of the country. * It encourages specialization in particular agricultural commodities. |

**Describe four ways of improving trading of agricultural produce at national level**

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| * Improve transport facilities at national and international level. * Promote good international relations such that nationals of member countries freely interact. * Remove trade barriers such as use of common currency. * Ensure easy access to international market information by potential exporters. * Promote information communication and technology (ICT) that would greatly enhance e-commerce by making affordable to most citizens. * Promote production of high quality agricultural commodities with low levels of chemical residual. * Improve advertisement through export promotion by government agencies. * Encourage production of a variety of agricultural commodities. This diversifies the commodities available for the export market. |

**TOPIC 9: PRICE ELASTICITY OF DEMAND AND SUPPLY**

**PRICE ELASTICITY OF DEMAND ()**

**Define price elasticity of demand.**

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| * Price elasticity of demand is a measure used in economics to show the responsiveness of the quantity demanded of a good or service to a change it its price. * Price elasticity of demand measures the quantity of goods demanded in a given market when the price of the goods changes. * It is determined by dividing the percentage change in the quantity demanded with the percentage change in price.   **Price elasticity of demand () =**  **=**  **=**  **Where**   * is the change in quantity demanded * is the change in price * is the original price * is the original quantity demand * is the new quantity demanded * is the new price |

**Example**

Below is a demand schedule for oranges in a market when the price per kilogram is gradually reduced from MK10 by units of MK2.

|  |  |
| --- | --- |
| Price (MK/KG) | Quantity demanded |
| 10 | 200 |
| 8 | 300 |
| 6 | 400 |
| 4 | 500 |
| 2 | 600 |

**Required**

**Calculate**

1. **The price elasticity of demand when the price falls from MK10 per kg to MK8 per kg.**

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| **=**  **Ed =**  **= x**  **= 2.5**  **The negative sign in the calculation of Ed is ignored** |

1. **The price elasticity of demand when the price falls from MK4 per kg to MK 2 per kg.**

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| **=**  **Ed =**  **= x**  **= 0.4**  **The negative sign in the calculation of Ed is ignored** |

**Explain three degrees of price elasticity of demand.**

1. **Elastic demand**

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| When the price elasticity of demand, Ed is greater than 1, the demand is said to be price elastic. This is because the quantity demanded changes by a higher percentage than the change in prices. A slight change in price of the commodity brings a relatively bigger change in the quantity demand.  Elastic demand is common with most luxurious goods such as cars, television and play stations.  Elastic demand is depicted in figure below  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\price_elasticity_elastic.png  When the price changes by a certain percentage “a” 25%, the quantity demanded declines by a far much higher percentage “b” 45.5%. |

1. **Unitary demand**

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| When the price elasticity of demand, Ed is equal 1. The demand is said to be unitary elastic; this means that the quantity demanded changes with the same percentage as the change in price.  The figure below shows a unitary demand curve.  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\price_elasticity_unitary.png  When the price changes by a certain percentage “c”33%, the quantity demanded declines by the same percentage “c”33%.  **Note:** When the price elasticity of demand = 1, it is said to be unitary elastic. |

1. **Inelastic demand**

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| When the price elasticity of demand Ed, is less than 1, the demand is said to price inelastic. This means that the quantity demanded changes at lower percentage compared to percentage change in price.  The figure below depicts an inelastic demand curve.  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\price_elasticity_inelastic.png  When price increases by “d”%, the quantity of goods demanded declines by “f”, 33%.  **Note**: When price elastic of demand <1, it is said to be inelastic. |

**PRICE ELASTICITY OF SUPPLY**

**Define the term price elasticity of supply.**

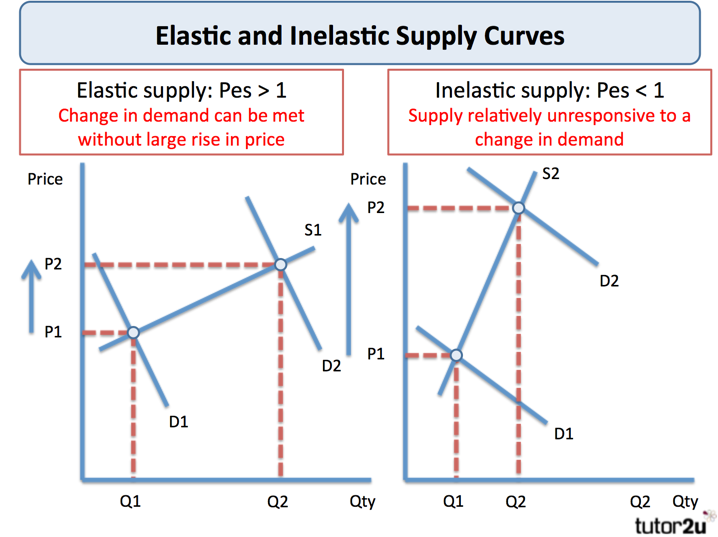
|  |
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| Price elasticity of supply is the measure of the degree of responsiveness of quantity of goods supplied to changes in price of the goods.  Price elasticity of supply is determined by dividing the percentage in the quantity supplied to changes in price of the goods.  Price elasticity of supply (Es) =  Es=  =**=**  **Where**   * is the change in quantity supplied * is the change in price * is the original price * is the original quantity supplied * is the new quantity supplied   is the new price |

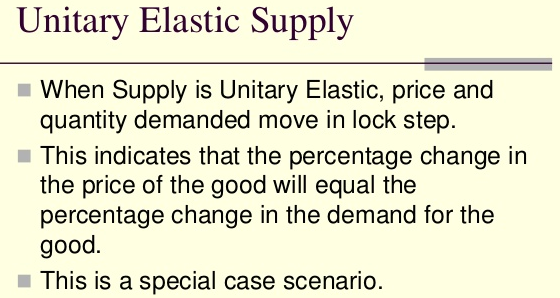
The table below shows the supply schedule of cabbages with change in price.

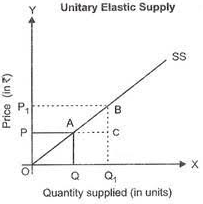
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Price (MK/KG) | 10 | 12 | 14 | 16 | 18 | 20 |
| Quantity supplied(Kg) | 200 | 250 | 290 | 320 | 350 | 375 |

**Required**

1. Calculate the price elasticity of supply when the price increases from 10 to Mk2
2. Calculate the price elasticity of supply when the elasticity decreases from K18 to K16.



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**Explain the importance of demand elasticity.**

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| 1. **International trade**   In order to fix prices of the goods to be exported, it is important to have the knowledge about the elasticity’s of demand for such goods. A country may fix high prices for products with inelastic demand.   1. **Formulation of government policies**   Government can impose high taxes on goods with inelastic demand and low rates of taxes are imposed on commodities with elastic demand.   1. **Factor pricing**   Demand elasticity helps in pricing of the factors of product. If demand for a particular factor is inelastic as compared to the other factors, then it will attract higher rewards.   1. **Pricing of goods and services by monopolies**   A monopoly is a market structure in which a single firm controls supply of goods or services. Example is ESCOM in Malawi. If demand for the product is elastic (a small change in price causing a very large change in demand), then the monopolist will fix low prices and still make huge profits.   1. **The paradox of poverty amidst plenty.**   This is a situation in which farmers remain poor despite their high agricultural productivity**.** The high supply causes a drastic drop in prices because of inelastic demand. In other words, consumers may not need more than what they normally buy. |

**TOPIC 10: CROP IMPROVEMENT**

**Describe the meaning of crop improvement and plant breeding.**

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| Crop improvement refers to plant breeding process geared towards improving both quality and quantity of produce while plant breeding is defined as the art and science of changing the genetics of plants in order to produce desired characteristics.  Crop improvement |

**Describe the aims of crop improvement.**

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| 1. To improve adaptation of plants to different ecological conditions. 2. To increase the average crop yields. 3. To increase the market value of the crop products such as ripening quality, taste and texture as demanded by consumers. 4. To improve the nutritional content of edible parts, that is, increase in protein, vitamin and mineral content. 5. To develop resistance to pest and disease for example groundnut variety RGI is bred to resist rosette disease. 6. To develop crops with ease of adaptations to new agricultural areas. 7. To develop crops which are well adapted to modern production techniques such as mechanical harvesting**.** 8. **To increase the crops high yielding ability through increase in biomass production.** |

**What is the difference between plant breeding and natural selection?**

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| * Plant breeding is the purposeful selection, growth and cross -pollination of particular plants. The plant breeders select those plants that have qualities such as bigger fruits, higher yield etc that are desired by human beings. Farmers do this by saving seed from those plants they thought had good characteristics. * In natural selection, plants that do better in a particular environment will set a seed and pass on the genes that made them successful in that environment. |

**List activities in crop improvement**

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| **The following are the activities which are carried out in order to improve crop produce**   1. **Collection of germplasm**   Conservation refers to protection of genetic diversity of crops from genetic erosion**.**  **Two important methods of germplasm conservation**   1. **In-situ conservation**   This involves conservation of germplasm under natural conditions and is achieved by protecting the area from human interference. Such areas may be national parks, biosphere reserve or gene sanctuary.   1. **Ex-situ conservation**   This is preservation of germplasm in gene banks or artificial conditions.  The following are the banks used in ex-situ conservation of germplasm   1. **Seed banks**   The germplasm is stored as seeds of various genotypes. Based on duration of storage, seed bank collections are classified into three groups**.**   * **Base collection-** These are seeds conserved for a long-term (50-100years) at about - with 5% moisture content. They are only distributed for regeneration. * **Active collection-** Seeds are stored at 0 Degree Celsius with 5-8% moisture content. The storage is for medium duration (10-15years). These collections are used for evaluation, multiplication and distribution of the new items. * **Working collections-** Seeds are stored at 5- with about 10% moistire content. The seeds are stored for 3-5 years. Such materials are regularly used in crop improvement programmes.  1. **Plant bank or field bank**  * This is an orchard or a field in which accessions (new items) of fruit trees or vegetatively propagated crops are grown and maintained.  1. **Shoot tips banks**  * In this bank, germplasm is conserved as slow growth cultures of shoot tips and node segments. They are also referred as meristem cultures**.**   **Advantages of conservation of genetic stocks by meristem cultures**   * Each genotype can be conserved indefinitely free from viruses or other pathogens. * It is advantageous for vegetatively propagated crops like Irish potatoes, sweet potatoes and cassava. * Vegetatively propagated material can be saved from natural disasters. * Regeneration of meristems is extremely easy. * Plant species having high viability can be easily conserved by meristem cultures.  1. **Cell and organ banks**  * They include a germplasm collection such as embryonic cell cultures, somatic or zygote embryos preserved at -196 Degree Celsius in liquid nitrogen.  1. **DNA banks**  * This is where DNA segments from the genomes of germplasm accessions are maintained and conserved.  1. **Germplasm evaluation**  * Evaluation refers to screening of germplasm with respect to morphological, genetical, economical, biochemical, physiological and entomological attributes. * **Aims of germplasm evaluation include**  1. To identify gene sources for resistance biotic and abiotic stresses, earliness, dwarfness, and productivity and quality traits. 2. To classify the germplasm to various groups 3. To get the significance of individual germplasm line. 4. **Germplasm cataloguing, data storage and retrieval**   This is the documentation of information on the species and variety names, place of origin, adaptation and its various attributes. Catalogues of the germplasm collection for various crops are published by gene banks.   1. **Actual improvements**   This involves transfer of genes for resistance to common diseases from wild relatives to the cultivated species. It may also involve selection of seeds that have desired qualities from harvested crops.   1. **Demonstrations**   Several demonstrations are carried out to prove advantages and adaptability of newly developed crops.   1. **Seed multiplication**   This is carried out in the research farms as well as in neigbouring farms**.**   1. **Seed distribution.**   Seeds are distributed to farmers for adoption. |

**Describe three methods of crop improvement.**

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| 1. **Introduction of new crop varieties**   This involves importation of superior varieties from other countries into Malawi. This stock serves as multiplication and propagation in the new area.  Examples of varieties introduced to Malawi from Tanzania is Maize variety Ukiriguli Composite B was imported from Tanzania to high altitude and high rainfall areas of Kirk range, Shire highlands, Lilongwe plains, Chitipa plains and Namwera areas.   1. **Selection**   This is where farmers constantly select high performing crops in their farms.  Two techniques of selection are   1. **Mass selection**   This is the selection of crops based on their phenotype and general performance. The seeds from the selected plants are bulked up for the next generation. The limitation of this method is that there is a large influence of the environment, phenotype and performance of the plants.   1. **Pureline selection**   This involves three stages   1. Numerous superior plants are selected from genetically variable population. 2. Progenies of the individual plants selected are grown and evaluated by simple observation frequently over a long period of time. 3. When selection can no longer be made on the basis of observation alone, trials are undertaken involving measurements to determine whether the remaining selections are superior in yielding ability and other aspects of performance. 4. **Hybridization**   This is the combination of desirable genes found in two or more different varieties to produce pure-breeding progeny which is superior in many aspects to the parental types.  In other words, it is the cross breeding in which two varieties are cross pollinated to raise a new variety which carries characteristics from both parents.  There are three steps that should be flowed   1. **Choosing parents**   The breeder chooses parents which show desirable characteristics. The good characteristics can be yielding ability, diseases or pest resistance, adaptation to environmental conditions. Those that show superiority are chosen to become parents of the new generation.   1. **Self-pollinate the plants**   Each parent line is self-pollinated by growing it separately on its own for 5-6 generations or beyond in order to develop pure lines. Ian the process some die off and are discarded.   1. Cross pollinate the in-bred lines   In-bred lines are realized through self-pollination. Pollen from one in-bred line is taken and transferred to the other in-bred line. |

**Explain the stages of hybridization.**

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| 1. **Selection of parents**   This involves the selection of parents that depends upon the aims and objectives of breeding. Parental plants must be selected from the local areas and are supposed to be the best suited to the existing conditions.   1. **Selfing of parents or artificial self-pollination**   This is essential for inducing homozygosity for eliminating the undesirable characters and obtaining inbreeds.   1. **Emasculation**   This involves growing the inbreeds under normal conditions and are emasculated.  It can be defined as the removal of stamens or anthers or the killing of the pollen grains of a flower without affecting in any way the female reproductive organs**.**   1. **Bagging**   The emasculated flower is immediately bagged to avoid pollination by any foreign pollen.   1. **Tagging**   The emasculated flowers are tagged just after bagging. The tags are attached to the base of flower with the help of thread.   1. **Crossing**   It can be defined as the artificial-cross pollination between the genetically unlike plants. In this method mature, fertile and viable pollens from the male parent are placed on the receptive stigma of emasculated flowers to bring about fertilization**.**   1. **Harvesting and Storing the FI seeds**   Crossed heads or pods of desirable plants are harvested and after complete drying they are threshed. Seeds are stored properly with original tags.   1. **Raising the FI generation**   In the coming season, the stored seeds are sown separately to raise the FI generation. The plants of F1 generation are progenies of cross seeds and therefore are hybrids. |

**What is the main limitation of hybridization?**

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| **Disadvantage-** The greatest challenge in hybridization is that it creates a great variability due to the enormity of the genes involved. |

**TOPIC 11: CROP PROCESSING**

**Define the term processing.**

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| It is the changing of raw forms of produce into finished products of higher value or which can be preserved for future use. |

**State the importance of crop processing.**

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| 1. It improves the shelf-life of the products making it possible to preserve the produce at times of surplus. This makes food available to consumers throughout the year. 2. Improves taste of the produce through addition of important nutrients in the processed foods. 3. Adds value to crops by preventing deterioration of their nutritive value. Processed tea and coffee are of higher market value and do not deteriorate in nutrient composition. 4. Food processing plants provide a major source of employment to the citizens as they are employed in various units of the processing plant. 5. The processed plants earn the country more foreign exchange compared to when unprocessed forms of the produce are exported. |

**PROCESSING OF MAIZE**

**Explain the practices that are carried out when processing maize.**

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| 1. **Dehusking**   This involves removal of the husks from the maize cobs when the maize crop is dry and it is done by hand. This is done to speed up the drying of the grains.   1. **Shelling**   It is the removal of maize grains from the maize cobs using hand or mechanically by the use of shellers. This is done to speed up the drying process.   1. **Drying of the grains**   The shelled maize is laid directly on a mat which is black in colour and allows the sun and wind to dry up the crop.  The maize grains may also be dried using solar driers, electric driers and forced air dehydrators. The maize should be dried to 11-13% moisture content.  Reasons why maize grain should be dried before storage   1. To minimize incidences of moulds developing on the teas which causes the deadly aflatoxins 2. To make the testa hard to resist insect attack. 3. To prevent germination of seeds when they are in the store. 4. **Cleaning the grains**   Shelled grains are winnowed to remove chaff and other foreign materials.  Winnowing machines or fanners are used in large scale operations.   1. **Dusting**   Maize grains are then treated with appropriate pesticides to protect them against storage pests.   1. **Packing**   The produce is placed in standardized bags in readiness for marketing.   1. **Milling**   Commercial maize millers buy maize grains and mill them into flour. The flour is packed into small quantities for distribution to consumers. |

**State the secondary product processed from maize.**

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| Maize flour such as gramil maize flour, animal feed, beer, mbwibwi , maize products such as cornflakes. |

**State the agro-based industries that process maize grains in Malawi.**

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| * Rab Processors Limited - Process maize grains to Snow White Ufa Oyera * Bakhressa Company- Maize Gramil flour |

**PROCESSING OF GROUNDNUTS**

**Describe the practices that are carried out when processing groundnuts.**

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| 1. **Shelling**   This involves extracting the nuts from the pods.   1. **Drying**   The nuts are dried by placing them on a black mat and allow the sun and wind to dry up the seeds. Cover with a cloth to protect it from insects and birds while drying.  Drying can also be done using solar driers, electric driers and forced air dehydrators   1. **Cleaning**   The dried nuts are then winnowed before packing in standardized bags for marketing.   1. **Oil extraction**   The clean dry nuts can be processed by oil pressing equipment into peanut oil, peanut butter and other products.  The agro-based industries that process groundnuts include  **Uniliver Brothers**- process groundnuts to Covo Cokking Oil  CORI- process groundnuts sunflower cooking oil.  Tambala Food Products Division- Process groundnuts to Kazing Cooking Oil. |

**PROCESSING OF MUSHROOM**

**Describe the processing techniques used to process mushrooms.**

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| 1. **Canning**   The mushrooms are preserved in brine, butter oil or vinegar.  The following operations are then carried out   * Grading * Blanching-(pre-cooking). Mushrooms are immersed briefly in boiling water. * Can filling in brine solutions * Sterilisation with heat and cooling through water spray. * Labelling the cans for storage.  1. **Individual quick freezing**  * The raw mushrooms are washed at processing units and then impacted, sliced and graded. They are then blanched, water cooled and subjected to tunnel freezing at -40 Degree Celsius. * The tunnel freezing stage may be replaced with vacuum freeze drying to retain the original couloirs, texture and freshness properties. * VCF involves cooling the mushrooms much below a temperature of - 40 Degree Celsius where the moisture present in the mushrooms is converted into tiny ice molecules. The ice sublimes into vapour when subjected to vacuum with a slight rise in temperature resulting into a dried product.  1. **Drying**   This involves sun drying, mechanical drying, air drying and microwave oven drying. After normal drying, vacuum drying process follows which is used to reduce pressure inside the mushrooms.   1. **Pickling of mushrooms**  * In pickling of mushrooms, white wine, vinegar, salt, sugar, garlic and olive oil are mixed with water and boiled for 12-15 minutes**.** The mushrooms are removed from the pan and completely dried. * The dried mushrooms are coated with olive oil which make the mushrooms to remain in good condition for about two months.  1. **Radiation preservation**   The mushrooms are exposed to a radiation of gamma rays to stop the post-harvest growth and deterioration. |

**What is blanching in crop processing?**

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| This involves immersing the crop briefly in boiling water. It is done to stop certain enzymatic reactions in the leaves and helps retain their colour and flavor. |

**What is involved in pickling in mushroom preservation?**

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| * In pickling of mushrooms, white wine, vinegar, salt, sugar, garlic and olive oil are mixed with water and boiled for 12-15 minutes**.** The mushrooms are removed from the pan and completely dried. * The dried mushrooms are coated with olive oil which makes the mushrooms to remain in good condition for about two months. |

**Explain radiation preservation of mushrooms.**

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| The mushrooms are exposed to a radiation of gamma rays to stop the post-harvest growth and deterioration |

**PROCESSING OF MANGOES**

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| Mangoes are best stored in processed form. Mangoes are processed into mango juice , nectar, jam, and chutney.  Mangoes are processed using the following procedure   * The fruits are cleaned * They are then simmered in water in stainless steel, glass or enamel pot. * When tender, the fruits are cut into small pieces and pressed through a food mill or hand operated fruit press. * Lemon juice can be added to taste. * The juice is then frozen or canned for storage. |

**PROCESSING OF AMARANTHUS (BONONGWE)**

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| They are leafy green plants. They may be harvested when abundant and preserved as dried vegetables or placed in a freezer.  Two methods of processing amaranthus include   1. **Drying**   Amaranthus can be dried in a home oven. The leaves require blanching before drying. Blanching is done by placing them in a boiling water bath or in steam for about 2 minutes. This stops certain enzymatic reactions in the leaves and helps retain their colour and flavor. The prepared blanched leaves are placed on baking or metal screen trays. The oven temperatures are set at 60 Degree Celsius and the door left open 2 to 4 inches for ventilation.  Drying time can be reduced if ventilation increases.   1. **Freezing**   Amaranthus leaves are blanched before freezing at temperatures between -18 to -21 Degree Celsius.  Packages for freezing should be water proof and vapour proof with as little air as possible to prevent oxidation during storage. The packages are then placed ion a freexer. |

**PROCESSING OF CASSAVA**

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| Cassava is better processed by   * peel and slice * Soaking it for some days to remove cyanides. * Was the cassava * Dry it up * Process it into flour   The flour can be stored in bags or baskets. |

**Explain how cassava flour can be made free of cyanides.**

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| Soaking cassava for some days to remove cyanides. |

**TOPIC 12: PASTURE**

**State the meaning of the term ‘pasture”.**

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| Pasture is land covered with grass and other plants found growing naturally or planted and suitable for grazing or feeding livestock. |

**Explain the importance of pasture**

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| 1. Pasture provides feeds for livestock. It forms the bulk of ruminant animals diet. 2. Low growing pasture crops create a soil cover hence reducing soil erosion.   Pasture grasses and legumes could be used in a crop rotation.   1. Leguminous pasture crops such as Desmodium, Stylosanthes with the aid of Rhizobium bacteria improve soil nutrient content by fixing nitrogen from the air into nitrates. 2. Pasture grasses could be used in crop rotation programmes to help break the development cycle of pests and disease-causatives. 3. Pasture can also be established to increase production in acidic soils which may not support crop production. 4. Pasture adds soil nutrients. Upon grazing nutrients circulate through the animal and back into the soil as dung and urine. 5. Pasture improves the structure of the soil. Decaying plant material improves the soil structure by promoting soil aggregation. 6. Reduces pests and diseases. Many grasses and legumes are resistant to pests and diseases that attack arable crops. When included in the arable rotations, they break the cycles of the pests and diseases. A good example is love grass and katambola Rhodes grasses are used in tobacco rotations to control eelworms. |

**TYPES OF PASTURE**

**Explain two types of pastures**

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| 1. **Indigenous pasture**   These pastures which are naturally growing pastures which include grasses and legumes**.** They are established through natural regeneration. They are found in uncultivated grasslands and dambos.  Examples of natural pastures include   * Thatching * Rapoko grass * Cat’s tail grass * Whiskey grass * Rendel grass * Bristle-leaved red top * Red grass * Wild oat grass * Red grass * Bent grass * Giant spear grass  1. **Exotic pasture**  * This is pasture planted by man. It is also cultivated pasture or pasture ley. * These grasses and legumes have high productivity compared to natural pasture. * They have high dry matter and crude protein content * Examples commonly cultivated grasses include  1. Rhodes grass 2. Buffel grass 3. Napier or elephant grass 4. Guinea grass  * Examples of commonly cultivated leguminous pasture.  1. Pencil flower 2. Butterfly 3. Purple bush-bean 4. Horse grain 5. Tick clover 6. Wild soya bean  * Examples of leguminous shrubs which are grown in some farms include  1. River tamarind 2. Msangu |

**Explain two classes of exotic pastures.**

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| 1. **Permanent pasture**  * Permanent pass ture is cultivated or planted pasture that contains at least one exotic species of grass and that is maned for 10-15 years. * Good examples of permanent pastures include  1. Star grass 2. Bush MINE GRASS 3. Buffel grass 4. Torpedo grass 5. **Temporary pasture (Leys)**  * Temporary (leys) pastures are cultivated pastures usually lasting 3-5 years. They may consist of a pure stand of grass or legume or the interplanting of the two. * Examples of grasses and legumes used in temporary pastures include  1. Rhodes grass 2. Guinea 3. Love grass 4. Napier grass 5. Setaria spp |

**Explain the benefits of exotic pastures over natural pastures.**

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| 1. **Dry matter yield** is higher in exotic pastures than in indigenous pastures 2. **Including legumes in exotic pastures**   This is beneficial in this way   1. The combined yield from grasses and legumes is higher than when they are each grown alone 2. The nitrates fixed by the legume pastures are used by the grass to increase the grass yield 3. The legumes have a higher protein content which improves the nutrient content of the feed. 4. Legumes have higher digestibility even when mature. 5. Legumes retain high nutritive value even when mature providing the much needed protein in the dry season. 6. **Higher in protein content.** Exotic legume pastures have higher crude protein content; they retain higher levels of protein when mature. 7. **Higher digestibility** regardless of whether they are grass pastures or legume pastures, whether they are grass pastures or legume pastures, whether the pastures are still young (in wet season) or mature(dry season) |

**Explain six ways of improving indigenous pasture.**

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| 1. Introduction of suitable legume crops. 2. Application of manure at the onset of rains. 3. Regular weeding 4. Controlled burning to remove the fibrous stem remains stem 5. Proper stocking rates. 6. Harvesting pasture at the appropriate time. |

**Define the term pure stand pasture.**

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| This is a pasture crop which is grown as one type only in a field. The stand can be either leguminous crop or grass crop but not both. |

**State the advantages and disadvantages of pure stand pasture.**

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| **Advantages of pure stand pasture**   1. It is easier to control weeds using herbicides in a pure stand pasture than in a mixed stand pasture. 2. There is better establishment as there is less competition for nutrients, space and light unlike in the mixed stand where competition is stiff between the crops 3. It is easier to collect seeds from a pure stand   **Limitations of pure stand pasture**   1. There is a lower yield per unit area in comparison to a mixed stand. 2. There are more cases of bloat in animals if the pasture crop are leguminous 3. The feed may not be very palatable if fed to livestock alone. 4. In case of outbreak of pests and diseases the farmer has nothing to relay on unlike in mixed stand pasture. |

**Define the term ‘mixed stand pasture’**

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| This refers to establishment of leguminous crops and grass crops on the same piece of land. It can be established by planting pasture legumes in an existing grass pasture. |

**Explain the disadvantages /limitations of mixed stand pasture.**

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| **Advantages**   1. Grass-legume pasture has higher nutrient value than either of them separately. 2. They improve soil fertility due to nitrogen fixation by the legumes and hence there is less usage of nitrogenous fertilizers. 3. Higher yield per unit area are realized compared to pure stand pasture. 4. Animals are less prone to bloat when grazed on mixed. 5. Grass metal fifth himself.   **Disadvantages** |

**METHODS OF PASTURE ESTABLISHMENT**

**State the five methods of pasture establishment.**

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| 1. Vegetative propagation 2. Broadcasting 3. Drilling 4. Under sowing 5. Over sowing |

**What is vegetative propagation?**

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| This is method of pasture establishment where vegetative materials or parts of plants other than seeds are used to produce new individual plants.. The vegetative materials are placed in the holes and covered with soil appropriately. |

**State the advantages and disadvantages of vegetative propagation method of establishing pasture.**

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| **Advantages of vegetative propagation**   1. Vegetative organs have sufficient food reserves to help the young shorts to become established. 2. Vegetative planting reduces the problem of dormancy. 3. It ensures genetic uniformity in pastures as all the offspring will resemble their parents. 4. The pasture plants assume the age of the parent plant thus reducing the juvenile period so the pasture mature earlier and start producing crop yields earlier. 5. They can lead to rapid growth of new plants owing to the large food reserves in the vegetative parts. 6. The offspring breeds true-to-type since its parental characteristics are observed. Desirable qualities in the parent plant such as diseases resistance and growth vigoiur are passed on directly to the young plant. 7. They do not depend on pollination and fertilization for reproduction.   **Disadvantages/limitations of vegetative propagation**   1. They are bulky and difficult to transport or store since they need a lot of space. 2. Lack of dispersal mechanisms often leads to overcrowding and unnecessary competition for light, moisture and nutrients. 3. There is no variability in characteristics hence new varieties cannot be easily developed. 4. The risk of transferring diseases to new plants is high. |

**Define the term broadcasting.**

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| * Broadcasting is a method of pasture establishment which involves scattering of seeds randomly over the seedbed then covered with a thin layer of soil. * In other words, pasture seed is mixed with diluents such as sand, saw dust or fertilizer and spread on the surface either by hand or using a fertilizer spreader and is then raked into the soil. |

**Explain the advantages and disadvantages of broadcasting method of establishing pasture.**

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| **Advantages of broadcasting**   1. It is quicker whether done by hand or with the machine. 2. It is the most suitable means for propagating small seeds. 3. It provides ample soil foliage cover as the plants grow**.**   **Disadvantages/limitations of broadcasting**   1. A high seed rate is used. 2. It has a poor germinating rate due to uneven depth of burying the seeds where the seedbed is not properly leveled. 3. There is lack of uniformity in establishment of the plants. 4. There can be overcrowding in different parts of the seedbed. 5. Seeds on the surface can easily be picked by birds or washed away by rainwater. |

**Define the term drilling in pasture establishment.**

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| It is the placement of the planting materials in drills at predetermined spacing. In manual drilling, a planting line can be used to achieve uniformity in plant spacing. In mechanizing drilling, planters are used for spacing according to preset measurements. After drilling, the soil is compacted by use of rollers. |

**Explain the advantages and disadvantages of drilling method of pasture establishment.**

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| **Advantages of drilling**   1. Plants are uniformly spaced making operations such as weeding and spraying. 2. Mechanising subsequent field operations is possible. 3. A lower seed rate is used than in the broadcasting method. 4. Correct plant population is established due to accurate spacing. This leads to high yields per unit area. 5. It enables germination to be uniform due to even depth of seed placement.   **Disadvantages of drilling**   1. It consumes more time and labour. 2. It requires more skill in measuring the spacing between drills. 3. It is not very ideal for areas which have steep slopes. Such areas are prone to soil erosion since it does not provide ample foliage cover for the soil. |

**What is under sowing in pasture establishment?**

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| It is a method of pasture establishment whereby the pasture crop is established under an already growing crop/nurse crop.  In under sowing, the nurse cropis established first and the pasture seeds are planted immediately after weeding the nurse crop. Conditions which favour under sowing are high rainfall and availability of fertilizers. |

**Explain the advantages and disadvantages of under sowing method of pasture establishment.**

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| **Advantages of under sowing**   1. The first crop provides shade to the pasture so that it may note easily wilt soon after planting. 2. It encourages faster establishment of pasture crop due to the conclusive environment created by the nurse crop. 3. It saves on the use of commercial fertilizers since two different crops benefit from the same application of fertilizers. 4. Enables the farmer to harvest an extra crop of maize from the plot. 5. There is intensive use of land.   **Disadvantages of under sowing**   1. Competition between the two crops for moisture and nutrients may affect their establishment. 2. The yield of each crop is less than if it were direct planted or grown on pure stand. 3. It is difficult to determine the right amount of fertilizer for the two crops. 4. Damage of the under sowing crop during the harvest of the nurse crop may occur. |

**Define the term over sowing.**

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| Over sowing is the establishment of a pasture legume in an existing grass pasture. Before sowing of pasture seeds, growth of an existing pasture is checked through slashing, burning or hard grazing. About 200-400kg single super phosphate fertilizer per hectare is applied and mixed with the soil and then the legume seeds are then planted. The legume seeds are inoculated with appropriate Rhizobium bacterial strain before planting. |

**Explain the advantages and disadvantages of over sowing method of pasture establishment.**

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| **Advantages of over sowing**   1. There is reduced soil erosion 2. It makes maximum use of semi-arable land. 3. There is minimum loss to grazing. 4. It maintains soil moisture content. 5. It promotes mixed stand pasture establishment forbetterlivestock diet. 6. It saves on cost of extensive land preparation since only weeding is required before sowing. 7. There is reduced labour and lower machinery investment.   **Disadvantages of over sowing**   1. Higher rodent and insect population 2. It requires high management skills. 3. There is wastage of seeds of the over sown crop since some will land on the space where the earlier established crop is growing. 4. The introduced pasture species may face competition for sunlight and nutrients from the already established pasture. |

**SEED RATE**

**Define the term seed rate.**

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| Seed rate is the amount of seeds required per hectare. In other words, seed rate is the amount of seeds required for sowing per unit area. Seed rate is measured in hectares. |

**CALCULATION OF THE SEED RATE**

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| To calculate the seed rate, you need to know the expected plant population per hectare, the seed size expressed as the number of seeds per kilogram, the purity percentage and germinating percentage of its seeds.  **Seed rate =** |

**EXAMPLES**

1. Calculate the seed rate for a certain grass species where :

Seed size = 200,000 seeds/kg

Purity = 80%

Germination percentage = 60%

Expected plant population = 600,000

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| **Workings**  **Seed rate =**  **Seed rate =**  **= 6.25kg/ha** |

1. **C**alculate the seed rate of a pasture grass given the following information:

Seed size = 100 seeds/kg

Purity = 72%

Germination percentage = 62%

Expected plant population = 300

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| **Workings**  **Seed rate =**  **Seed rate =**  **= 2.24kg/ha** |

1. The seed rate of a given pasture is 10.7k/ha. Calculate the expected plant population per hectare given that the seed size is 222,000 seeds per kilogram, purity is 75% and the germination percentage is 56%.

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| **Seed rate =**  **10.7 =**  **= 997,668 plants** |

**Explain seven factors that affect pasture seed rate.**

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| 1. **Seed size**   This is always expressed as the number of seeds per kilogram. The higher the number of seeds per kilogram the lower the seed rate.   1. **Growth habit of pasture**   Lower seed rates are used in spreading pasture or those with ability to tiller compared to vertical growing types.   1. **Soil tilth**   When soil tilth is rough, higher seed rates are used to compensate for those which may be blocked by soil lumps and hence fail to emerge.   1. **Method of sowing**   Drilling uses lower seed rate compared to broadcasting method of sowing pastures.   1. **Purity percentage**   Pure seeds have lower seed rates than impure and unselected seeds. Some impure and unselected seeds may fail to germinate. To compensate for this probability a higher seed rate is used**.**   1. **Germination percentage**   Seeds with low viability are planted at higher seed rates than those which are more viable. The higher the germination percentage the lower the seed rate.   1. **Plant spacing**   Closely spaced plants will have a higher seed rate than sparsely spaced plants. |

**TREATING PASTURE SEEDS**

**Explain what is meant by term ‘treating pasture seeds’**

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| This involves all practices carried out on the seeds to improve their germination ability and encourage successful establishment. |

**Explain five ways of treating pasture seeds.**

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| 1. **Hulling/shelling**   Hulling is the removal of the pod from around the seed.   * Hulling is the removal of the pod especially in leguminous pasture such as desmodium. * Hulling can be done by **pounding the pods in a mortor** (mtondo) and **winnowing them**. It helps to obtain grains from pods.  1. **Scarification**  * Scarification is the process of breaking up or softening the hard testa of some legume seeds in order to speed up water penetration for quick germination. * Scarification can be done **mechanically** or by **immersing the seeds** in hot water for few mini  1. **Cleaning**  * Cleaning involves removal of chaff and off-type seeds in order improve the seed purity.  1. **Inoculation**  * Inoculation is the process of coating legume seeds with a nitroculture of the right rhizobial strain in order to encourage formation hence boosting nitrogen fixation. * The below dhows the legumes their strains of Rhizobia sp  |  |  | | --- | --- | | Strain of Rhizobium spp | Pasture legume | | Rhizobium trifolli | Clover | | Rhizobium melioti | Lucerne | | Rhizobium lupini | Lupin | | Rhizobium japonicum | Soya beans |  1. **Pelleting**  * Pelleting involves sticking a thin layer of lime or gypsum around the legume seed. * Lime and gypsum amend the soil pH and improves its establishment. * Gypsum has acidifying effects, hence it lowers the pH. This may inhibit the activities of the ***Rhizobium*** bacteria hence making inoculation unsuccessful. |

**Explain the importance of each method of pasture treatment**

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| 1. **Hulling**  * It helps to obtain grains from pods., * It makes pelleting of the seen easier * It increased the rate of seed germination.  1. **Scarification**  * Scarification is the process of breaking up or softening the hard testa of some legume seeds in order to speed up water penetration for quick germination.  1. **Cleaning**  * Cleaning involves removal of chaff and off-type seeds in order improve the seed purity.  1. **Inoculation**  * Inoculation is the process of coating legume seeds with a nitro culture of the right rhizobial strain in order to encourage formation hence boosting nitrogen fixation.  1. **Pelleting**  * Pelliting involves sticking a thin layer of lime or gypsum around the legume seed. * Lime and gypsum amend the soil pH and improves its establishment. |

**ACTIVITIES INVOLVED IN PASTURE MANAGEMENT**

**Explain the procedures for pasture established.**

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| 1. **Proper time pasture establishment.**   Best results are achieved when pastures are planted as early as possible in the rainy season not later than January end. Like any other crop, needs to be planted with the first rains. This ensures that it finishes its establishment phase within the same year. Late pasture establishment will deprive animals of their feeds as it extends into next season.   1. Land/seed bed preparation   The is cleared and ploughed deeply during the dry season. Crop residues decompose and big shrubs are then buried. This gives ample time to eradicate perennial rhizomatic weeds   1. Selecting pasture seed   Successful pasture establishment depends on the quality of the seed. Seed quality is expressed as the pure line seed content (PLSC)  PLSC=  The higher the figure the higher the seed quality. |

**State the criteria that should be considered when establishing permanent or temporary pastures.**

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| 1. **Adaptability to the environment-** It is important to choose a species that is suitable for the area. 2. **High overall dry matter production per unit area**. - Grasses or legumes chosen must of high levels of yield per hectare. They must respond to fertilizer application. 3. **Compatibility with desired species-** A grass/legume gives better results than stand alone. Climbing legumes (siratro and silver leaf) can grow with taller grasses while stylo and lotononis grow with shorter 4. **High feeding value-** Choose pastures with high crude protein content and maintain the high levels into the dry season. 5. **Continued digestibility of the grasses or legumes-** Choose pasture species that remain green or maintain its juvenile stage into the dry season. They are easily chewable. Palatable and digestible. 6. **Proposed method of utilization of the pasture-** Decide the utilization method of the pasture - for grazing, hay, silage or cut and carry. 7. **High tolerance of waterlogged conditions-** Pastures that tolerate waterlogged dambo conditions are chosen since in Malawi dambo offer the most grazing areas. These pastures should include torpedo, tanner grass, star grass, legume pastures such as lotononis, 8. **Resistance to local pests and diseases-** Siratro resists nematodes**.** 9. **Role of the pasture in the rotation-** Include Katambola Rhodes in tobacco rotation to control nematodes. |

**Explain four activities involved in pasture management.**

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| 1. **Applying the correct type and amount of fertilizer.**   This involves application of fertilizers in already established pasture which is basically top dressing. It is carried out immediately after topping. Topping is the removal of stemmy fibrous materials left after a period of pasture grazing so as to stimulate fresh growth.  Pure stand grass should top- dressed with compound fertilizer 23:21:0+4S at the rate of 100kg/ha and calcium ammonia nitrate (CAN) at the rate of 100-200kg/ha.  Leguminous pasture and stand pasture should be top -dressed with super phosphates at the rate of 100kg/ha.  **State five** **reasons why top-dressing is important in pasture management.**   1. To improve the nutritive value of the pasture. 2. To replenish soil nutrients 3. To increase the total yield of the pasture. 4. To improve the physical characteristics 5. To correct the chemical properties of the soil such as pH. 6. **Weeding the pastureland**   This involves controlling weeds in pasture fields by slashing, use of selective herbicides or by uprooting or by uprooting the weeds.  **Examples of common pasture weeds includes**   1. Thorn apple 2. Sodom apple 3. Lantana/Tickberry   **State five reasons why weeding is important in pasture management.**   1. Weed competes with pastures for nutrients, moisture, space and sunlight which ultimately affect the overall performance of the pastures**.** 2. Weeds interfere with proper pasture establishment thereby prolonging the establishment and maturity period**.** 3. Presence of weeds reduces the quality and overall herbage yields. 4. Some weeds such as Datura such as stramonium may result in livestock poisoning if fed on. 5. Weeds shorten the lifespan of a pasture stand. 6. Some weeds taint the colour and flavor of milk, for example, wild onions**.** 7. **Controlling pests and diseases**   This involves controlling pests of the pasture such as moles, termites’ army worms and aphids. The moles can be controlled by trapping, flooding and use of rodenticides.  Diseases like, rust, which attack grass pasture can be controlled by rogueing.  Rogueing refers uprooting or removal of diseases plants from the soil.   1. **Grazing animals**  * This involves grazing livestock on the pasture. Defoliation refers to the grazing livestock on pasture. Defoliation can be either early defoliation or late defoliation.   **Early defoliation**  Early defoliation is refers to grazing livestock on pasture which are less than four weeks.  **Effects of early defoliation on pasture**   1. Low dry matter yield hence low in nutrients 2. Low crude protein yield 3. High dry matter digestibility but low digestibility nutrients 4. High moisture content 5. Early defoliation leads to gradual weakening of the stand and reduction in the life of the stand.   **Late defoliation**  Late defoliation refers to first grazing of livestock on pasture  **Effects of Late defoliation on the pasture**   1. High cellulose content 2. High dry matter content 3. High lignin content 4. Low crude protein content. 5. Low leaf : Stem ratio hence reduced palatability 6. Low digestibility.   **OVERGRAZING AND UNDERGRAZING**  When grazing the pasture land, controlled light grazing is recommended, Overgrazing and under grazing should be avoided as much as possible  **Limitations of overgrazing**   1. Gradual increase of weeds due to development of bare patches. 2. Pasture crops are gradual weakened 3. General land degradation as soil erosion sets in due to trampling   **Limitations of undergrazing**   1. Leads to wastage of pasture as animal foul graze; that is , they pick some pasture as they trample on the rest. 2. Due to selective grazing by the livestock, pasture gets too woody and unpalatable. 3. Decline in regrowth of pasture. 4. Low growing pasture plants are smothered due to shading effects 5. **Controlling burning of the pasture in the dry season**   At the end of the dry season, controlled burning should be carried out on the pasture**.**  **Benefits of controlled grazing**   1. It removes the dry fibrous herbage so that fresh pasture regrowth may occur 2. It prevents woody shrubs from inhibiting the pastureland 3. It controls parasites like ticks by burning some of the life cycle stages on the ground 4. It controls pests and diseases which might be in the soil. 5. It reduces weed plants not eaten by animals.   **Problems of burning the pasture**   1. It encourages soil erosion 2. It may lead to death of some pasture 3. It causes loss of soil fertility. |

**GRAZING SYSTEMS IN PASTURE MANAGEMENT**

**Explain two main grazing systems.**

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| 1. **Rotational grazing**   Rotational grazing refers to the practice livestock on a part of a pasture (paddock) for some time, down to a certain level after which the animals are moved to another part of the pasture (paddock) so that the time the animals are returned to the first paddock, the pasture will have regenerated**.**  **C:\Users\new\Desktop\cmmm\download (2).png**  **Explain four methods of achieving rotational grazing.**   1. **Paddocking**   Paddocking refers to the grazing of animals in one paddock for a short period usually a few weeks then moving them to another paddock. Paddocking saves on the labour for herding and controls pests and diseases.   1. **Strip grazing**   Strip grazing refers to grazing of animals on a restricted area of the pasture for a time then moving them to new areas after the grass level has gone down. The animals are restricted by use of an electric fence or other temporary.   1. **Herding**   Herding refers to where the herdsperson controls the grazing of animals by confining them to an area of pasture for some time. The animals are then moved to another area after the grass level drops.  In this method, the herdsperson looks after the animals as they graze.   1. **Tethering**   This involves tying an animal to a post with a rope such that the animal feeds within a restricted area (as shown in the figure below). When the grass level within the grazing area is reduced, the animal is moved to another spot.  The limitation of tethering is that it causes pasture wastage through trampling and defecation by the animal.  **State six benefits/advantages of rotational grazing.**   1. Reduces build-up of parasites and diseases as animals do not remain in one grazing area for long. 2. Allows pasture to regrow before being grazed again. 3. Manure is evenly distributed in the field increasing soil fertility hence increased forage production. 4. Excess forage can be conserved. 5. Allows management practices on ungrazed portions such as reseeding, fertilizer applications, weed control, irrigation, parasite and disease control or cutting back. 6. Allows certain species of plants to fruit and form seeds. 7. Pastures have increased resistance to drought as soil covers encourage water conservation in the soil.   **State five disadvantages of rotational grazing.**   1. Animals may not have high milk yield due to much energy spent walking in the grazing fields. 2. Animals may not properly utilize the fields 3. Low returns per unit area 4. Does not allow high stocking rate. 5. There is low accumulation of manure**.** 6. **Zero grazing (stall grazing or cut and carry)**   Under this system, the animals are kept in total confinement where feeds are provided to them**.**  The structure used in housing the animals under this system of grazing is called a stall or a zero-grazing unit.  **State the advantages of zero-grazing/stall feeding.**   1. Under good management, animals have a high milk yield. 2. There is quick accumulation of manure. 3. It is easy to control diseases and parasites. 4. There is little land space requirements that is, it allows high stocking rate. 5. High returns per unit area under good management 6. Animals utilize fodder much better than in pasturage**.**   **State the disadvantages of zero-grazing/stall feeding.**   1. High initial capital is required to establish and put up the animal stalls. 2. Very high level of management skills is required because the farmer provides everything to the animals. 3. It is labour-intensive. Practices such as feeding animals, cleaning the housing unit, observing heat signs for Artificial Insemination etc. 4. There is fast spread of diseases in the stall. |

**PASTURE CONSERVATION**

**Define the term pasture conservation.**

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| Pasture conservation refers to the practice of preserving excess pasture for futureuse |

**Explain three reasons why is it is important to conserve forage +or why is it important to conserve forage**

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| 1. For better and full utilization of available land 2. It ensures availability of livestock feed throughout the year during season. 3. It is a source of income. The conserved pasture may be sold to generate income to the farmer |

**State three methods of forage conservation**

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| Pasture can be preserved through the following forms   1. Hay 2. Silage 3. Standing hay |

**What is hay?**

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| Hay refers to forage crops which have been cut and dried to about 15-20% moisture content so that they can safely be stored without undergoing fermentation and becoming mouldy. Hay can be made from pasture grass and legumes such as desmodium |

**Briefly describe the process of making hay.**

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| 1. Cut the forage crop when 50% of the plants have flowered. 2. Dry the cut crop to about 14-20% moisture content over 2-3 days. 3. Gather the hay and store in a shade out of reach by rain water. 4. Stack the dry material into bales. |

**Explain the factors that affect the quality of hay.**

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| 1. **Pasture species used-** Legumes usually have high crude protein hence are of higher quality than grasses. 2. **Age of pasture at cutting-** Forage has maximum nutrients if harvested when 50% of the plants have flowered. Delay in harvesting leads to a lower nutrient content since the nutrients would have been used in seed setting. 3. **Moisture content-** Hay should be dried to the appropriate moisture content to prevent fermentation which will lower its quality. 4. **Leafiness of pasture-** The higher the leaf stem ratio, the higher the quality the quality. 5. **Method of storage-** The mode of storage should protect the hay from rain water which may result into formation of moulds. 6. **Weather conditions during the dying process-** If rained on, leaching of soluble nutrients is likely to occur. 7. **Presence of foreign material-** The presence of weeds in the hay affects the quality of the hay made. |

**Outline the advantages and disadvantages of using hay.**

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| **Advantages of hay making**   1. It does not require many skills to make. 2. The cut grass is easily dried by sunshine. 3. It does not require a lot labour.   **Disadvantages of hay making**   1. Some nutrients are lost during drying. 2. It requires a lot of space for storage as it is bulky. 3. Drying period is dependent on weather condition. If rained on, leaching of soluble nutrients occurs. |

**What is silage?**

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| Silage is cut forage which is an aerobically fermented and preserved when they are green. It can be stored for a long period of time. The process of silage making is called ensiling and the structure where it is prepared is known as silo. |

**Briefly describe the process of making silage**

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| 1. Prepare a silo. 2. Cut the forage at the appropriate stage of growth 3. Wilt it for 6-12 hours depending on prevailing weather conditions to 65%-75% moisture. 4. Chop the forage into small pieces. 5. Fill the silo, compacting after every 10-12com layer. 6. Fill the silo as rapidly as possible preferably within one day. 7. Check on the temperature regularly during the ensiling period. It should be an average of 31 Degree Celsius**.** 8. Cover the ensiled material with a polythene sheet or a layer of dry grass. 9. Cover the silo with a thick layer of soil to form a concave appearance. 10. Dig a trench around the silo to drain off rainwater. |

**Outline four principles of ensiling.**

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| 1. Aerobic respiration must be reduced as much as possible by compaction and rapid filling. This is because it utilizes the available soluble carbohydrates hence lowering the quantity of nutrients in the silage. 2. When the silo is covered, the oxygen supply is cut off. Aerobic respiration gradually ceases and anaerobic respiration sets in. This leads to rapid increase of Lactobacillus spp bacteria within the first three to four days of covering the silo. 3. Lactobacillus ssp bacteria acts on the readily available carbohydrates, producing lactic acid and trace amounts of acetic, propionic, formic and succinic acids. 4. The increase in lactic acid concentration leads to a reduction in forage pH from 4.0 to 2.0 or even lower. The pH inhibits further bacterial multiplication and growth and hence preserves the silage. The process is complete in 2-3 weeks. The resulting silage material may be preserved for years as long as the silo remains unopened. |

**Explain three types of silo.**

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| 1. **Clamp silo**   It is constructed above the ground level with slanting walls. The sides are made of a pair of timber with soil put in between.   1. **Trench silo**   This is a rectangular excavation done under the ground. Its size depends on the quantity of the material to be ensiled.   1. **Bunker silo**   This is often made of concrete above the ground level. It has perpendicular walls which are suitable for mechanical ensiling. |

**State the qualities or characteristics of good silage.**

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| 1. Should be from high quality forage cut at the proper stage of growth. 2. Should have a pH of 4.2 or below. 3. Should have 5 to 9% of lactic acidic. 4. Should be free of moulds and odour such as that of ammonia and butyric acid. 5. Should be green to yellow in colour in colour but not brown or black. 6. Should have a fine texture but with no slimeness. |

**Explain the factors that affect the quality of silage.**

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| 1. **Age of the crop when cut for ensiling.** Flowering stage is the best when the crop plants have a lot of nutrients. 2. **Pasture species used.** Legumes have higher crude protein hence higher in nutritive value than the pasture grasses. 3. **Moisture content of the forage crop-** High moisture content lowers the quality of silage to sour. Lower moisture content makes the material pack insufficiently in the silo. 4. **Presence of foreign materials-** Addition of water, molasses and grains increases the palatability of the silage. 5. **Extent of compaction-** This affects the temperature in the silo which is crucial for the fermentationprocess. 6. **Filling duration-** Faster filling of a silo is best, as it minimizes loss of nutrients by volatilization 7. **Leaf: stem ratio of the silage material used.-** The higher the ratio, the better the quality as this affects the palatability of the feed. 8. **Method of storage used-** should ensure that all material is well covered to prevent entry of water which may cause mould formation. |

**Explain the advantages and disadvantages of silage making.**

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| **Advantages of silage making**   1. There is minimal loss of nutrients in the preserved feed. 2. It is less dependent on weather conditions for its preparation unlike hay which requires sunshine for drying. 3. Once ensiled, there are no storage problems and silage can therefore be preserved for long. 4. Ensiling kills all weed seeds hence discouraging the spread of weeds.   **Disadvantages of silage making**   1. It requires high level of skills 2. It is labour intensive and expensive 3. It is susceptible to loss of nutrients through seepage and voloatilisation. 4. It is bulky to store and handle. 5. Must be fed soon after removal from the silo or else it spoils. 6. Grass loses original taste. |

**Define the term foggage or standing hay.**

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| It is ungrazed forage left in the field for feeding during dry periods. |

**Explain two advantages and four disadvantages of foggaging or standing hay.**

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| **Advantages of foggaging**   1. No transport or handling costs are incurred. 2. Animals get a healthier diet in its natural form   **Disadvantages of foggaging**   1. The degree of nutrient loss is high especially when the forage is fed on. 2. There are losses through trampling. 3. Herbage quality is low due to overgrown foliage 4. It can only meet the maintenance ration requirements of animals and supplementary feeds should be provided. |

**Explain the factors that affect the quality of conserved pasture.**

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| 1. **Pasture species-** Leguminous pastures are rich in crude proteins than grass. 2. **Digestibility of pasture-** Cultivate pasture have a higher digestibility than natural pasture. 3. **Ratio of legumes to grasses in pasture-** The lower the ratio, the higher the digestibility and usefulness to animals. 4. **Ratio of leaves to stems-** The higher the ratio, the higher the quality. 5. **Stage of growth at which the forage is used-** At the flowering stage, pastures provide the highest nutritive value 6. **Crude protein content of pasture-** Some types of grasses and legumes have varying amounts of crude protein. 7. **Soil fertility-** Level of nutrients present in the soil determines the mineral composition of the pasture. 8. **Toxicity level of the species.-** Certain fodder crops have higher levels of alkaloid chemicals which may lower the palatability of the pasture to animals. 9. **Palatability-** Some pasture species are more palatable than others. |

**TOPIC 13: MANGO PRODUCTION**

**State the importance of fruits.**

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| 1. **Nutritional importance**  * Fruits are sources of vitamins A, B, C, E and others. * Fruits provide minerals such as calcium, magnesium, Iron, zinc, potassium and phosphorus. * Fruits provide plenty of soluble dietary fibre which helps to reduce cholesterol and fats from the body. * Fruits help in detoxification of the human body * They help to cleanse the body especially those with high acid levels such as oranges and pineapples.  1. **Socio-economic importance**  * Fruits can help to generate income and foreign exchange respectively. * Exporting fruits promotes international trade and cooperation amongst trading partners.  1. **Source of raw material for agro-based industries**   Fruit farming provide raw materials for various agro-based such as canning and preservation (fresh fruits), coir industries (coconut) etc.   1. **source of employment**   Agro-based industries that process fruits employ a lot of people either directly or indirectly**.**   1. **They are a good source of laxative effect in our digestive system preventing the likelihood of constipation.** |

**Draw the cross-section of ripe mango.**

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**Identify different mango varieties.**

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| **Variety** | **Characteristics** |
| **Dodo/Maboloma** | The tree is very large, tall with upright growth, dense foliage and small leaves hence difficult to harvest **(disadvantage of dodo).** The seeds are polyembryonic; its fruits are large and fairly oval.  The cultivar has a good resistance to anthracnose but susceptible to powdery mildew |
| **Tommy Atkins** | The tree is large with dense rounded canopy. Its fruits are medium to large, oval to oblong in shape. They are highly resistance to anthracnose and powdery mildew. |
| **Keitt** | The tree is medium sized, moderate vigorous with long arching branches and open canopy. It is a heavy and regular bearer. Its fruits are oval in shape, plump without a beak and a round base. The skin is tough and thick. They are highly resistance to anthracnose and is susceptible to sunburn and bacterial spot. |
| **Sensation** | The tree is vigorous with an open canopy. Its fruits have a rounded apex and show a slight back formation. The seed is mono-embryonic. The cultivar is resistant to bacterial spot and gives high yields. |
| **Haden** | The tree is quite large and spreading. Its fruits are medium to large sized with an average length of 10cm and 8cm with. The seed is mono-embryonic.  It is suitable fot hot dry areas  The fruit is well coloured with excellent flavour.  The tree is susceptible to anthracnose and moderate resistance to Powdery Mildew. |
| **Kent** | The tree is large, vigorously growing with a dense upright canopy. The seed is mono-embryonic. The fruit shape is regular ovate with a rounded base with two slight beaks. |
| **Irwin** | Trees are moderately vigorously growers, developing open canopies. Its fruit is ovate in shape, with rounded base and a pointed apex lacking a beak. |
| **Zill** | The trees are vigorous growers that develop large spreading canopies. The fruit is oval in shape with a rounded apex and contains a small beak. Its fruit has mono-embryonic seeds. |
| **Van Dyke** | The trees are large and vigorous. The fruit is medium to large, nearly round in shape. The fruit has great resistance to anthracnose and powdery. |
| **Apple** | Trees are large and vigorous. The fruit is medium to large, nearly round in shape. The fruit is susceptible to anthracnose and has powdery mildew. |
| **Anderson** | It is large in size. It skin is thick and has a green to yellow colour. It is suitable for canning. |

**What are the factors that are considered when selecting site for mango production?**

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| 1. **Type of soil**   Mangoes do well in a range of soil types, from light sandy loams to red clays with a pH range of 5.5 -7.5. The soils should be deep, fertile and well drained.   1. **Temperature**   Mangoes do well in areas with temperatures between 25 Degree Celsius - 24 Degree Celsius and they do not tolerate frost.   1. **Altitude**   They do well from sea level up to 1200 m above sea level.   1. **Water supply**   They require about 600 mm-1500 mm of rainfall per year which is well distributed. Mangoes require a dry period at the time of flowering and sufficient heat during the fruit ripening period. Frequent rains or high humidity. Frequent rains or high humidity during the flowering period increases incidences of powdery mildew and anthracnose diseases hence not suitable for fruit setting.   1. **Soil depth**   The soil depth should be deep to allow extensive roots development. A deep, fertile, sandy loam soil that drains well.   1. **Well drained**   Soil should be free of water-logging. It should be of low water table.   1. **Fertile soil-** A fertile soil should be selected for mango production. 2. **Salinity**- Mangoes have a low tolerance to salts**.** 3. **Ph optimum pH is 5.5 - 7.5.** |

**Explain how a land for mango production is prepared.**

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| 1. Clear the land and carry out primary cultivation during the dry season. This ensures perennial weeds are controlled. 2. Make planting holes 60cm x 60cm x 100cm in wet areas while in dry areas dig 90cm x 90cm x 100cm deep. The holes should be prepared early enough to allow weathering of the soil. 3. Separate the top soil and subsoil as the hole is dug. Mix the topsoil with about 20kg of well decomposed manure and 1kg of triple super phosphate fertilizer, return this to the hole. The subsoil is spread around the hole to form a basin for water conservation. 4. Space the holes 8m x 8m to 14m depending on the variety’s growth habit. |

**Describe the procedure for transplanting mango seedlings.**

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| The following activities are carried out during transplanting of mango seedlings   1. Transplant the seedlings when 6-8 cm long 2. Water seedlings before transplanting so that the soil particles remain held together at the roots. 3. Plant at the beginning of the rainy season 4. Care should be taken when handling plants so as not to cause damage to shoots, buds or bark 5. Using a sharp knife cut and remove the polythene pot. 6. Prune back roots, especially those circular roots. This stimulates new root development once in the ground. 7. Plant the seedling at the centre of the hole. 8. Plant to the depth of the root collar( to the level of existing nursery soil) 9. Press the soil firmly around the root zone. 10. Place mulching material especially inorganic mulch. 11. Regular watering especially in the first year will help the trees to survive. |

**Outline two weed control methods in a mango orchard**

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| 1. Mechanical method through digging them up and mulching 2. Chemical method by using herbicides such as glyphosate. |

**PEST OF MANGOES**

**State three pests of mangoes.**

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| 1. Mango weevil 2. Mango scales 3. Fruit flies |

**SUGNS AND CONTROL OF PESTS OF MANGOES.**

1. **FRUIT FLY**

**Outline the signs of mango scales in a mango crop.**

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| SIGNS OF ATTACK | Small spots on the skin of the fruits |

**Give three control measures of fruit fly**

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| **Control of Fruit fly** | * Collect all fallen fruits. twice s week during the fruit season and burn or bury at least 50cm depths * Eradicate all non-economic host plants such as neglected citrus, guavas, hot and sweet papers. * Remove fruits with dimples and those that ooze clear sap. * Use fruit traps to reduce their population * Regular use of poison baits. |

1. **MANGO SCALES**

**Outline the signs of mango scales in a mango crop. State how cam mango scales be controlled.**

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| **Signs of attack** | * Infected trees have poor growth * It causes die back of branches and eventually fruits drop off * Soft scales excrete honey dew causing growth of sooty mould * In heavy infections ,leaves turn black |
| **Control of Mango scales** | * Naturally, biological agents like parasitic wasps, ladybird, beetles and lacewings control scales * Spray appropriate insecticides such as bifenthion |

1. **Mango stone weevil**

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| **Signs**  They cause premature fall of the fruits or rotting in store.  **Control**   * Proper disposal of the fallen fruits like picking them and burying them * Burning fallen fruits so that the larva will not mature. |

**DISEASES OF MANGOES**

1. **ANTHRACNOSE**

**Identify the cause of anthracnose disease of mangoes.**

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| **It is caused by fungus** |

**Outline two signs of a mango tree attacked by anthracnose disease.**

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| * Infected flowers usually wither and die before fruits form * Infections on leaves results into leaf spots that grow to form an irregular patch. * Rotting of fruits * Fruits are bitter and sugarless |

**Describe two control measures of anthracnose disease in a mango orchard.**

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| * Use tolerant varieties. Tommy Atkins is more resistant to anthracnose compared to Haden and Sensation. * Remove dead branches, twigs and dead leaves and destroy. * Spray appropriate copper fungicides such as, Benoml, mancozeb starting at the stage of flower bud formation, flowering and fruit setting until the fruits have developed to half |

1. **POWDERY MILDEW**

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| Causes of Powdery | It is caused by Fungus |
| **Signs of Powdery Mildew** | It forms white powdery growth on leaves, flowers and young fruits |
| **Control measures** | * Plant mango varieties which are intolerant to mildew. Resistant varieties include Sensation, and Tommy * Spraying fungicides like kerathane and Benoml. |

**TOPIC 14: CATTLE PRODUCTION**

**List two main categories of cattle depending on the region of their origin.**

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| 1. **Indigenous/ local cattle**   These are cattle whose origin is within the tropics and are well adapted to the tropical climate characterized by high temperatures and little rainfall.  Examples of indigenous cattle are   1. Malawi Zebu 2. Brahman 3. Afrikander 4. Boran 5. **Exotic/Temperate cattle**   These are cattle originated outside the tropics. They are mostly adapted for cool climatic conditions.  Examples of exotic breeds include   1. Friesian 2. Jersey 3. Aryshire 4. Guernsey 5. Hereford etc |

**Explain the differences between indigenous and exotic breeds of cattle.**

|  |  |
| --- | --- |
| **Exotic** | **Indigenous cattle** |
| * Have no humps | * Have humps which store fat |
| * Adults are relatively large | * Adults are relatively small |
| * Have short and wide head | * Long and narrow head |
| * Skin is thin and tight on the body | * Skin is thick and loose falling in folds |
| * Susceptible to tropical diseases | * Tolerant to tropical diseases |
| * Mature early | * Mature late |
| * Produce a lot of milk | * Produces less milk |
| * Cannot walk long distances in search of water and pasture without lowering production | * can walk long distances in search of water and pasture without lowering production |
| * Have a short calving interval | * Have a long calving interval |
| * Have a long lactation period | * Have a short lactation period |

**BREEDS OF CATTLE**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Purpose** | **Beef breeds reared in Malawi** | **Origin** |
| Beef breeds | are kept for met | Hereford | United Kingdom |
|  |  | Charolais | France |
|  |  | Boran | Kenya |
|  |  | Afrikander | South Africa |
|  |  | Brahman | India |
|  |  | Malawi Zebu | Indigenous |
|  |  | Simmental | Switzerland |
| **Exotic breeds** | **Purpose** | **Dairy breeds kept in Malawi** | **Origin** |
|  | kept for milk | Friesian | Holland |
|  |  | Guernsey | England |
|  |  | Jersey | England |
|  |  | Aryshire | Scotland |

**State the differences between dairy cattle and beef cattle.**

|  |  |
| --- | --- |
| **Dairy cattle** | **Beef cattle** |
| * Have a wedge/triangular shape | * Have a block/cyndrical shape |
| * Have a large and well developed udder | * Udder is relatively small in size |
| * Body less meaty | * Have well fleshed body |
| * Have a long lean neck | * Have a short neck |
| * Most are poor grazers | * Most are good grazers |
| * Less tolerant to high temperatures | * Most can tolerate high temperature |
| * Have a large abdomen | * Have a small abdomen. |
| * They are usually docile and of mild temperament | * They are relatively aggressive |
| * Legs are relatively long | * Have short strong legs |
| * Less resistance to diseases | * More susceptible to diseases |

**Describe characteristics of cattle dairy production**

|  |
| --- |
| * Have a wedge/triangular shape |
| * Have a large and well developed udder |
| * Body less meaty |
| * Have a long lean neck |
| * Most are poor grazers |
| * Less tolerant to high temperatures |
| * Have a large abdomen |
| * They are usually docile and of mild temperament |
| * Legs are relatively long |
| * Less resistance to diseases |

**Describe characteristics of cattle beef production.**

|  |
| --- |
| * Have a block/cyndrical shape |
| * Udder is relatively small in size |
| * Have well fleshed body |
| * Have a short neck |
| * Most are good grazers |
| * Most can tolerate high temperature |
| * Have a small abdomen. |
| * They are relatively aggressive |
| * Have short strong legs |
| * More susceptible to diseases |

**Describe four observable characteristics of cattle breeds kept for dairy.**

|  |
| --- |
| 1. The Legs are short and strong 2. Have a large abdomen 3. Have a wedge/triangular shape 4. Have a large and well developed udder 5. Have a long lean neck 6. Wide and well set hind quarters 7. Docile and mild temperament for easy handling during milking. 8. Thin body which carries little fresh and its pain bones are visible. |

**Describe the observable characteristics of cattle for beef production.**

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| 1. They are rectangular or square shaped referred to as blocky. 2. Have short strong legs 3. The body is compact and deep 4. The animal grows fast and mature quickly 5. They have heavy bodies with a lot of fresh 6. Udder is relatively small in size 7. Have a small abdomen. 8. Have a short neck 9. Deep chest and girth 10. Breed regularly 11. They are good foragers 12. Tolerant to high ambient temperature 13. High ability to convert pastures to high quality beef |

**Characteristics of cattle breeds for dairy**

1. **Friesian**

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| * It is originated from Holland * They are black and white in colour. The tail switch, legs and forehead are white * They are larger than other breeds   **Characteristics of Friesian cattle**   * They are wedge shaped * They are docile but the bulls can be vicious depending on management * They are poor grazers * They are tolerant to cold but not heat. * They produce the largest quantity of milk about 9000 kg of milk on average lactation of 305 days, that is, 30 litres per day. * It has 3.5% butterfat content in milk. * It is ideal for upgrading indigenous   The figure below shows Jersey below: |

**Aryshire**

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| --- |
| * It is originated from Holland and the bulls weigh 700kg   **Characteristics of Aryshire**   * Cows have straight top lines level rumps and good udders. * Horns are long and face upwards * The neck is thicker and shorter than in other breeds * Can withstand heat much better than Friesian because of the lighter coat colour. * Teats are small and well spaced * It produces about 6,000 kg of milk per lactation. The milk has 4% butterfat content in milk. * They are hardy and can feed on poor pasture. * Figure shows a picture of an Aryshire. |

**Guernsey**

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| * It is originated from Guernsey Island off the coast of France. * Bulls weigh 700kg live weight   **Characteristics of Guernsey**   * Good for milk production * Fairly hard and toralate * Udders are less symmetrical than those of Jersey * They are quite and easy to handle. * They produce about 5,000kg per lactation. * They are good grazers * Figure shows a picture of Guernsey cow and its calf |

Jersey

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| * It is originated from English Channel in England. * The bull weighs 600kg live weight.   **Characteristics of Jersey cattle**   * They have a straight top line, level rumps and forehead * They have sharp withers. * Their eyes are prominent * They are excellent grazers on poor pasture. * They are nervous and sensitive. * They are resistant to high temperature. * They produce milk yield about 4,000kg per lactation of 305 days. * The colour of the milk is yellow. The milk has a butter content of 5%-5.3% * Bulls are aggressive and vicious * Figure shows a picture of Jersey bull |

**CHARACTERISTICS OF CATTLE BREEDS FOR BEEF PRODUCTION**

1. **Malawi Zebu**

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| * This is an indigenous breed of cattle in Malawi. * It has small body size * It has slow growth rate * It has long calving intervals of up to 540 days. * It is black, brown or white colour. |

1. **Hereford**

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| * It is originated from Herefordshire in England. * The bull weighs 1000kg live weight. |

**MANAGEMENT PRACTICES FOR BEEF AND DAIRY PRODUCTION**

**Explain two management systems which are used in beef cattle in Malawi.**

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| 1. **Extensive system**   Under this system, beef cattle are grazed on communal grazing fields. The animals are attended by herd boys or girls to grazing areas to the dambo areas where there is good, fresh grass.  Ranching is another form of extensive system in Malawi. Ranching involves grazing animals freely in the large farms.  **Examples of ranching in Malawi include**   1. Dzalanyama ranch in Lilongwe 2. Kuti in Salima 3. Beef cattle ranch in Chikwawa and Nsanje.   **Advantage o**f **extensive system**   1. It is cheap to keep the animals on communal land   **Disadvantages of extensive system**   1. It is difficult to control diseases and parasites 2. Too many cattle may be in a small area, this leads to land degradation and overgrazing. 3. Animals take time to reach slaughter weight since animals walk from place to place looking for grass and water. Energy is lost in the process hence productivity is therefore very law 4. **Intensive system**   Under this system, the beef cattle are kept in feedlots or grazed in paddocks where grazing is practiced.  **Examples of intensive system**   1. **Rotational grazing** - Allows the grass to grow and checks the buildup of parasites and disease -causing organisms. 2. **Stall feeding**- This is where animals are intensively feed on concentrates, crop residues, agricultural by-products, grass and minerals   **Advantages of intensive system**   1. The animals are fattening up quickly since animal movement is restricted. 2. Disease and parasites control is easier.   **Disadvantages of intensive system**   1. System is more expensive. 2. Labour intensive. |

**Define the term finishing up.**

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| This is the practice of giving concentrates to beef cattle during the last three to four weeks to slaughter to ensure that the young steers reach the required weight for slaughter. |

**MANAGING DAIRY COWS**

**Explain the factors that affect milk yield in the dairy cows.**

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| 1. **The breed itself-** 2. **Milking techniques** It is important that it is completed within eight to ten minutes as this coincides with the milk-let down period. Avoid over milking and under milking. 3. **Age of the cow.** - Milk yield increases with each calving up to the fifth lactation. 4. **Health o the cow- Dairy animals should be in good health.** Diseases such as Mastitis and milk fever affect the quantity and quality of milk produced. 5. **Character of the cow-** A dairy cow should have a quite temperament. Highly irritable cows tend to give less milk. 6. **Nutrition of the animal-** Dairy cows feed for maintenance and production. Fresh grass should be supplemented with crop residues and concentrates to ensure adequate milk production. 7. **Season /time of the year-** It is important to plan mating so that calving takes place when there is plenty of fresh grass. This is important for the growth and development of the calf and to enable the cow to produce enough milk. 8. **Treatment of the** cow - Lactating cows have to be treated gently to avoid holding milk yield. 9. **Period of Lactation -** A ‘lactation curve’ shows what happens to the yield of milk from the calving day. After 305 days the cow dries off. 10. **Milking frequency - It** is recommended that cows be milked twice a day. |

**Describe management practices of cattle breeds for beef and dairy production.**

1. **Housing**

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| * Cattle need proper housing to protect them against adverse environment against adverse environmental conditions. * Dairy cattle require an extra housing structure for milking (dairy or milking paralour) * A proper housing unit protects the animal against rain, cold and predators, especially carnivores. |

**What are the characteristic of the good house for cattle?**

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| 1. **It** should have several sections which include: 2. Night shade 3. Calf pen fitted with a feed and water trough 4. Milking section 5. Feed and equipment store 6. It should be easy to clean to prevent accumulation of dust. 7. It should be spacious 8. It should be well ventilated to prevent infection. 9. It should be durable 10. It should be economical to construct. 11. It should be well lit. 12. It should be well drained. |

**State the requirements for a suitable house for stall feeding beef cattle.**

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| 1. It should be sited on a well-drained ground. 2. It should be well thatched. 3. There should be enough bedding on the floor. 4. It should be well-ventilated and roomy. |

**What are the four requirements of a good house for cattle?**

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| Itshould provide room for   1. Sleeping 2. Feeding 3. Milking 4. Sun bushing |

1. **Feeding**

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| 1. **Roughages**  * The main feed for cattle is roughages. Roughages have high fibre content. * Roughages are divided into succulent and dry roughages. * **Succulent roughages** have high moisture content. Examples of succulent roughages include fresh pasture, fresh fodder, silent and any material freshly cut and fed to livestock. * Dry roughages have low moisture content. Examples of dry roughages are hay, wheat straw, barley, maize and any other dried plant material.  1. **Concentrates**  * Concentrates are commercially prepared feeds usually with a high level of nutrients per unit weight. Concentrates have low moisture content and hence they are not the main feed for cattle. |

**Describe the suitable feed for cattle.**

|  |
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| The suitable feed for cattle is roughages. Roughages have high fibre content.   * Roughages are divided into succulent and dry roughages. * **Succulent roughages** have high moisture content. Examples of succulent roughages include fresh pasture, fresh fodder, silent and any material freshly cut and fed to livestock. * Dry roughages have low moisture content. Examples of dry roughages are hay, wheat straw, barley, maize and any other dried plant material. |

**Describe the conditions under which the animals can be fed on concentrates**.

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| 1. **When young-** This is because their digestive system is not fully developed hence cannot be able to handle large amounts of roughages.   An example is calf pellets**.**   * **Calf pellets** are special feeds for calves as they are rich in nutrients and also have a high digestibility**.**  1. **Lactating cow**- They can also be fed on concentrates to boost milk production. Examples of concentrates given to lactating cows include cotton seed cake, groundnut seed cake and bran. 2. **Sick animals** - They may be given concentrates to hasten the recovery process. 3. **During the dry season**- concentrates may be given to cattle so as to supplement the roughage. 4. **During pregnancy**- Dairy cows are given high quality concentrates 6-8 weeks before calving.   **Steaming up** is the practice of giving concentrates to dairy cows 6-8 weeks before calving. |

**What is colostrum?**

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| It is the first milk produced by the cow after giving birth and the calf continues taking it for the next 4-5days**.** |

**Explain for importance of colostrums to the calf.**

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| 1. **It** contains antibodies which are necessary for body immunity. 2. It is more nutriuous than the milk a cow produces after the colostrums. Colostrums is rich in proteins, vitamins, minerals and fat. 3. Its digestibility is high and therefore suitable for calves whose digestive systems are not yet ready for solid feeds. |

**Define the term ‘flushing”.**

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| It refers to the practice of giving concentrates to the cow two months after calving to induce heat period in a cow. |

1. **Mention four common diseases that affect cattle in Malawi.**

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| 1. **Protozoan diseases** - These include East Cost Fever, Anaplasmosis and Nangana/Trypanosomiasis. 2. **Viral diseases -** Foot and Mouth disease, rinderpest and lumpy skin disease. 3. **Bacteria disease-** These include Black quarter, tuberculosis, anthrax and mastitis 4. **Nutritional diseases- These** include Bloat and Milk Fever. |

**EAST COST FEVER**

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| --- | --- |
| **Causes** | East Coast Fever is called by a protozoa Theileria parva |
| **Transmission** | It is transmitted by the brown tick |
| **Signs and Symptoms** | 1. High fever about 41 degree Celsius 2. Swollen lymph nodes which appear around the ear then spread to other parts of the body. 3. Difficulty in breathing in the late stages of the diseases. 4. Nasal discharge and characteristics cough due to oedema in the lungs 5. The animal isolates itself from the others 6. Rough coat 7. Flow of tears 8. Anemic condition occurs |
| **Control** | 1. Regular spraying or dipping using appropriate acaricides to control ticks 2. Fencing of the farm to keep away stray animals which may carry ticks with them |
| **Treatment** | Use appropriate drugs such as Butalex and Clexon. |

**BRUCELLOSIS**

|  |  |  |
| --- | --- | --- |
| **CAUSES** | **Caused by ingestion** |  |
| **Symptoms** |  | Profuse sweating-  Absorption in pregnant cows  Swollen testes in bulls  Inflammmation**-** |

**GALLSICKNESS/ANAPLASMOSIS**

|  |  |
| --- | --- |
| **Causes** | Gall Sickness is caused by the **protozoa *Anaplasma marginale.*** |
| **Transmission** | It is transmitted by biting insects such as mosquitoes, flies and mechanically through contaminated surgical instruments. |
| **Signs and symptoms** | 1. Animal develops fever that is a rise in body temperature. 2. The animal develops constipation or release hard dung. 3. Mucous membranes become pale and in some cases jaundiced due to anaemia 4. Fast breathing and fast heart beat. 5. No rumen movement that is no chewing of cud. 6. The animal produces yellow urine. |
| **Control** | 1. Dipping or spraying the animal to control ticks 2. control biting insects 3. Using clean surgical instruments when carrying out operations such as castration. |
| **Treatment** | Intramuscular injection of antibiotics and iron injections like iron dextram. |

**TRYPANOSOMIASIS**

|  |  |
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| **Causes** | * It is caused by a protozoa of Trypanosoma spp**.** |
| **Transmission/vector** | * It is transmitted by tsetse flies. * It can also be transmitted by other biting insects and contaminated syringes |
| **Symptoms/signs** | 1. Staring coat 2. Enlargement of superficial lymph nodes 3. Chronic loss of body condition in that the animal losses appetite 4. The animal gets exhausted and very weak 5. Anaemic conditions occur with a tendency of the animal to lick and eat soil. 6. Loss of hair at the tail switch 7. Belly region becomes 8. Fast breathing 9. Intermittent fever |
| **Control measures** | 1. Effective control of testes flies which acts as a disease transmitting vector. 2. Confinement of game animals in game animals in game parks as these act as these act as alternate hosts for the disease vectors. 3. Breeding trypano-resistant animals. |
| Treatment | * Use appropriate drugs such as Novdium, Berenil, Evidium or any other trypananocidals. |

**Mention the diseases that are caused by the virus that attack cattle.**

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| These include   1. Rinderpest 2. Foot and Mouth disease 3. Lumpy Skin disease |

**RINDERPEST**

|  |  |
| --- | --- |
| **causes** | A virus called Paramyxo virus |
| **Transmission** | It is transmitted by direct contact, discharges on beddings or containers , ingestion or inhalation |
| **Signs of rinderpest** | * Rapid rise in temperature * mucous membranes of the mouth and nose become red-hot and painful * dry and cracked muzzle * smelly ulcers develop in the mouth and nose * labored breathing and persistent cough * Profuse diarrhea * Eye and nasal discharge * Animals grind their teeth * Staring coat * Death in 2 - 10 days. |
| **Control measures** | * Imposition of quarantine in cases of outbreak * Vaccination of all animals that is more than one year old. * Kill the entire infected animal and dispose off their carcasses. * Disinfect animal houses * Isolate the sick animal |
| **Treatment** | Giving antibiotics to the sick animals |

**FOOT AND MOUTH DISEASE**

|  |  |
| --- | --- |
| **Causes** | It is caused by a virus Enterovirus |
| **Transmission** | The virus can be transmitted by contaminated litter, machinery, garbage, feet and syringes |
| **Signs** | * High fever which lasts for only a few hours * Profuse and continuous salivation * Blisters form in the mouth, muzzle, teats, udder etc * Kicking of feet * Lameness due to vesicle formation in the interdigital space and coronet**.** * Great reduction in milk production * Inflammation of tongue, lips and gums making it difficult for the animals to eat. |
| **Control** | * Imposition of quarantine in cases of outbreaks * Vaccinating the animals every six months * Disinfect the animal’s hooves. * Slaughter, burn and bury infected animals |
| **Treatment** | * Giving antibiotics to the animal. |

**LUMPY SKIN DISEASE**

|  |  |
| --- | --- |
| **Causes** | * Virus |
| **Transmission** | * Fever * Skin lumps covering the whole day * Emaciation * Milk production ceases * Low mortality |
| **Control** | * Vaccination * Quarantine * Vector control |
| **Treatment** | * Animals generally recover with good nursing care**.** * Antibiotics for secondary infections are administered |

**BACTERIAL DISEASES**

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| Thefollowing are the diseases that attack cattle and are caused.   1. Black quarter 2. Tuberculosis 3. Anthrax 4. Mastitis |

**BLACK QUARTER**

|  |  |
| --- | --- |
| **Causes** | It is caused by a bacterium called Clostridium |
| **Transmission** | * Rise in body temperature * Grunting and grinding of teeth by the animal * Acute lameness of the hind legs. * loss of appetite * Death occur 12-48houtds * Black meal which has a sweet smell in the high * Animal stopped cud |
| **Control** | * Regular vaccination of young stock at six months interval. * Quarantine the livestock of the physically of the an * Do not open the carcass of the animals that have died of the disease. |
| **Treatment** | * Treat the disease with antibiotics such as penicillin, tetracycline |

**TUBERCULOSIS**

|  |  |
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| **Cause** | It iscaused by the bacterium known as **Mycobacterium bovis.** |
| **Transmission** | Inhalation of droplets containing the bacteria in the adult cattle and can also be taken with contaminated milk in young calves. |
| **Signs** | * Respiratory problems * Coughing * Swelling of lymph nodes at the junction of the neck and head around the throat. * The animal appears dull and lose appetite. |
| **Control** | * Carry out quarantine measures * Slaughter and properly dispose of the infected stock. |

**ANTHRAX**

**Describe the causes anthrax disease, signs of anthrax and what measures should a factor carry out to control anthrax disease in cattle.**

|  |  |
| --- | --- |
| **Causes** | **It** is caused by bacteria such as Streptococcus spp, Staphylococcus spp and Psteurella spp. |
| **Signs** | * High fever * shivering * Difficulty in breathing * Blood stains in faeces and milk * Dysentry, that is bloody diarrhoea * Absence of stiffening of the carcass upon death * Extensive bloating after death |
| **Control** | * Proper disposal of the carcass by burying deep about 2m * Imposition of quarantine in case of an outbreak * routine vaccination yearly * Disinfect the animal house * Giving ant-anthrax serum to the affected animals |

**MASTITIS**

**Describe the causes anthrax disease, signs of mastitis disease and what measures should a factor carry out to control anthrax disease in his dairy breed cattle.**

|  |  |
| --- | --- |
| **It is an infectious disease of mammary glands** | |
| Cause | It is caused by bacteria known as Streptococcus spp, Staphylococcus spp and Pasteurella spp |
| Signs | * Blood clots or pus in milk * Pain in the udder or teats during milking * Swollen or inflamed udder * Rise in the body temperature. * Clots in milk or milk appearing as a clear liquid. * Drop in milk yield. * Blocked teat canal * Rapid and weak pulse. |
| **Control** | * Practice harm hygiene * Immediate farm treatment of infected cow top avoid spreading it to healthy cows * Test for mastitis before milking to avoid it spreading to healthy cows. * Applying milking jelly or milking salve after milking to prevent drying and cracking of teats. * Cull those animal which do not respond to treatments * Vaccinate the animals against mastitis one a year. |
| Treatment | Administer anti-mastitis drugs or antibiotics such as Tetracycline.  If udder is inflamed, give corticosteroids |

**NUTRITIONAL DISEASES**

**Mention two nutritional diseases that attack the cattle.**

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| The two nutritional disease that attack the cattle are   1. Milk fever- Affect t dairy cows 2. Bloat |

**MILK FEVER/PASTURIENT PARESIS**

**Describe the causes, signs and effects of Milk fever disease in cattle. What measures should a farmer carry out to control milk fever disease in his cattle breed?**

|  |  |
| --- | --- |
| **Causes** | It is caused by low calcium in the blood |
| **Signs** | * Muscular twitching causing the animal to tremble * Staggering as the animal moves. * Inability to stand. The animal lies down on its side most of the time. * Dull and starring eyes with dilated pupils. * Extremeties feel cold to tough. * The animal lies on the sternum with its neck twisted on one side. * The body temperature falls. * General paralysis. The animal’s body functions such as urination, defaecation and milk production stops. This is followed by death. |
| **Control** | * Deed animals on a diet rich in calcium especially during pregnancy and early lactating period. * Give intramuscular injection of calcium 2-3 days before calving. * Cull susceptible animals |
| **Treatment** | * Injection of calcium borogluconate solution intravenously, calfojet. * Pump air into the udder to limit milk synthesis. |

**BLOAT/TAMPANITES**

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| Bloat is a condition in which gases accumulate in the rumen due to rapid fermentation of the feed eaten by the animal. The rumen becomes so distended that it compresses the lungs and other internal organs. It may result to death. |

**Explain three ways how the bloat disease is caused.**

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| 1. Feeding animals on large amounts of legume and lush forage such as cabbage leaves and lush grass. 2. Blockade of oesophagus by large food particles such as potatoes and carrots. 3. Injury to the nerve supply of the rumen causing paralysis of the rumen. 4. Abrupt change in feeds given to animals from very dry feeds to very succulents |

**State five signs of bloat disease.**

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| 1. Difficulty in breathing 2. Profuse salivation 3. The animal lies down and is unable to rise up. 4. Grunting and kicking at the belly 5. Death occurs within hours due to the pressure on blood vessels, heart and lungs. |

**Mention two ways of controlling bloat disease**.

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| --- |
| 1. Provide roughages just before best the animal 2. Give feed livestock on wilted grasses ANR poppa |

**HOW TO CONTROL CATTLE DISEASES**

**Explain how does each of the following help to control diseases of the cattle.**

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| 1. **Vaccination**   This means introduction of disease causing organisms which are less pathogenic with an aim of inducing the body to produce antibodies to fight against them. The animals develop immunity.  **Immunity** is the ability of an animal to fight infection by itself  **TYPES OF IMMUNITY**   1. **Natural immunity**- This is immunity acquired by an animal that was infected by disease and has recovered. Antibodies remain in its body waiting for the same pathogens. 2. **Artificial immunity**- This is immunity an animal acquires through vaccination. 3. **Natural passive immunity**- This is immunity acquired by a calf when it takes the first milk called colostrums from its mother. The colostrums contains antibodies which are passed from the mother into the calf’s blood stream/ 4. **Quarantine-** This is a method of excluding an enzootic area whenever there is an outbreak of disease so that does not remains in that area without crossing to new areas where it has never existed before. 5. **Isolation -** This is a method of keeping an infected animal away from the rest until the infection has been treated. The aim is to prevent spreading to the healthy ones through contamination of feed, water and the floor. 6. **Slaughter-** This method of dealing with the diseases that has no treatment or the treatment is not cost effective. The infected animal is slaughtered to ease the suffering of the infected animal. Examples of the diseases will be used are Foot and Mouth disease East Coast Fever etc. 7. **Control of vectors - this** controlling the diseases by destroying vectors in the life cycle. |

**PARASITES**

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| Parasites are organisms which derive part or all their nourishments from other orhaisms. |

**Mention two common external parasites of cattle.**

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| These include (a) Ticks  (b) Tsetse flies**.** |

**Draw the tick life cycle**

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| **C:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\images.jpgC:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\Typical-three-host-life-cycle-of-a-female-Ixodid-hard-tick-Source-Apanaskevich-and.png** |

**Describe the types of ticks, signs of attack, effects of tick attack on hosts and how can they be controlled.**

|  |  |
| --- | --- |
| **Where do you they attack** | * External parasites. They are found on or under the skin of the host’s body. |
| **Types of ticks**  **The figure below shows a tick** | * These include  1. **Soft ticks**  * They have a tough leathery outer coating  1. **Hard ticks**  * They have a hard, shield-like covering at the upper surface in males. * The females have a small area behind the head. |
| **Signs of attack** | * presence of ticks on or under the skin of the animal’s body * loss of fur * Irritation of the skin * sores or wounds on the skin * Emaciation * Wounds on the skin |
| **Effects of attack on livestock** | * They transmit East Coast Fever disease in cattle * They cause anaemia and damage the skin |
| **Ways of controlling ticks** | 1. **Hand dressing**   This involves the application of chemicals known as acaricides by hand where spraywash may not reach that is in the inner grooves of ears by use of pyegrease**.**   1. **Fencing**   This involves enclosing the farm by a fence which restricts movement of animals thus minimizing the spread of ticks. Double fencing and use of zero grazing units ensure effective tick control.   1. **Rotational grazing**   This reduces the build-up of ticks in pasture**.**   1. **Burning of infected pasture**   This method destroys adult ticks, their eggs, moulting larvae and the nymphs in range lands.   1. **Ploughing the land**   This method buries ticks deeply on the ground thus rendering them unable to live.   1. Dipping the animals to kill the adult ticks |

**TSETSE FLIES**

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| Tsetse flies are blood-sucking insects which mainly inhabit bushy areas and certain shade trees. They are vector or transmit trypanosomiasis disease (nagana) in livestock.  The diagram below shows the tsetse flies |

**Describe effects of tsetse flies attack on cattle, signs of attack and how can they be controlled.**

|  |  |
| --- | --- |
| **Effect of tsetse flies attack** | Transmit trypanosomiasis disease (nagana) in livestock |
| **Signs of tsetse flies attack** | * loss of fur * Irritation of the skin * sores or wounds on the skin * Emaciation * Loss of production * The animals feel weak due to loss of blood to tsetse fly. |
| **How to control tsetse flies** | * Clearing the bushes in areas infested by tsetse flies. * Spraying the infested vegetation with appropriate insecticides * Sterilization of the male tsetse flies by use of chemicals * Trapping of the flies using special nets with appropriate chemicals * Creating buffer zones near Game reserves * Slaughtering the infected animal |

**INTERNAL/ENDOPARASITES OF CATTLE**

**Describe the internal parasites of cattle.**

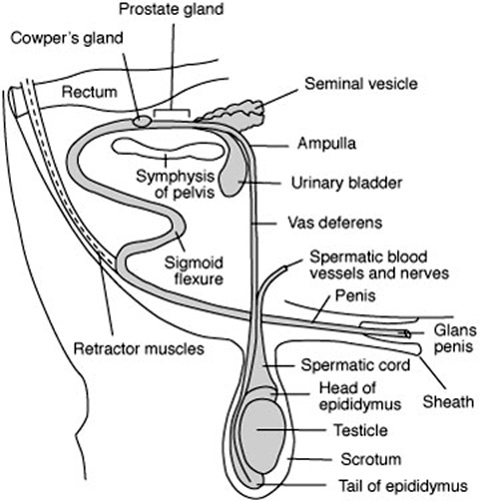
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| --- |
| The internal parasites that attack cattle are divide into two   1. Flat worms such as **liver flukes**     They are grouped into two   1. **Trematodes**  * These are flat worms with flattened dorso-ventral bodies that is the back and belly are close together. * Examples of trematodes are liver fluke which attack cattle and sheep * The figure below shows parts of the liver fluke. It has two suckers, one in the centre of the conical projection and the other on the ventral surface close to the conical projection * Liver flukes are prevalent in low-lying, wet marshy lands or areas prone to flooding.   **Effects of liver fluke attack on cattle and sheep**   * + They cause a disease called fasciolassis or distomatosis   **Signs of attack by liver fluke**   * + Digestive upsets due to blocking of bile duct   + Swollen abdomen   + Emanciation and in extreme cases, recumbency leading to death   + Anaemia occurs as a result of the destruction of liver tissues   + Oedema in the jaws ( swollen lower jaws)   + Retarded growth in calves with thrifty skin   **Control measures of liver fluke**   * Routine drenching by use of appropriate drugs such as antihelminthic drugs * Destroying water snails by treating swampy water with copper sulphate * Fencing off heavily infested swampy areas to prevent farm animals from grazing in such infested areas. * Draining swampy areas within the farm * Practice rotational grazing in order to defer the animal from the grazing land.  1. **Cestodes**   This group of flatworms has body sections with complete reproductive organs. An example is a tape worm  A tapeworm consists of a head called **(scolex)** and a chain of body segments referred to as **strobila.**The scolex possesses suckers and hooks for attachment onto the host**.**  The two most common tapeworm species that affect livestock are   1. **Taenia saginata**- affects cattle only 2. **Taenia solium** - affects pigs only   **Signs of tapeworm attack**   * Rough hair coat * Digestive disturbances such as diarrhea and occasional constipation * Pot belly * Anaemia * Oedema * Egg segments or proglottids in the faeces   **Control measures of tapeworms**   * Routinely deworm animals using appropriate drugs such as nilzan, albendazole and mebendazole. * Plough the pasture land to kill the cysts * Proper disposal of human waste through proper use of latrines * Proper cooking meat * Proper meant inspection. * Drenching the animals * Rotational grazing so that the eggs cannot be picked by the susceptible host.  1. **Round worms**  * These are usually cylindrical in shape and pink or white in colour. They exist as male and female. * Roundworms inhabit the alimentary canal of cattle**.**   **Signs of roundworms attack**   * Retarded growth * Scours * Anaemia * Pot belly   **Control measures of roundworm attack**   * Avoid grazing animals on muddy grounds * Avoid grazing animals on wet grass early in the morning when the larvae are active. * Deworm the animals using drenching with phenothiazine. * Low stocking rate of animals * Rotational grazing helps to reduce rate of infection as low populations of the worms can be resisted animals. |

**TOPIC 15: REPRODUCTIVE SYSTEMS OF POULTRY AND CATTLE**

**Define the following terms**

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| 1. **Reproduction-** It is the process by which individuals are produced 2. **Fertilization -** It is the process in which a sperm unites with an ovum to form a zygote |

**Draw and label the male reproductive systems of organ of the bull.**

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**State the functions of each of the following parts of the male reproductive system of the bull. Or give the role of each of the following in cattle**

|  |  |
| --- | --- |
| **Part** | **Functions** |
| **Scrotum ( a thin & distended skin)** | * It suspends the testicles outside the body cavity to provide an ideal temperature for sperm development * It protects the testes |
| **Testicles/Testes** | * They produce male gametes- sperms * They secrete male sex hormones |
| **Epididymis** | * It acts as a temporary store for sperm cells |
| **Vas deferens/sperm ducts** | * They conduct sperms from the epididymis to the urethra where the reproductive system joins the urinary system |
| **Urethra**  It is a canal runs through the penis | * It serves as a passage for both semen and urine. |
| **Glands**  **T**hese include Cowper’s glands, prostate gland and seminal vesicles | * **Prostate gland** produces a saline glucose rich fluid that activates the sperms * **Cowper’s gland** produces a mucoid fluid that precedes the sperm.   The mucoid fluid helps to neutralize the acidity of the urine in the urethra which is harmful to the sperms.   * **The seminal vesicles** gland produce seminal fluid in which the sperms are carried |
| **Penis shaft** | * The organ that penetrates the vagina at the time of mating and makes it possible for the introduction of sperm cells into the vagina.   **NB:**  Copulation is the penetration of the penis into the vagina. Ejaculation is the discharge of semen fromthe penis into the female organ. |
| **Sigmoid flexure** | * It is an S-shaped bend which enables the penis to retract after copulation * In other words, it enables the penis to get out of the sheath as it penetrates into the female’s reproductive system when it stretches and retract after copulation |
| **Retractor muscles** | * They help in pulling the erect and exposed penis back into the sheath. |
| **Prepuce /The sheath** | * It protects the glans from external injury   NB: The glans penis is free end of the penis  containing sensory nerves. |

**Draw and label the parts of the female reproductive organ in cattle (cow)**

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| A female reproductive system organ consists of two ovaries, fallopian tubes (oviducts), uterus, vagina and vulva. See figure below: |

**What is the function of the following parts in a cow?**

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| --- | --- |
| **Parts** | **Functions** |
| **Vulva** | * It conducts urine outside and receives the penis into the vagina during copulation. * It acts as a passage for the calf during parturition. |
| **urinary bladder** | The urinary bladder stores urine |
| **Urethra** | The urethra conducts urine to the floor of the vagina and out through the vulva. |
| **Vagina** | * It is the copulatory organ where sperms are deposited. * It is a highly elastic passage through which a foetus is expelled from the uterus. |
| **Cervix** | * It is through this opening that the spermatozoa pass * The calf passes through it into the vagina during delivery. |
| **Fallopian Tubes** | * Site of fertilization(where union of the spermatozoa and the ovum) |
| **Uterus** | * Site of zygote gets implanted and developed |
| **Funnel** | * It receives the ovum during ovulation and directing it into the fallopian tube. |
| **Ovaries** | * They produce ova in the process called ovulation * They produce sex hormones which control sexual cycle.   NB: Oestrogen hormone produced by ovaries induces Oestrus (heat period). |

**THE REPRODUCTIVE SYSTEM IN A CHICKEN**

**PARTS OF THE COCK’S REPRODUCTIVE ORGAN**

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| The male reproductive organ consists of   * Testes * Epididymis, * Vas deferens * Papillae * Cloaca**.**   **The Figure below shows parts of a cock’s reproductive organ.** |

**Describe the function of the following parts of the cock’s reproductive organ.**

|  |  |
| --- | --- |
| **Testes** | * They secrete male sex hormones * They produce sex male cell( spermatozoa) |
| **Epididymis** | * It serves as a temporary storage of the sperm cell. |
| **Vas deferens** | * It is a sperm duct hence conducts semem from the epididymis to the cloaca. |
| **Papillae** | * It projects outside the cloaca to deposit semen into the females cloaca. |
| **Cloaca** | * It allows the exit of semen into the cloaca of the hen |

**THE REPRODUCTIVE ORGAN OF THE HEN**

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| The figure below shows parts of a hen’s reproductive organ.  **C:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\images (6).jpg** |

**Explain the functions of each of the following parts of the reproductive organ of a hen. Or describe the reproductive process in the hen.**

|  |  |
| --- | --- |
| **Ovary** | * They produce thousands of ova. It where the egg is coated with the egg yolk. |
| **The oviduct** | * It is the passage of the egg yolk towards the funnel. |
| **Infundubulum (funnel)**  The eggs take about 15 minutes to pass through it to the isthmus. | * It engulfs the egg yolk. * It the site of the fertilization- where the egg yolk gets fertilized with the sperm. * It forms the chalaza ( a membrane of twisted strings that suspends the yolk in position) |
| **Magnum**  The eggs take about 3 hours to pass through it to the isthmus. | * It is where the albumen (the egg white) is added to the egg. * It causes the rotation of the yolk |
| **Isthmus**  An egg takes 1 (hours in it before moving into the uterus) | * It is where the thin outer membrane and inner membranes are added to the egg to enclose the egg content. * It is where the water, vitamins and mineral salts are added to the egg. |
| **Uterus/Shell gland**  The eggs take 18-21 hours in the shell gland before moving it to the isthmus. | * It is where more water and mineral salts are added to the dense albumen by the process of osmosis. * It is where the shell is put on to the egg through the deposition of calcium deposits followed by the addition of shell pigments. |
| **Vagina** | * The passage of the ready for oviposition in the cloaca. |
| **Cloaca** | * The cloaca serves as a copulatory organ where the vent of the hen opens to the cloaca and sperms are deposited into it. They then followed through the oviduct to the sperm nets in the infundibulum. * It is used for oviposition (the process of egg laying) |

**Explain the functions of the shell to the egg.**

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| The shell protects the egg contents, gives its ultimate shape and allows the gaseous exchange.. |

**AGE AT PUBERTY FOR CATTLE**

**Explain what is meant by the term ‘puberty”.**

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| It is a stage of sexual maturity or reproductive competence in animals. The animal has the ability to release gametes and manifests a complete sexual behavior sequence. It is controlled by hormones.  In males, the **hormone testosterone** controls the maturation of reproductive organ as well as the sperms and desire to mate.  In females, the **hormone oestrogen** controls the maturation of the reproductive organ, egg development and ovulation. |

**State the age at puberty for each of the following animals.**

|  |  |  |
| --- | --- | --- |
| **Species** | **Male** | **Female** |
| **Cattle** | 11 months | 11 months |
| **Sheep** | 7 months | 7 months |
| **Goats** | 7 months | 7 months |
| **Rabbits** | 3-4 months | 3-4 months |

**Explain the factors that influence the onset of puberty in animals.**

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| 1. **Genetics-** Different breeds reach puberty at different ages. For example, Jersey reaches puberty earlier than Friesian. Whereas Aberdeen Angus reaches puberty earlier than Charolais. 2. **Animal type-** Dairy cattle reach puberty earlier than beef cattle. 3. **Cross breeds- Cross** breeds reach puberty earlier than pure breeds due to heterosis (hybrid vigour). 4. **Body weight-** Dairy cattle will reach puberty when they have attained 30-40% of the adult weight where as beef cattle at 45-5% of the adult weight. 5. **Nutrition-** Poorly fed animals will delay puberty while flush feeding may stimulate puberty. Flushing is the practice of giving feeds high in energy in large quantities to the animals. 6. **Temperature-** Warmer temperatures lead to early onset of puberty while extremes of temperatures extend the onset. 7. **Exposure to opposite sex** - Animals exposed to the opposite sex reach puberty earlier than those raised in the same sex groupings. 8. **Breeds-** Exotic breeds reach puberty earlier than indigenous breeds. |

**OESTROUS CYCLE FOR A COW**

**Explain what is meant by the term “oestrus cycle” in a cow.**

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| It is the period between two successive heat periods in animals. It occurs in animals during the time of ovulation when the female animal is ready to mate. |

**Explain why it is important for the farmer to have the knowledge of Oestrus cycle in cows.**

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| It is necessary if the farmer is to carry out successful breeding programme. This is because it enables the farmer to ensure mating is done at the right time. |

**Describe four phases of oestrus cycle in cows.**

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| 1. **Proestrous (Day 17- 20)**   There is regression of the corpus luteum of the previous cycle hence a drop in the progesterone in circulation. The dominant follicle outgrows the others producing increasing amount of oestrogen. In late proestrous, the influence of oestrogen on the reproductive tract and behviour of cows can be observed.   1. **Oestrous (Day one of new cycle)**   The dominant follicle reaches its maximum growth, matures and ruptures releasing the ovum. Ovulation takes place approximately 3o hours after the onset of oestrus and after the behavioural signs of oestrous have ceased. Ovulation is induced by high concentration of luteinizing hormone.  Behavioural signs of oestrous include the following   1. Restlessness 2. Drop in milk production 3. Standing to be mounted 4. Presence of clear mucus discharge from the vulva. 5. Reddening of the vulva. 6. **Metoestrous cycle (Day 2 - 4)**   In this period, the oestrous ends and corpus luteum is formed. Progesterone levels in circulation begin to rise. During this time, a phenomenon known as ‘metoestrous bleeding’ occurs in approximately 90% of heifers and not more than 45% of cows. Patches and streaks of blood are seen in the vaginal mucous staining the tail and perineum.   1. **Dioestrous ( Day 5-4)**   This is the period of maximum corpus luteum size and function. There are high levels of progesterone in circulation. At the end of dioestrous, luteolysis of the corpus luteum begins |

**SIGNS OF HEAT IN LIVESTOCK**

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| This is a period during the reproductive cycle when the female animals become sexually receptive, signaling they are ready for mating.  The female animals show certain behavioural and physiological indicators of this period. The best times to observe these signs are during cool times of the day. For example, early in the morning, before feeding and milking, early afternoon and late evening. |

**Explain five signs of heat in cows.**

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| The following are the signs that the cow on heat will show:   1. It becomes restless or moves about searching for a male. 2. The vulva swells or becomes enlarged, flabby, red and wet. 3. There is clear mucus discharge from the vulva 4. there is reduced appetite 5. The animal attempts to ride or amount other cows in the herd or stands still when amounted or ridded by other cows. 6. The cow bellows or moos unnecessarily. 7. The milk yield in lactating cows drops suddenly. 8. Frequent urination. 9. There is a slight rise in body temperature. 10. The cow sniffs other animals on the vulva and allows others to sniff it |

**How can successful mating be achieved by males and females in cattle.**

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| For successful mating, the male and female should mate during the ovulation period. The best time a cow on heat is 12 hours after the onset of heat 9morning -evening rule). If signs of heat were observed in the morning, serve the cow in the evening and if it was observed in the afternoon serve it in the morning, |

**Explain five signs of heat in an ewe (sheep).**

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| An ewe on heat will show the following signs   1. Seeks out for rams. 2. Stands to be mounted. 3. Rapid tail movement or raised tail in the presence of a ram. 4. Nervousness. 5. Increased vocalizations. 6. Decreased in appetite 7. Reddened and swollen vulva. |

**Give five signs of heat in nanny (goat).**

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| A nanny on heat will show the following signs   1. restlessness 2. Mounting others and stands still to be mounted. 3. It seeks out for males. 4. Constant vocalizations. 5. Loss of appetite. 6. Rubbing up against herd-mates. 7. Redness and swelling around the vulva. 8. Thin clear mucous discharge from the vulva**.** |

**Explain five signs of heat in rabbits (doe).**

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| A rabbit doe on heat will show the following signs.   1. It becomes restless and tries to contact other rabbits in adjacent hutch. 2. The external genitalia become red and swollen. 3. It rubs against the walls and food containers. 4. It throws itself on its side. 5. When mounted it bends its tail up over the back. 6. Frequent urination. |

**GESTATION PERIOD**

**Define the term gestation period.**

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| It is the period from conception to the birth of a young animal 9period of pregnancy). |

**What is the gestation period of each of the following animals?**

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| Animal species | Length of gestation(days) |
| Cow | 275-285 |
| Sheep(ewe) | 148-150 |
| Goat (Nanny) | 143-150 |
| Rabbit(de) | 143-153 |
| Sow(pig) | 114-116 |

**PROCESS OF REPRODUCTION IN CATTLE**

**Reproductive process in cattle involves the following**

1. **Mating**

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| This can be natural or artificial insemination (A.I)  In natural mating, a bull directly mounts a female on heat and introduces semen into the reproductive tract of the cow while in artificial insemination (A.1), semen collected from a superior male is introduced into the female reproductive tract by use of a pistolette or other means. |

1. **Fertilization**

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| Fertilization is the process through which the nucleus of a male fuses with the nucleus of a female gamete to form a zygote in the upper part of the oviduct after copulation.  The zygote moves down the oviduct to the uterus and as it moves, it undergoes several cell division to form a hollow mass of cells called embryo. It develops finger-like projections called villi with which it attaches itself on the wall of the uterus in a process called implantation.  Thee villi together with the walls of uterus develop into a special organ called the placenta. |

1. **Embryo development**

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| During the early stages of embryo development, the villi form the sites of material exchange between the embryo and material blood vessels in the uterine wall.  **Amnion-** It is a membrane that surrounds the embryo forming an amniotic cavity within which the embryo lies. The amniotic cavity is filled with the **amniotic fluid.**  **Functions of amniotic fluid**   1. It provides support to the embryo 2. It acts as shock absorber to protect the embryo against mechanical injury**.**   The embryo becomes a foetus at about 3 months of pregnancy. |

1. **Parturition (calving)**

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| Parturition is the process of giving birth |

**Explain or describe five signs of parturition (calving) in a cow.**

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| A cow which is about to parturate shows the following signs   1. Restlessness 2. Loss of appetite 3. Enlargement of udder that I, the udder is fully filled with colostrums 4. Coliseum may drip out of the teats in high lactating cows 5. The vulva swells and becomes red, much larger and flabby. 6. Slimmy mucous discharge from the vulva. 7. The cow isolates itself from the rest of the herd. 8. There is relaxation of ligaments on either side of the pelvic bones. This causes the pin -bones to widen. |

**DYSTOCIA OR DYSTOKIA**

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| It is the term used when a cow is having difficulties or complications in giving birth. |

**Signs of complication during the process of parturition**

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| 1. A long delay in the appearance of the calf once the water bag breaks. 2. If calving over three hours after some parts of the calf appear. 3. If there is **breech presentation**- This is where the calf is coming out abnormally, that is, rear parts trying to come out first. 4. If cow is distress such that there is no sign of water bag after many hours of straining. 5. Only one limb appearing after water bag has burst. 6. Discharge of smelly fluid indication death of calf. |

**Draw and label the parts of a cross-section of an udder of the cow.**

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| C:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\T0218E02.gif  **Milk-let down**  It is the process where mil passes down from the alveoli to the lower parts of the udder, the gland cistern.  **Alveoli-** It is where the milk is produced  **Gland cistern-** stores milk temporarily.  **Oxytocyn-** It is the hormone that influences milk-let down in cows**.** |

**State the hormones that influence reproductive process in a cow.**

|  |  |  |
| --- | --- | --- |
| **Name of hormone** | **Secreting Gland** | **Function** |
| Follicle Stimulating Hormone | Pituitary gland | * It stimulates the growth of the follicles * It stimulates the development of the ovaries |
| **Oestrogen** | Follicle and developing ovary | * Brings about oestrus * It influences the development of mammary glands * It influences the pituitary gland to produce Luteinizing Hormone. |
| Luteinizing Hormone | Pituitary | Stimulates rapture of follicle to release eggs  Initiates production of corpus luteum essential for maintenance of pregnancy |
| Progesterone | Corpus Luteum and Placenta of pregnant animal | * Influences development of ovary * Stimulates follicle development * Influences development of mammary glands * Influences the development of uterine walls * Inhibits ova production if the animal is pregnant. |

**TOPIC 16: LIVESTOCK IMPROVEMENT**

**Define the Define the term livestock improvement**

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| Livestock improvement refers to the science of changing the genetic constitution of animals in order to have desirable characteristics. |

**Give four aims of livestock improvement**

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| Major aims of livestock improvement are:   * T o obtain high quality products such as milk, meat and wool. * To increase production capacity of the animals, that is, its production potential. * To increase disease and parasite resistance of the animal. * To increase the animals ‘tolerance to high temperature and to other adverse environmental conditions. * Have high growth rate |

**Explain the three main methods of livestock improvement**

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| 1. **Introduction of exotic breeds**   This is the process of importing exotic pure bred animals with superior qualities from another country. The exotic breeds such as **Friesians** and **Jerseys** by importing superior semen, importing bulls or importing embryos.  The males imported or semen harvested from them can be used to mate the local; female animals in the process called **Artificial Insemination**. The imported embryo is implanted in the uterus of local females through **embryo transfer**.   1. **Selection**   This is a practice in livestock improvement in which animals are chosen on the basis of their superiority and develop a breed which is better performing than the previous one. Those that are inferior are sold out.   1. **Breeding**   This is a method of animal improvement in which selected animals are mated for the purpose of raising offspring which are better than either parents to assume heterosis (hybrid vigour). In other words, this is the process of mating selected animals for the purpose of animals with desired traits. |

**METHODS OF SELECTION**

**Describe three methods of selecting livestock for breeding.**

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| 1. **Individual or mass selection/ artificial selection**   This involves the selection of individuals based on their performance in which the phenotypic characteristics (colour, size of the body, shape of head) are used to choose the best animal.  Under this method of selection, the animals chosen to be the parents are those whose performance is closest to the breeding objective. For example, in dairy cattle, the herd chosen should be that producing high milk yield.  It is also called individual selection because the election os based on performance of the individual aimals  **Sib selection** is where a high producing bull is chosen based on the performance of a close relative or mother.   1. **Selection by contemporary comparison**   This is the comparison of animals based on their individual performance. The best individual is selected from animals of the same age-group that have been similarly treated and should be within the same environment.   1. **Selection by progeny testing**   This is the measurement of the genetic value of the animal on the basis of the production records of its offspring. It chooses the male animal that has produced many offsprings than a female.  In order to get the best results from progeny testing, the following points are considered.   1. Test as many sire off springs as possible 2. Make sure that the dams are randomized to each sire within that age group if possible. 3. Produce as many offsprings per sir as possible. 4. No offspring used should be culled till the end of the test. |

**SELECTION OF DAIRY CATTLE**

**Describe the characteristics that should be considered when selecting dairy cattle for breeding purpose.**

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| 1. **Productivity**   Select cattle according to the production records (such as yield of milk per lactation, butter fat content and length of lactation period) of individual cows   1. **Body conformation**   The dairy cow must have a lean body. A typical cow is slightly wedge-shaped (triangular shaped) when viewed from the side, from above and from the front. If viewed from the side, a dairy cow should be seen to have a greater depth of body at its hind quarters than at the front quarters. Top view (aerial) of a dairy cow should show wide hindquarters and comparatively narrow from front quarters.  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\images (1).png   1. **Reproductive traits**   Select dairy cows with good mothering ability and calving interval. Good dairy animals should calve once a year.   1. **Adaptability to the environment**   Choose breeds that are well adapted to a particular environment.   1. **Healthy**   Select animals which have been less affected by prevalent environmental diseases.   1. **Physical defects**   Choose animals which do not have any physical defects   1. **Dairy temperament**   Select animals with good dairy temperament. Docility is preferred since docile animals are easy to handle. |

**Describe the confirmation of the dairy cattle.**

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| The dairy cow must have a lean body. A typical cow is slightly wedge-shaped 9triangular shaped) when viewed from the side, from above and from the front. If viewed from the side, a dairy cow should be seen to have a greater depth of body at its hind quarters than at the front quarters. Top view (aerial) of a dairy cow should show wide hindquarters and comparatively narrow from front quarters. |

**Describe the characteristics of beef cattle that should be considered when selecting for breeding purpose.**

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| 1. **Body conformation**   Beef cattle should have a rectangular or blocky or square body shape with relatively heavier hind quarters. The body should be low set and compact, have great width and depth throughout with all parts smoothly blended together. . The animal should be thickly and evenly fleshed. The legs should be straight, short and squarely set. The brisket should be wide and protruding forward.  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\e9ddc977bd45f21304a895b7e65f277c.png  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000280-0001-0001-0000-000000000000}\images.jpg   1. **Productivity**   Select animals that show good meat marbling, that is, uniform distribution of fat in the meat. The kill out percentage should also be considered and the average kill out percentage should over 60%.  Kill out percentage = x 100   1. **Maturity**   They should have a rapid growth rate and reach slaughter weight early.   1. **Health of the animal**   Select animals resistant to prevalent diseases particularly with good health records.   1. **Adaptability**   Select animals which are tolerant to the prevailing environmental conditions. |

**LIVESTOCK BREEDING SYSTEMS**

**Explain the characteristics of livestock to be selected for breeding.**

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| 1. **Fast growth-** This is a merit because farmers do not wait for too long a time before they start receiving income from sale of the animals or their products. 2. **Resistances to diseases and pests-** This reduces production costs. 3. **High survival rate (low infant mortality rate)** to increase rate of animal multiplication. 4. **High production rate**- The selected animals should be able to produce high milk and protection from any impending danger. 5. **Good mothering ability-** Mothers must be able to provide their young ones with milk and protection from any impending danger. 6. **High fertility rate-** In beef production, mothers should be able to conceive every year in order to increase number of beef cattle. 7. **High meat quantity and quality** 8. **Temperament-** A breed which is docile is easy to milk, use as source of farm power and their meat is of good quality. |

**Explain three common breeding systems employed in livestock improvement. Outline the advantages and disadvantages of each system.**

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| 1. **Inbreeding**   It is the mating of individuals who are closely related than average relationships of all individuals in a population.  **Examples of inbreeding**   1. a brother and a sister 2. Half-brother and half-sister 3. A son and a mother 4. A father and a daughter   **Advantages of inbreeding**   1. It concentrates desirable genes and retains known merits within a population. 2. It helps expose undesirable recessive genes early within a herd so that such animals may be culled. 3. It promotes uniformity in a population 4. It is useful in testing male animals for abnormalities that is, testing whether they are carriers of hereditary defects.   **Disadvantages of inbreeding**   1. It leads to weak, inferior animals by concentrating too many recessive gene pairs in the progeny. 2. There is reduced performance in the animal (inbreeding depression) 3. There is reduction in vitality. 4. **Cross- breeding**   It is the mating of two animals belonging to different breeds.  **Examples of cross-breeding**   1. Friesian bull and Malawi Zebu 2. Hereford bull and Aberdeen Angus cow 3. Large White Boar and Landrace 4. White Leghorn and Hampshire Red Chicken   **Advantages of cross-breeding**   1. The crossbred offspring has an average performance 2. It increases heterozygosity in all crossbred offsprings 3. **Out breeding**   It is the mating of unrelated pure breed animals with the same breed.  Example  Mating a Holstein Friesian bull with a British Friesian  **Advantage of out breeding**   1. Results in generic improvement which enhances vigour 2. The method is suitable for beginners in breeding 3. It brings desirable traits into the herd by overshadowing undesirable traits that are already present.   **Disadvantages of out breeding**   1. It is expensive to import semen for individual farmers 2. It is affected by untimely importation of semen |

**Define the term Artificial Insemination (AI).**

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| It is a tool used for livestock improvement in which it involves introduction of sperms into the female’s reproductive system without use of a bull.  Semen is collected from outstanding bulls by use of artificial vagina as it tries to mount a female. The semen is diluted using diluents which consist of egg yolk, milk and glucose. It is later stored in liquid nitrogen which is under very low temperature.  https://i.ytimg.com/vi/o8sHvMk8C2U/hqdefault.jpghttps://c2.staticflickr.com/6/5205/5262333083_19906f1b99_b.jpg |

**Explain the advantages and disadvantages of Artificial Insemination.**

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| **Advantages of Artificial Insemination**   1. Semen from one male can be used to serve many females. 2. Semen can be stored for many years and still use it long after the bull is dead, 3. It reduces the cost of buying and keeping a bull. 4. It reduces spread of sexually transmitted diseases 5. Breeding is very easy. 6. Bulls which are heavy to mount can have their semen still be used which would have breed difficult under natural conditions. 7. Traits of an outstanding bull can spreads more widely than use of a live bull because it only takes transportation of its semen to countries far and wide.   **Disadvantages of Artificial Insemination**   1. The system required highly skilled personnel 2. It is expensive to manage the AI program. 3. Due to some logistical problems such as transport, it is difficult for the skilled officer to come and inseminate a cow in time when heat signs are detected. |