



Grand Agriculture Seminar Advanced Level

Organized by; ATA-Uganda

Host; Lubiri High School-Mengo

Date; 30th June 2019



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Agriculture Resource Centre

For all your agriculture practical needs

KK Trust Plaza, Namirembe Road,

Shop No.D7 Level 2.



PROGRAMME LINEUP

	ACTIVITY	TIME
1	Arrival of participants (facilitator, teachers and students)	7:30-8:30am
2	<ul style="list-style-type: none"> ☞ Assembling of all participants in the main hall (students, teachers and facilitators) ☞ <i>Opening prayer</i> ☞ <i>Singing of Buganda and national anthems</i> ☞ <i>Welcoming speech from the H/M Lubiri High School</i> ☞ <i>Opening remarks from organizers and introduction of teachers and their respective schools, facilitators and other resourceful persons.</i> ☞ <i>Motivational Speech from M.U Kirimani,</i> 	8:20-9:10am
3	Special presentations; Item No. 1; <i>What are the examiners looking for</i> by Matege Jafar Item No. 2; <i>Common mistakes candidates make in agric exams</i> by Nkonte Lawrence	9:10 - 9:30am
4	Student dispatch to their respective halls for the sessions	
5	<u>First session</u> A-level: <i>practical session begins in the Agric. laboratories</i> O-level: <i>theory session begins in the main hall</i>	9:30-1:30pm
6	Lunch /Entertainment/visiting book stalls	1:30-2:10pm
7	<u>Second session</u> A-level: <i>theory session begins in the main hall</i> O-level: <i>practical session begins in the Agric. Laboratories</i>	2:10-4:40pm
8	Closing remarks	4:40-5:00pm
9	Departure	From 5:00pm

1.0 Opening remarks from organizers

Dear candidates, welcome to the 8th annual A-level grand agriculture seminar. We hope each one of you is here because of the passion to succeed in the forthcoming UNEB examinations. Indeed we understand your plight and we too are committed more than ever to make sure your dream of excelling is met. ATA-Uganda has decided to organize Agriculture seminar for you with the aim of giving guidance and equipping you with necessary skills and attitudes pertinent in your triumphant pursuit of UNEB Agriculture examinations.

Candidates are reminded that the questions laid down in this booklet are not from the forthcoming UNEB examinations; in fact the questions were set randomly from the stipulated UACE agriculture teaching syllabus. You're advised not to over rely on these questions, but to read, consult and browse widely from other sources.

Finally, we thank Lubiri High School specifically the Headmistress for allowing to host us and to make our inspirational seminars possible. It is our hope that we will live up to your expectations. On the same note, we call on other potential schools to do the same when requested.

1.1 Preamble

There are three papers, each with different skills and competences required

Paper 1: it is a theory paper consisting of multiple and short answer questions all of which are compulsory. It is marked out of **100** marks and takes **2** hours and **30** minutes. It has two sections as follows:

Section A: composed of **30** multiple-choice questions, contributing **30** marks.

Section B: composed of **7** structured questions, contributing **70** marks.

Paper 2: it is a theory paper consisting of essay-type questions. It has of 5 sections (A, B, C, D and E) representing the five sections of the syllabus. Section **A** has only one compulsory. The other sections have **2** questions each, out of which a candidate answers only one question. Therefore the paper consists of **9** questions out of which, a candidate is required to attempt only **5** of the **9** questions. Each question carries a maximum score of **20** marks making a total score of **100** marks for the entire paper. The paper takes **3** hours.

Paper 3: it is a practical paper consisting of **5** compulsory questions from different sections of the syllabus (science, crop, animal, mechanization and soil). Each question is awarded a maximum of **10** marks making a total of **50** marks. The paper takes **2** hours.

Conditions and rules for the UNEB grading system

GRADE	MARKS	C4	60+	P8	35+
D1	80+	C5	55+	F9	00+
D2	75+	C6	50+		
C3	66+	P7	45+		

Grade	Conditions
A	<ul style="list-style-type: none"> At worst C3 in one of the three papers and the rest must be distinctions i.e. 1,1,3/1,2,3/2,2,3 = A For two papers ALL MUST be distinctions i.e. 1,1/1,2/2,2 = A
B	<ul style="list-style-type: none"> At worst C4 in one of the three papers and higher grades in the rest i.e. 1,2,4/2,2,4/3,3,4/1,1,4/3,3,3/3,2,4 = B For two papers at worst C3 in one of the papers and higher grades in the second paper i.e. 1,3/2,3/3,3 = B
C	<ul style="list-style-type: none"> At worst C5 in one of the three papers and higher grades in the rest i.e. 1,1,5/1,2,5/2,2,5/2,3,5/3,4,5/4,4,5 = C For two papers C4 in one of the papers and the rest must be a higher grade i.e. 1,4/2,4/3,4/4,4 = C
D	<ul style="list-style-type: none"> At worst C6 in one of the three papers and higher grades in the rest i.e. 1,2,6/1,1,6/1,3,6/2,2,6/3,3,6/4,5,6/5,5,6 = D

	<ul style="list-style-type: none"> • Then for two papers it must be C5 at worst and higher or better grades i.e. 1,5/ 2,5/ 3,5/ 4,5/ 5,5 = D
E	<ul style="list-style-type: none"> • At worst P7 or 8 in one of the three papers and then higher grades in the other papers i.e. 1,1,7/ 1,2,7/ 3,3,7 etc = E
O	<ul style="list-style-type: none"> • At worst 2 passes in two out of the three papers and then better grades i.e. 2,7,7/ 6,7,7 = O • F9 in one of the papers with the rest of the three papers having between D1-C6 • For two papers one pass and a better score = O • In two papers F9 and credit = O
F	<ul style="list-style-type: none"> • At worst 2 F9s out of the three papers = F • F9 and P8 in two of the three papers • F9 in one of the two papers and a pass = F

1.3 Keywords Commonly Used In Agriculture Examinations

There are key or direction words examiners use which you must familiarize with. Knowing the meaning of such words will enable you to interpret and answer the questions correctly. It is important to pay attention to the key or „direction“ words in every question in an examination so that you do not waste valuable time doing something different from what you have been asked to do.

Analyze: this also requires you to identify and explain the main ideas.

Compare: give similarities and differences between two items or situations.

Account for: give reasons as to why something took place.

Define/what: give the precise meaning of a word or phrase. A definition should not go beyond a paragraph.

Describe: this requires a candidate to state in words (with the aid of diagram where appropriate) the main points of the topic. Note that examples play an important role in enhancing your answer.

Discuss: this requires you to examine by argument, giving reasons for and against, and drawing a conclusion based on facts.

Examine: this requires that you identify the main ideas and describe them in order to bring out their significance.

Explain: this requires a candidate to make a given term or piece of information clear. Some laws and principles may be applied. Sometime a diagram or a graph may be useful. The use of examples to clarify information is usually helpful. However, make sure that the example you give is applicable.

Identify: requires you to provide certain facts or to prove that you understand the content.

Illustrate: use a figure or diagram (any non-text format) as an example to explain or clarify something.

List: present in brief form. No need to explain.

Name: give points only, no explanations.

Outline: give the main features or general principles of the subject omitting minor details and emphasizing on the sequence.

State: this requires one to present in brief, clear form and no supporting argument.

Why: give clear reasons supported by sound argument.

Note; *Facilitators will expound more on the above terms during their presentations.*

1.4 Essential tips for candidates during examination period

- ☞ Read consistently without discriminating against any topic tested in the paper you are preparing to sit for. There is no guarantee that a topic that was examined in the previous year cannot be examined next year.
- ☞ Make sure you are familiar with the examinations' timetable so that you can revise for the right paper at the right time. Confusion with regard to the timetable can cause serious panic.
- ☞ Take care of your health by eating well and make sure you get enough sleep. Some candidates read for so many hours prior to the examination that they fall sick. You can avoid this by carefully drawing a revision timetable that includes slots for rest.
- ☞ Make sure you are ready to move to the examination room at least 30 minutes before the start of the examination. This will give you enough time to freshen up and put together your writing material and any other equipment you may need during the examination. Never get late for the examination as this could lead to confusion and panic, or even exclusion from an examination.
- ☞ Once in the examination room, listen to instructions by the invigilators/supervisors and obey them dutifully so as to avoid getting into trouble.
- ☞ Read the instructions on the examination paper carefully before you start writing. In case the instructions are not clear, consult the invigilators. You must record your index and random numbers carefully. Do not write your school name anywhere on the paper. UNEB forbids this.
- ☞ Once you are allowed to start writing, compose yourself and go through the questions carefully, for about ten minutes. This will help you to have a 'feel' of the entire paper, hence enhancing your confidence.
- ☞ Make sure you calculate the time available and allocate it appropriately in relation to the marks awarded. The least amount of time should be spent on part A, while part B should be given more time.
- ☞ Make sure you write carefully. Some candidates do not score well in examinations not because they do not know the answers, but due to carelessness and poor handwriting. Going through your points could help to eliminate these mistakes that would cost you a lot of marks.
- ☞ It is good practice to sketch the answers for each question briefly before writing out the full answers. This will eliminate the possibility of forgetting some points and at the same time help in the logical arrangement of the answers.
- ☞ Allow a few minutes at the end of the exam-taking period to check for careless mistakes such as misspellings, making two answers for a single question, and unnumbered questions.

- ☞ Keeping a positive attitude during exam will help you to focus on the exam and to improve your score.

1.5 Tips for answering objective-type questions

- ☞ Eliminate the incorrect answers as you proceed to the probable answer. Note that if you can eliminate two of four answer choices, your chances of choosing the correct answer will double.
- ☞ Some questions require you to choose the answer that is not true. For these questions, you should first eliminate answers that you know are true.
- ☞ Test questions are not necessarily arranged in order of increasing difficulty. If you are unable to answer a question, mark it and move on to other questions.
- ☞ Do not spend a long period of time on any single question. Mark a question that you cannot answer quickly, and come back to it later.
- ☞ Whenever possible, highlight or underline important numbers words critical to correctly answering a question.
- ☞ Double check with a calculator (if allowed) all mathematical calculations involved in answering a question.
- ☞ Choose an answer based on both what you know as well as any information presented in the question.
- ☞ If time permits, take short mental breaks to improve your concentration during an exam.
- ☞ If you run short of time, quickly scan the unanswered questions to see which might be easiest to answer.

1.6 Don'ts in an examination

- ☞ Don't cross out work that may be partly correct unless you have finished replacing it with something better.
- ☞ Don't write out the question. This is wastage of time as marks are given only to the answer
- ☞ Don't draw using an ink pen. Always use a pencil and label your drawing.

Note; Facilitators will expound more on the above during their presentations.

Special Presentations

Item No. 1; What are the examiners looking for?

Presenter: Wanganga Robert Time; 10min

The common complaint from examiners is the “*candidate failing to answer the question*”. This complaint is expressed in a number of ways, for instance;

- a) Answer too short,
- b) Answer too long,
- c) Irrelevant material included,
- d) Relevant material left out,
- e) Absence of diagram(s) or graphs

- f) Entire part of the of the question missing.
- g) Failure to give correct responses to question.

Item No. 2; Common mistakes candidates make in agriculture exams

Presenter: Nkonte Lawrence, Time: 20min

Candidates make many mistakes in the course of writing their examination papers and these mistakes cumulatively make them score poor grades. The following are some of the common mistakes made by candidate;

1. Poor communication (language problem): more often students fail to put across their arguments because of weak communication skills. Common errors here include;
 - a) Grammatical errors for example use of wrong tenses poor phrasing of points.
 - b) Spelling mistakes making it difficult to comprehend the work of candidates. Candidates are penalized whenever they fail to spell correctly the technical words for example the word infrastructure, entrepreneur etc.
 - c) Incomplete sentences (hanging statements and phrases); this makes the work of the candidate sketchy and in most cases meaningless. For example, no marks are awarded to incomplete definitions and statements.
 - d) Use of unique abbreviations; only conventional abbreviations are accepted.
 - e) Use of slang in essay writing for example '*bizbs*'
2. Poor handwriting: this makes the work of the candidate unreadable and to lack the flow of content and thus nothing good is conceived out of it. Poor handwriting also implies that all technical words are misspelled. It also leads to loss of interpretation thus no communication is made.
3. Poor choice of questions: this is due to poor preparation, lack of subject content, having vague knowledge of all questions and looking at questions at the surface without critically analyzing it.
4. Lack of optimization (insufficient point): this is due to the following:
 - a) Having no plan for the answers to the question and where there is one, it is not followed.
 - b) Lack of concentration during the course of the examination.
 - c) Doing work in a hurry.
 - d) Working without focus due to lack of seriousness.
 - e) Points noted down are as a result of rote learning (cram work)
 - f) Weak mastery of 'concepts'.
5. Poor illustrations: these include wrong examples, incomplete diagrams, irrelevant statistical data, wrong graphs and curves etc. it is clearly stated in the instructions that credit is only given to relevant illustrations. Graphical illustrations must be well labeled and drawn to concepts.
6. Lack of originality in presentation: this is manifested in essay with no clear explanation of the points, use of similar phrasing for all point, presentation that shows inadequate research and above all, essays that portray rote learning.

7. Lack of consistence: an essay which is not consistent is one which lacks flow of presentation. The points are scanty, weak in content and trivial. The essays are such that each point does not have the same strength and depth of analysis as the other. Usually, such students explain fully the first point, mention or state fully the second and the third point, and in a sketchy form (outline) the rest of the points.
8. Strong and traditional points are presented last and not explained at all. The work is disorganized and content confused. The marking of the examinations would imply that candidates only get full marks for the few first point and for the bulk of their work. They get only marks for mentioning points or in most cases no marks at all.
9. Untidy work: this is dirty work with lots of crossing and all sorts of deletion. Such work is difficult to follow and the content is confused. A lot of marks are lost due to disjoining work that is tiring to follow and hard to award marks.
10. Poor time management: this is shown in candidates failing to complete the work during the stipulated time. This is usually caused by; weak comprehension of questions, writing more points than the number asked, putting too much emphasis on triviality. For example, the student is requested to mention but he/she goes ahead to explain the points or even give illustrations, also panic during the examination leading to candidate rewriting questions or repeating answers or canceling already written points or questions in the course of the examination.

2.1 How to score highly in agriculture examinations

A systematic presentation is definitely what an examiner wants. A successful candidate should observe the following;

- ☞ Read the instructions carefully before starting to answer any question
- ☞ Plan the work carefully, maturely, analytically and orderly.
- ☞ Write strong and traditional points first and, while writing, consider the tense and key words used in the question.
- ☞ Optimize the work by putting down all possible points to the question. Points should collate to the marks the candidate is supposed to score in the question.
- ☞ Choose and attempt questions which are simple and clear. Take time to analyze questions than hurriedly choose questions with key words, which are not familiar.
- ☞ Make sure that comprehensive points are not watered down by wrong examples and other form of illustrations.
- ☞ Write neatly, consistently, analytically and comprehensively.
- ☞ Use paragraphs even if the point is one word especially for essays.
- ☞ Ensure that your point is made within the first line of your paragraph. Why hide the point you are trying to make. Remember examiners don't want to be inconvenienced.
- ☞ Make sure that each sentence written down yields marks- otherwise why write it!

2.2 Question Approach

Category A; questions requiring factors influencing/determining/affecting

Such questions need you to give neutral factors. Explain the factor with two sides; one showing high level and the other one showing low level. You should not equal or correlate the two sides of the point when explaining. Avoid using speculative terms like if, when, incase.....

Use present simple tense and present continuous but not future tense i.e. shall may, can etc. may not be allowed.

Category B; questions requiring one to account for a phenomenon

Account for being used for causes. ii. Account for being used for reasons.

For example; Used to..... so as to..... in order..... for purposes of to answer the question that require reasons.

Category C; questions requiring one to differentiate or distinguish between two phenomena

Use a conjunction between the two definitions.

Category D; questions requiring limiting/hindering/discouraging/challenges of /challenges faced.

Give biased factors. They should be negative. Explanation should be one sided pointing out clearly how they are limiting/hindering a certain case to take place.

Always use the present/now tense.

Category E; questions requiring suggestion

Questions of this nature require a student to strictly use the future tense in point statement and in the explanation.

Words which are expected are; should, can, may both in the point and in the statement.

Category F; questions requiring measures being taken/promoting factors.

These call for present continuous tense/now tense. The point statements and the explanations must be reflecting the now tense i.e. ising.

3.0 Discussion Questions and Suggested Answers to Questions

INTRODUCTORY AGRICULTURE SCIENCE

Question 34

Two sets of ten pea seeds were germinated. Set A was placed in normal day light conditions in the laboratory; whereas B was placed in a dark cupboard. Starting a few days later, the shoot lengths were measured after every 10 hours, and the mean lengths are shown in **table 1** below.

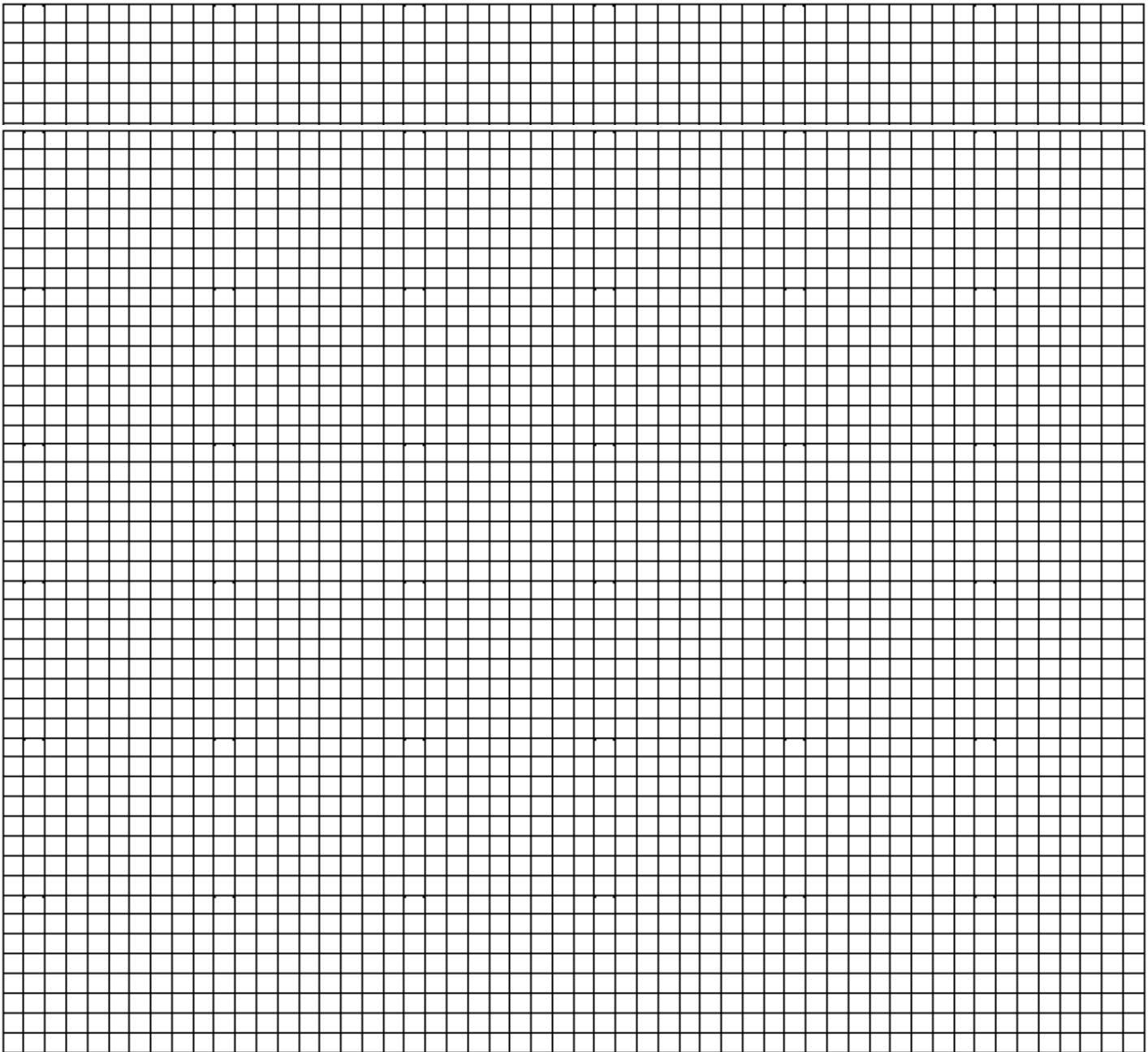
Table 1

Time (hours)	10	20	30	40	50	60	70	80
Set A length (mm)	10	12	18	21	26	29	45	52
Set B length (mm)	15	21	26	32	46	60	78	94

- a) Using the data in **table 1** above plot the figures on graph paper to show the growth curves of the two sets of seeds.
- b) From the graph state the mean shoot length of each set of seedlings at 2 am on day 3 of measuring.
- c) State two external conditions which should be constant for both sets.
- d) Explain briefly why curve A is different from curve B
- e) Suggest the fate of seedlings in set B if they were allowed to continue growing under these conditions.

Suggested answers

- a) Using the data in **table 1** above plot the figures on graph paper to show the growth curves of the two sets of seeds.



b) The mean shoot length of each set of seedlings at 2 am on day 3 of measuring.

The mean shoot length of seedlings in set A is 47 mm

The mean shoot length of seedlings in set B is 81 mm

c) Two external conditions which should be constant for both sets.

Temperature (Warmth)

Water (Moisture)

Oxygen (Air)

d) Reasons why curve A is different from curve B

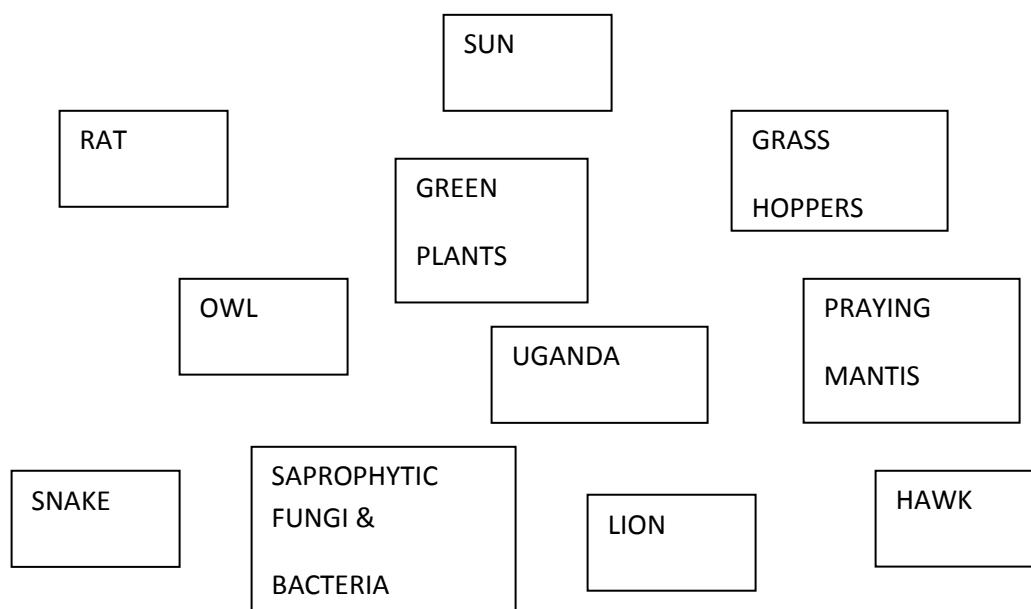
The mean shoot length in set A is shorter compared to the mean shoot length in set B. This is due to the fact that shoots in set A were exposed to light and therefore they were able to carry out photosynthesis whereas shoots in set B lacked light required for photosynthesis and therefore etiolated in search for light and hence grew taller than those in set A

e) The fate of seedlings in set B if they were allowed to continue growing under these conditions.

Seedlings in set B will continue to etiolate and then die out due to lack of light necessary for photosynthesis

Question 34

The figure below shows a food web in a terrestrial habitat.



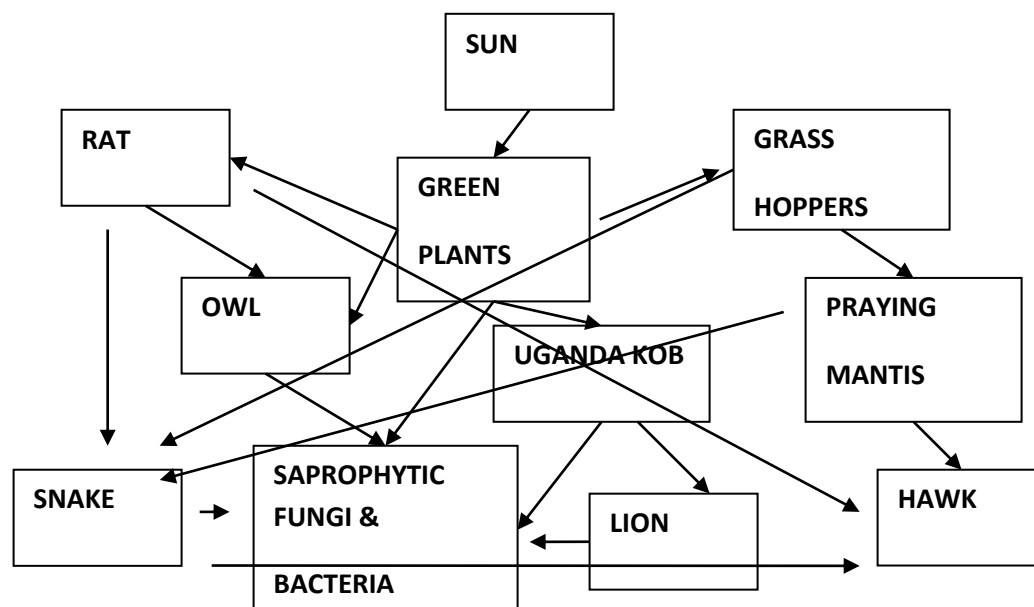
a) Complete the food web by inserting the arrows linking the different organisms.

b) State with reasons, which organisms in the food web would be most directly affected if saprophytic fungi and bacteria were removed.

c) Explain how modern agricultural practice affects the natural ecosystem.

Suggested answers

(a) Complete the food web by inserting the arrows linking the different organisms.



(b) with reasons, which organisms in the food web would be most directly affected if saprophytic fungi and bacteria were removed.

The green plants will be most directly affected due to the fact that saprophytes and bacteria are responsible for decay and decomposition of dead living organisms from which plants derive their required nutrients necessary for growth and development, therefore if they are removed, there will be no decomposition and decay and therefore plants will be deprived of nutrients

(c) How modern agricultural practice affects the ecological system.

The modern agricultural practices include;

- ☞ Use of agrochemicals such as pesticides, herbicides and acaricides
- ☞ Use of inorganic/industrial synthesized fertilizers
- ☞ Use of level three machines such as tractors (mechanization)
- ☞ Use of intensive irrigation
- ☞ Use of green houses
- ☞ Use of GMOs(genetically modified organisms)

Such practices affect the eco system in the following ways

- ☞ Causes pest resurgence
- ☞ Cause eutrophication
- ☞ Some are persistent and non-biodegradable passing thru food chains in a more concentrated form
- ☞ Leads to environmental pollution
- ☞ Leads to ozone layer depletion hence increased global warming
- ☞ Creates hard pans and soil caps distorting soil structure and soil living organisms
- ☞ Leads to acidified rain water which affects soil PH and soil living organisms

- ☞ Leads to soil salinity and leaching of plant nutrients
- ☞ Kill important soil organisms, animals and man
- ☞ May lead to soil erosion and its related effects

Question 34

The following table shows the relative rate of transpiration in three different trees growing under similar conditions.

Tree	Relative Transpiration Rate
Avocado	195
Cactus	20
Pine	70

- a) What is transpiration
- b) State the difference between relative rate of transpiration between avocado and cactus trees
- c) Account for the difference in Relative Transpiration Rate between avocado and cactus trees.
- d) Suggest which of the trees would be in the environments listed below
 - (i) Semi arid
 - (ii) Dry lands
 - (iii) Rain forests
- e) Give reasons for your answers above
- f) Name other three conditions necessary for transpiration
- g) State two importance of transpiration to plants.
- h) Give two agronomic practices that can be employed by the Farmer to control transpiration rates.

Suggested answers**(a) What is transpiration**

This is a process through which plants lose water in form of vapour to the atmosphere through the stomata, cuticle and lenticels.

(b) Difference between relative rate of transpiration between avocado and cactus trees

The rate of transpiration is high in Avocado trees at 195 whereas the rate of transpiration is low in cactus at 20.

(c) Account for the difference in Relative Transpiration Rate between avocado and cactus trees.

The difference can be attributed to leaf surface area and surface area to volume ratio. Transpiration of a plant increases with its total leaf surface area, and with leaf surface area to volume ratio. Avocado leaves have a large leaf surface area with a small leaf surface area

to volume ratio hence a higher rate of transpiration as compared with cactus with small leaf surface area with a large leaf surface area to volume ratio.

In addition the avocado trees have more stomata per unit area and hence greater rates of stomatal transpiration as compared to cactus

(d) Suggest which of the trees would be in the environments listed below

- ☞ Semi-arid = **Pine trees**
- ☞ Dry lands = **Cactus trees**
- ☞ Rain forests = **Avocado trees**

(e) Give reasons for your answers above

Trees in dry lands develop mechanisms to minimize water loss thru transpiration and therefore have lower transpiration rates, such mechanisms may be reducing leaf size to needles or to spines, reduces number of stomata or having sunken stomata, have deep tap roots among others whereas plants in plenty of water don't develop special features and mechanism of controlling water loss and therefore have high rates of transpiration. From the information, avocado trees have high rates and therefore they are rain forests where there is water followed by pine tree and least in cactus tree indicating absence of water, cactus trees have developed mechanisms of reducing transpiration rates since they are in dry area.

(f) Name other three conditions necessary for transpiration

- ☞ Temperature
- ☞ Humidity
- ☞ Vapour pressure
- ☞ Wind
- ☞ Light
- ☞ Availability of soil water

(g) State two importance of transpiration to plants.

- ☞ Helps to cool plants especially in conditions of direct sunlight
- ☞ Helps in mineral salt distribution thru out the plant as a result of transpiration pull

(h) Give two agronomic practices that can be employed by the Farmer to control transpiration rates.

- ☞ Carrying out Pruning
- ☞ Applying Irrigation
- ☞ Use of green houses

Question 35

- (a) Describe the events that take place in meiosis I during cell division
- (b) Outline the causes of variation in a population of organisms
- (c) Define an ecosystem and describe how agricultural practices affect the ecosystem

Suggested answers

(a) Prophase I: in this stage, nucleolus re-appears. Centrioles arrange at opposite sides of the nucleolus. Homologous chromosomes associate (lie side by side) this is called synapsis and each pair is called a bivalent. In late prophase, chromosomes round each other and when they separate, chromosomes remain in contact at points called chiasmata.

(b) Causes of Variation in a population of organisms

- ☞ Climate: organisms living within their favourable climate may develop and attain the average trait scores contrary to the organisms living in poor climate.
- ☞ Diet i.e. good or bad diet may affect the genetic potential leading to phenotypic variation (growth rate, body size, low production).
- ☞ Diseases: these may interfere with the normal manifestation of genetic potential of an organism (e.g. reduction in growth, infertility and reduced production).
- ☞ Genetic interactions and epistasis.
- ☞ Interbreeding and cross breeding between organisms.
- ☞ Mutation of the germ cells, especially gene mutation and chromosomal mutations as these may change the genetic and phenotype of the individuals in a population.
- ☞ Polygenic inheritance where two or more pairs of alleles contribute to a single phenotypic trait.
- ☞ Selection and breeding of organisms that may lead to development of new traits in a population.

(c) An ecosystem is a natural unit composed of living and non-living components whose interactions results in a stable, self-perpetuating system. It is made up of communities of organisms which interact with one another and with nonliving constituents of the community.

Effect of modern agricultural practices on the ecosystem

- ☞ Applied fertilizers find their way into water bodies such as rivers and lakes causing eutrophication.
- ☞ Applied chemicals such as herbicides, fungicides, insecticides find their way into water bodies causing pollution and affecting aquatic life.
- ☞ Land clearing done prior to cultivation destroys and changes vegetation and habitats for wild life.
- ☞ The conventional tillage practices destroy the soil flora and fauna, and cause considerable Soil erosion, leading to siltation of water bodies and affecting aquatic life.
- ☞ Fumes, fuels and oils from machinery pollute the environment.

Question 36

- (a) Differentiate between
- (i) Genetic engineering and gene cloning.
 - (ii) Gene mutation and polyploidy.
- (b) State the superior characteristics exhibited by genetically engineered crops.
- (c) Outline the limitations of genetic engineering in agriculture.

Suggested answers

(a) (i) Genetic engineering is the artificial alteration of the genome of a living cell for medical, industrial and agricultural use.

While, **Gene cloning**: is the process of replicating the genes.

(ii) Gene mutation is a change in the DNA of a gene. While,

Polyploidy is a condition in which cells contain multiple, complete sets of chromosome.

(b) Superior characteristics exhibited by genetically engineered crops

- ☞ Tolerant to drought
- ☞ Adapted to variety of soil conditions
- ☞ Resistant to pests and diseases
- ☞ Have high nutritional value
- ☞ Grow and mature faster
- ☞ Give high yields
- ☞ Tolerant to pesticides

(c) Limitations of genetic engineering in agriculture

- ☞ Due to un-controlled breeding in most plants the modified genes may find their way into wild making the wild species of plants such as weeds difficult to control by herbicides.
- ☞ Genetically modified organisms have a social rejection from the people and as such have low market and value in most countries.
- ☞ It requires a lot of costs in acquiring equipment and reagents to use.
- ☞ It requires high skills in molecular biotechnology which are not easy to acquire by many breeders and farmers especially in the tropics.
- ☞ May encourage farmers to overuse herbicides to control weeds and with time, making weeds resistant to the herbicides, leaving farmers with few weed-control options.
- ☞ Modified genes may also find their way into human population, increasing genetic defects and possibility of ailments such as cancer.
- ☞ Some useful insects such as pollinators may also be affected by some insect killing genes incorporated in plants. This, in the future may reduce pollination and eventually reduce yields.
- ☞ Sterility may be enhanced in many plants and animals due to massive manipulation of genes. This may increase the cost of planting seeds as farmers cannot save planting seeds from the harvested seeds but always to buy original seeds from seed suppliers
- ☞ With time pests may become resistant to the toxins in plants, leading to pest resurgence.

Question 37

- (a) Discuss the factors that affect the rate of photosynthesis in plants.
- (b) Outline the crop husbandry practices that increase photosynthesis.

Suggested answers**(a) Factors affecting the rate of photosynthesis**

- ☞ *CO₂ concentration*: the concentration of CO₂ in the atmosphere is usually 0.03%. An increase in CO₂ concentration usually causes the rate of photosynthesis to be faster. This is because there are more molecules of CO₂ to combine with hydrogen to form the carbohydrate. This condition can only happen when other conditions for photosynthesis are optimum.
- ☞ *Light intensity*: photosynthesis occur faster in brighter light than in dim light. This is because water molecules are split faster in the chloroplast resulting in quick formation of hydrogen ions for reduction of CO₂.
- ☞ *Temperature*: a rise in temperature causes an increase in the rate of photosynthesis until the optimum temperature. A further increase in temperature beyond optimum level causes a decrease in the rate of photosynthesis because high temperature denatures active enzymes. The optimum temperature range for most plants in temperate zone is about 20-30°C.
- ☞ *Amount of chlorophyll in leaves*: leaves with much chlorophyll carry out photosynthesis faster than those with less chlorophyll under the same external conditions. This is because such leaves trap more light energy for photolysis of water than the others with less chlorophyll.
- ☞ *Water*: water provides the hydrogen molecule for reducing carbon dioxide to carbohydrate. Thus photosynthesis increases when the supply of water is adequate. However field crops are able to tolerate water shortage without any significant effects on photosynthesis, and it is only when wilting sets in that photosynthesis is retarded. Also, water stress may force leaves to close stomatal pore in a bid to reduce water deficit thus interfering with CO₂ uptake.
- ☞ *Mineral salts*: mineral such as Fe, Mn, Mg and N are used in the making of chlorophyll. Any deficiency of these mineral salts may result in a low chlorophyll level (chlorosis) and so limit the light reaction. Also phosphorus may limit the production of ATP, affecting enzyme production.

(b) Crop husbandry practices that increase photosynthesis

- ☞ *Timely planting of crops*: this ensures that crops get ample supply of water from the rain and nutrients which are vital in photosynthesis process.
- ☞ *Proper crop spacing*: spacing of crops prevents shading between crops and increases light interception by crop leaves. Light provides the energy necessary to drive the process of photosynthesis.
- ☞ *Application of fertilizers*: these provide nutrients to the crops to support leaf growth (vegetative growth), leaf longevity, chlorophyll formation and enzyme activation.
- ☞ *Irrigation of crops*: this provides continuous supply of water to the sites of photosynthesis (leaves and green stems). Water is a raw material in photosynthesis.
- ☞ *Control of pests and diseases*: pests and diseases attack foliage and damage or lead death of leaves, and as a result, reduce the surface area under which photosynthesis can take place.

- ☞ *Control of weeds*: weeds may grow very fast shading crop plants. This reduces light interception by crop leaves leading to reduced photosynthesis.
- ☞ *De- tasseling*: this is important in crops such as maize. After successful pollination of the cob, the male inflorescent is cut off to prevent shading from the tassel on flag leaf as this could reduce light interception and consequently reduce photosynthesis.
- ☞ *Provision of artificial light in green houses*: light can be supplied by special bulbs to increase the rate of photosynthesis. However this is only economical in high value crops.
- ☞ *Pruning and thinning*: reduces shading between crop leaves, thus increasing light interception.

ANIMAL PRODUCTION

Question 1

- (a) Explain the factors that predispose farm animals to diseases.
- (b) Outline the measures that can be used to prevent disease outbreak on the farm.

Suggested answers

(a) Factors that predisposes farm animals to diseases

Predisposing factors are conditions inside or outside the body of an animal that make the animal vulnerable to disease or injury. They include the following:

- ☞ Genetic factors or breed of the animal: certain diseases attack certain species or breeds of animals. Fowl typhoid and swine fever, for example, attack poultry and pigs, respectively.
- ☞ Age of the animal: Some diseases attack animals at a certain age. Calf scours, for example, attacks calves while piglet anaemia attacks piglets. Lamb dysentery attacks lambs.
- ☞ Level of production: High milk-producing animals, for example, are prone to certain diseases such as milk fever. Mastitis also attacks high-producing cows.
- ☞ Sex of the animal: Some diseases are sex-linked. For instance contagious abortus and mastitis which attack female animals and orchitis which attacks male animals.
- ☞ Hygiene of the environment: unhygienic conditions are a source of infections such as coccidiosis and calf scours.
- ☞ Immunity of the animal: some animals have higher levels of immunity hence are able to resist infections compared to others.
- ☞ Health status of the animal: healthy animals are able to resist infections unlike to sick animals.
- ☞ Injuries: An injury on a teat of a cow, for example, can lead to mastitis.
- ☞ Level of nutrition: good feeding of animal on a balanced ration increases the animal's resistance to infections. However, poor feeding reduces immunity and predisposes livestock to deficiency diseases.
- ☞ Physiological condition of the animals e.g. pregnant or lactating.
- ☞ Poor disposal of dead animals;
- ☞ Prevalence of vectors around the farm;
- ☞ Overcrowding of animal: leading to easy spread of infectious diseases;

(b) Measures that can be used to prevent disease outbreak on the farm;

- ☞ Purchase animals from reputable producers; check to see production and reproductive records, and the look of the entire herd, in addition to the animal(s) being considered for purchase.
- ☞ Buy animals that are healthy; Ask for the appropriate health records or allow the veterinary doctor to check the animal for any clinical signs of ill-health.
- ☞ Isolate the new animal(s) for a suitable length of time before introducing them to the herd. Sufficient time should be allowed for symptoms of disease to appear or for measurable levels of antibodies to be produced (in the event that the infection is in the incubation stage).
- ☞ Control visitors on the farm; restrict visitors and vehicles from entering the farm. Do not allow visitor and truck into the farm unless they have been adequately checked, cleaned and disinfected.
- ☞ Have overalls and boots available for people who must enter into the livestock buildings, lots, and pastures. Street clothes should not be worn into these areas. Have and use footbaths with fresh disinfectant.
- ☞ Control birds, rodents, and stray animals as these may be carriers of diseases into the farm.
- ☞ Purchase feeds from reputable suppliers or mix feeds directly on the farm to avoid introduction of infections through contaminated feeds. Check and ensure that feeds are not expired.
- ☞ Double fencing along line fences may be necessary to protect your animals from those of a poorly managed neighboring herd.
- ☞ Control runoff from the neighbouring farm as this may carry disease parasites into the farm. Consider the location of animal buildings and lots in order to protect them from a neighbour's drainage.
- ☞ Quick detection and isolation of sick or suspected animals from the herd or flock and giving them immediate treatment. This prevents the spread of the disease to other animals on the farm.
- ☞ Animal dead of infectious diseases should be disposed of immediately to prevent the spread of the disease to other animals on the farm. Carcass can be disposed of by burying them deep in the ground or burning to ash.
- ☞ Regular vaccination of all animals on the farm to provide resistance against diseases to the animals.

Question 2

- (a) Describe the ideal site that the farmer would consider when establishing an apiary.
- (b) Give the advantages of using a queen excluder in a top bar bee hive.
- (c) Outline the management practices that increase honey production.

Suggested answers**The ideal site for the apiary should be:**

- ☞ The site should be away from human activities: play grounds and noisy commercial or industrial areas.
- ☞ It should be away from farm animals as animals can enter the apiary and provoke bees to strike.
- ☞ It should be near food source such as flowering plants and crops.
- ☞ It should be away from swampy or flooded valley or bottom land with stagnant water. Humid areas promote fungal infections and prevent proper honey curing.
- ☞ It should be accessibility with good roads on the leeward side of a hill to prevent strong winds.
- ☞ It should be away from smoke and fire, danger of vandalism and unfriendly neighbours.
- ☞ It should be away from direct sunshine and high atmospheric temperature.

(b) Advantages of using a queen excluder in modern bee hives.

- ☞ Helps to confine the queen to lay eggs only in the brood chamber leaving the supers only for honey storage.
- ☞ The honey in the supers is clean as it contains no brood.
- ☞ Wax harvested from the hive is clean as the harvested combs contain only extractable honey.
- ☞ It allows honey harvesting without much disturbance to the queen and the brood.
- ☞ It encourages the queen to lay more eggs thus, increasing the bee population which also translates into increased honey production.

(c) Apiary management practices that increase honey production

- ☞ Pest and disease control by keeping high level of hygiene in the apiary.
- ☞ Provision of foraging plants to provide pollen and nectar to bees (this can be achieved by growing crops such as sunflower, mango, avocado and citrus).
- ☞ Provision of security by fencing the apiary
- ☞ Provision of the shade to the hives
- ☞ Provision of water and food supplements during dry seasons
- ☞ Regular cleaning and hygiene practices
- ☞ Regular colony inspection.
- ☞ Re-stocking of the empty hives.
- ☞ Swarm control by provision of proper conditions in the hives
- ☞ Timely harvesting, processing and selling of honey.

Question 4

- (a) Define dystocia and give its causes in farm animals.
- (b) A cow in labour was observed with having difficulty in giving birth. Diagnosis of the problem revealed a calf's presence in the birth canal with front feet first and the head bending downwards between the front feet. Describe how you can help the cow to safely give birth. Use of caesarean section not allowed.
- (c) Describe the care that a farmer should give to pregnant animals on the farm.

Suggested answers

(a) Dystocia is a condition in which an animal in labour has difficulty in giving birth to young.

Causes of dystocia;

- ☞ Improper presentation of the foetus in the birth canal.
- ☞ Narrow birth canal in relation to the foetal size.
- ☞ Inadequate production of relaxin and, or oxytocin hormone which help in the dilation of the muscle and ligament of cervix and pelvis, and contraction of the uterine and abdominal cavity.
- ☞ Pathological conditions of the dam or foetus; weak or sick mother experience dystocia, and also poor developed foetus and weak foetus may also lead to dystocia.
- ☞ Fused joint or siamese twins and monstrosities such as calves with two heads or extra appendages.

(b) How to help a cow with difficult birth to safely give birth

- ☞ Restrain the animal using a crush or a headgate.
- ☞ Put on plastic gloves and apply a suitable lubricant over the gloves.
- ☞ Manoeuvre the gloved and well lubricated hand through the birth canal.
- ☞ Push the calf back into the uterus using gloved hand.
- ☞ Raise one leg up and to the side to give room to move the head.
- ☞ Grasp the muzzle of the calf and pull the head upward and towards the birth canal.
- ☞ Apply obstetrical chains to each leg and then pull the calf gently as the cow pushes.
- ☞ When the calf is out, remove the chain and help it to breathe in case it is not breathing.

(c) Care for the pregnant animals.

- ☞ The farmer should first carry out pregnancy diagnosis to establish whether the animal is pregnant or not.
- ☞ Proper feeding of the animal on balanced diet to cater for the increased nutrient needs for the mother and the foetus.
- ☞ Vaccination and immediate treatment of animals.
- ☞ Isolation of the animal from the males as these may continue chasing the pregnant animal resulting into stress and abortion. This important especially in goats.
- ☞ Regular parasite controlling by spraying and controlled dipping and deworming.
- ☞ Keep the animal away from severe weather such as strong rainfall and sunshine.
- ☞ Give the animal enough rest and avoid overworking of the animal.
- ☞ Give the animal plenty of clean drinking water regularly.
- ☞ When the animal is left with two months to give birth, it should be dried off to allow more nutrients to be channeled to the rapidly developing embryo.
- ☞ Towards the end of pregnancy the animal should be steamed up by giving it extra-nutritious feeds to provide more nutrients for the developing embryo.
- ☞ Towards the end of pregnancy the animal should be isolated and placed in the delivery paddock or pen.
- ☞ Provide bedding or nesting material to the animal.

Question 5

- (a) Outline the objectives of conserving forage on the farm.
- (b) Describe the procedure of making good quality silage on the farm.
- (c) Give the factors that affect the quality of conserved hay on the farm.

Suggested answers**(a) Objectives of conserving forage on the farm.**

- ☞ To provide more efficient animal production by making use of wasted pasture surpluses in the growing season.
- ☞ To increase the nutritional value of forage e.g. hay provide more fibre for proper rumen functioning and silage provides lactic acid, important in lactating animals.
- ☞ To allow for intensive farming with higher stocking rate than would otherwise be possible. This is because there is increased forage production.
- ☞ To bridge the nutrient gap during periods of scarcity.
- ☞ On large scale farms, conserved forage can be sold for cash e.g. baled hay.
- ☞ To allow animals to eat plant materials that would be dangerous to eat in fresh form. For example most succulent plant materials may cause bloat in ruminants so such plant materials would require conservation in dry form before being given to animals.
- ☞ To avoid unnecessary wastage of forage during time of plenty i.e. during rainy season.

(b) Procedure of making good quality silage on the farm.

- ☞ Prepare the silo. The silo should be clean and enough to accommodate all the forage. The silo can be stack silo or pit silo.
- ☞ Select good, palatable forage at flowering stage. At this stage the plant is fairly edible, tender and has high protein content.
- ☞ Cut the forage and allow it to wilt for 4 – 48 hours depending on the weather conditions.
- ☞ Transfer the forage to the silo site and chop it into small pieces (4-10cm). This allows easy piling and compaction of the forage in the silo.
- ☞ Pack the forage evenly in the silo. The silo should be filled about 1m in the first day and should be allowed to warm up to 40°C but not more, before the next layer is added. This encourages lactic acid producing bacteria to multiply.
- ☞ Add molasses to provide energy to microbes involved in the fermentation process. Also, add urea to increase the nitrogen content of the silage.
- ☞ Consolidate the forage by trampling or running a tractor on the material to remove excess air from the forage. Excess air in the forage may result into rotting and severe losses of nutrients in the silage.
- ☞ Seal off the silo to exclude air and water from the silo. The material should be covered with a polythene sheet and about 15cm layer of soil should be spread on top to weight the material down.
- ☞ Make a trench around the pit to keep surface runoff away from the pit.

(c) Factors affecting the quality of hay

- ☞ The type and nutrient value of the forage
- ☞ The stage of growth of the forage
- ☞ The weather conditions such as rain and sunshine
- ☞ The rate of drying of the forage
- ☞ The method used in drying the forage sun drying vs. air drying
- ☞ The method of storage of hay
- ☞ The amount and type of additives applied

Question 6

- (a) Explain the factors that a farmer should consider when selecting poultry breeding stock.
- (b) Outline the routine management practices of layers in a deep litter house.

Suggested answers**(a) Factors that a farmer should consider when selecting poultry breeding stock;**

- ☞ Breeder's health: birds should be examined for good health. The cockerel should be attentive to hens and should court them from time to time, without bullying. Birds should have clear bright eyes, have a red comb without any blue edges and the birds should be alert.
- ☞ Freedom from body defects that would interfere with free breeding; birds that have bowed legs or bent tails for example should not be used for breeding as these problems will just be passed on.
- ☞ Good reproductive characteristics in terms of fertility, hatchability, egg production (high hen housed and hen day production), and egg size.
- ☞ Age; the recommended age for mating of cockerel and pullets is 6 months. Using very young or very old birds reduces fertility of the produced eggs. Very young hens also produce small eggs and of low hatchability.
- ☞ Good mothering ability; this is important for brooding hens.
- ☞ Ability to be accepted or preferred by the cock.
- ☞ Cocks must be strong and able to breed many hens without excessive loss of body condition.
- ☞ Faster growth rate/maturity rate
- ☞ Good resistance to infections.
- ☞ Acceptable body conformation and feather colour subject to the breed, type and sex.
- ☞ Good feed conversion ability, i.e. into meat or eggs.
- ☞ Low rearing mortality.
- ☞ Low laying mortality.
- ☞ High growth and fast maturity (low age at 50% production).

(b) Routine management practices of layers in a deep litter house;

- ☞ Providing enough floor space to the birds; avoid congestion of birds in the house.
- ☞ Providing well balanced diet and supplement of vitamins and minerals especially calcium.
- ☞ Providing birds with clean water all the time. Lack of water results in reduced egg production and possibly death.

- ☞ In order to stimulate eggs production the length of artificial light should be increased to provide sixteen to eighteen hours.
- ☞ Trimming all the beaks of the flock to prevent egg pecking.
- ☞ Identify all the birds in the house for proper record keeping and supervision.
- ☞ Vaccinate all birds against infections such as gumboro, fowl typhoid, Newcastle and fowl pox.
- ☞ Providing good ventilation in the house.
- ☞ Providing perches for birds to roost on.
- ☞ Providing enough feeding and water troughs in well positioned points.
- ☞ Providing enough nesting boxes in strategic points. They should be darkened to prevent egg eating.
- ☞ Treating sick birds with suitable drugs according to the veterinary advice.
- ☞ Turning the litter regularly to prevent it from caking and becoming hard.
- ☞ Collecting eggs regularly from the nests.
- ☞ Culling poor layers i.e. sickly, too fat or too thin, and those with small-dry vent.
- ☞ Taking daily and weekly records of all the activities; production, selling, feeding and health.

Question 7

- (a) Explain the factors that affect the stocking rate of a fish pond.
- (b) What are the causes of the following conditions of the fish pond
 - (i) Low pH.
 - (ii) Low oxygen.
- (c) Outline the advantages and disadvantages of using cages to rear fish.

Suggested answers

(a) Factors that affect stoking rate of a pond

- ☞ Fish species: some fish species require more space because of their behaviour.
- ☞ The rate of reproduction e.g. low stocking rate is recommended with species which multiply very fast.
- ☞ The size and weight of fish: larger fish require relatively more space than smaller fish of the same species.
- ☞ Fertility of the pond and its ability to provide natural food supply.
- ☞ The amount of natural and supplementary feeds.
- ☞ The size of the pond.
- ☞ Water quality (metabolite contamination and oxygen supply).
- ☞ The growth rate of the fish and the period of time the fish take to mature.
- ☞ Level of management of the pond such as fertilizer application supplementary feeding.
- ☞ Pests and diseases

(ii) Causes of low pH of the pond:

- ☞ Constant acidic rains
- ☞ Application of acidic fertilizers.
- ☞ Accumulation of metabolites and wastes from the fish.

- ☞ Acidic soils on which the pond was constructed.
- ☞ Accumulation of organic matter in the pond. These decompose to produce organic acids

(ii) Causes of low oxygen in the pond:

- ☞ High level of respiration from fish due to high stocking rate.
- ☞ Over fertilizing of the pond leading to algal bloom which make a mat over the water surface, preventing diffusion of oxygen into the pond from the atmosphere.
- ☞ Muddy or turbid condition of the pond, stopping sunlight from reaching water plants thus, reducing photosynthesis and finally reducing amount of oxygen being released.
- ☞ Cloudy days that reduce sunlight energy and photosynthesis.
- ☞ Dense vegetation in and around the pond that use atmospheric oxygen at night.
- ☞ High pond temperatures which reduces the oxygen holding capacity of water.
- ☞ Limited wind to stir water to increase oxygen diffusion.

(c) Advantages of rearing fish in cages

- ☞ Requires very little maintenance and management.
- ☞ Fish are protected from predators.
- ☞ Allow more fish production (high stock densities)
- ☞ Requires very low investment.
- ☞ Fish suffers less from diseases.
- ☞ Constant water exchange inside and outside the cage provide sound environmental condition for fish which improve growth.

Disadvantages of rearing fish in cages

- ☞ There is high risk of damage to the cages due to flood and high wave current.
- ☞ Adverse environmental changes such as pollution, extreme temperature and water level changes are dangerous to caged fish.
- ☞ High feed quality is required.

Question 8

- Outline the Indicators which show that a natural pasture is in need of improvement
- Explain how you can improve the efficiency a natural pasture.
- Give the benefits of a mixed pasture.

Suggested answers**(a) Indicators which show that a natural pasture is in need of improvement**

- ☞ The presence of poor unproductive grass species. Some species of grass may be less nutritious or may have low digestibility.
- ☞ High proportion of dead plant tissues on the ground which may prevent free movement of water and air into the soil.
- ☞ Increased selective grazing as a result of increased less palatable or unpalatable pasture species. In pasture selective grazing is exhibited by irregular grazed pasture i.e. some spots may be heavily grazed while other spots remain under grazed.
- ☞ Presence of weeds and poisonous plant species such as tick berry, Sodom apple, thorn apple and black night shade.

- ☞ Presence of parasites such as liver flukes and ticks in the herd. Liver flukes may be as a result of poor drainage in the pasture resulting in the prevalence of water snails which are the intermediate hosts for liver flukes.
- ☞ Reduced milk and meat production in animals in terms quantity and quality
- ☞ Reduced weight gain in especially growing stock. This is most applicable in meat animals.
- ☞ Overgrown pasture with less foliage high stalk and less palatable leaves.
- ☞ Presence of wet spots especially during rainy season. Such wet spot could act as breeding place for parasites such as liver flukes and mosquitoes.

(b) How to improve the efficiency of a natural pasture

- ☞ Introduction of well adapted pasture legumes which add nitrogen to the soil.
- ☞ Use of creeping grasses which simply grow in that environment to provide more ground cover and modify soil temperature and soil moisture availability.
- ☞ Controlling inedible or toxic species and encouraging the plants which give the highest yield when ingested by animals
- ☞ Application of fertilizers to prevent nutrient deficiencies limiting pasture growth.
- ☞ Application of agricultural lime to reduce acidity and improve the structure of soils so as to improve the soil conditions for pasture growth.
- ☞ Irrigation of pastures especially during dry spells. This helps to maintain continuity of feed supply to animals.
- ☞ Water retention on seasonally flooded areas to extend the period of forage growth.
- ☞ Control of run off by ridging and terracing to increase infiltration of water into the soil.
- ☞ Clearing of shrubs and trees to avoid shading of grasses.
- ☞ Fencing of pastures to control diseases and pests and to facilitate controlled grazing.
- ☞ Keeping the right number of animals on the pasture to avoid over grazing
- ☞ Provision of drinking water in the pasture. The water points should be well distributed to avoid localized grazing which may either lead to overgrazing or under grazing.
- ☞ Controlled burning to destroy a mat of undecayed plant residues on the ground so as to increase infiltration of water and air circulation. Also burning helps to stimulate fresh growth and to destroy animal parasites in the pasture.
- ☞ Draining of all wet spots to control parasite such as mosquitoes and liver flukes.
- ☞ Regular topping of overgrown pasture to stimulate fresh growth.
- ☞ Use of baits to pick and control parasites in the pasture. Baits are later treated to kill all the parasites they picked from the pasture.
- ☞ Provision of animal shades in the pasture to protect animals from bad weather such as rains, sunshine and winds.

Benefits of a mixed pasture

- ☞ Different species have different rooting habit. Some may be deep rooters while others may be shallow rooters. This ensures even removal of nutrients at different soil depths.
- ☞ Because different plants have different maturity time, pasture production is guaranteed all the year round. This ensures stability of production in animal.
- ☞ There is increased energy value of pastures since different plants supply different levels of carbohydrates and other essential minerals.

- ☞ There is increased supply of organic matter from leaf fall this helps to conserve moisture and suppress weed growth.
- ☞ Legumes in the mixture help to fix nitrogen in the soil. The nitrogen fixed is used by growing grasses in the mixture, thus reducing expenditure on nitrogenous fertilizers.
- ☞ Legumes in the mixture increases palatability and nutritive value of the pasture thus minimizing the need for supplementary feeding.
- ☞ Because of the rooting habit of legumes they are more tolerant to drought thus extend the grazing period into dry seasons.
- ☞ Legumes provide good soil cover and supply more organic matter to the soil; this helps to minimize soil erosion and conserves soil moisture.
- ☞ A mixture of legumes and grasses gives a higher yield of herbage than either grasses or legumes planted alone.
- ☞ The mixture reduces management costs by reducing the frequency and intensity of weeding and fertilizer application.

CROP PRODUCTION

Question 9

- (a) Outline the benefits and Limitations of urban farming.
- (b) Explain how farming can be encouraged in urban and peri-urban areas
- (c) Outline the benefits of processing farm produce

Suggested answers

(a) Benefits of urban farming

- ☞ Helps to reduce organic garbage by utilizing organic waste as compost by urban farms.
- ☞ Public land dedicated to urban agriculture is maintained by farmers and gardeners, reducing maintenance costs for the City.
- ☞ Reduces costs of transporting food from rural areas.
- ☞ Increases local employment, e.g., landscaping, design, green house construction, urban farming, and retailing.
- ☞ Ensures utilisation of under-used resources e.g. rooftops, roadsides, and vacant land.
- ☞ Provides an opportunity for treating industrial wastes and wastewater through re-use in agriculture.
- ☞ Attracts new businesses such as agricultural equipment industries, processing facilities, restaurants, shops, and markets.
- ☞ Increases opportunity to access healthy food for low-income people in urban areas.
- ☞ Increases social opportunities in the form of community gardening, mentoring programs, shopping at farmer's markets, and harvest festivals.
- ☞ Provides food security to urban people in case of natural disaster in rural areas.
- ☞ Urban farmers and gardeners can assist in protecting public spaces from unofficial uses and informal re-zoning.

Limitations of urban farming

- ☞ High cost of inputs such as irrigation water and labour in urban areas.

- ☞ High level of pollution from industries.
- ☞ Lack of policy and regulations addressing urban farming in statutory plans.
- ☞ Limited space in urban areas.
- ☞ Possible noise, dust, traffic, pesticide use, and odour associated with farming activities
- ☞ Restrictions on building of farm structures such as greenhouses and storage sheds in towns
- ☞ Restrictions on keeping small livestock and farm animals (e.g. chickens and bees).
- ☞ Restrictions on the selling of produce from farm sites.
- ☞ Theft and vandalism of crops and animals.

(b) Encouraging the adoption of farming in urban and peri-urban areas

- ☞ Providing school aged children living in urban environments a hands-on farm experience.
- ☞ Supplying compost manure from the collected garbage for free to urban farmers.
- ☞ Supporting urban farmers by providing credit or space on condition that ecological modes of production are used along with adherence to food safety regulations.
- ☞ Creating permanent sites for farmers' markets throughout the city; incorporate necessary utilities, parking, and loading areas into the design and provide these facilities at minimal cost.
- ☞ Support public-private partnerships between city councils and urban farmers to establish stable agricultural activities in and near cities.
- ☞ Support or provide incentives to schools, hospitals, military centres, and other landowners to promote food production on their grounds.
- ☞ Review bylaws governing the keeping of livestock and other animals within the City.
- ☞ Establish a municipal agricultural land bank to link available land with people wishing to farm by issuing temporary licenses to users.
- ☞ Incorporate urban agriculture into new developments by creating a package of incentives for developers who incorporate urban agriculture into their designs.
- ☞ Designate peri-urban agricultural zones in city development plans as parts of "green belts" or "green corridors".
- ☞ Providing security to urban farmers.
- ☞ Providing demonstration gardens for urban people to learn from.

Explain the points as required by the question

(c) Benefits of processing farm produce

- ☞ Raises the economic value of farm products thus brings higher income to farmers by selling of better quality products.
- ☞ Reduces bulkiness of the farm products thus lowering storage, transportation and marketing costs
- ☞ Processing farm produce lengthens storage life of the crop
- ☞ Processing improves the nutritional value of the produce thus improving the diet of the populace
- ☞ Converts otherwise useless farm wastes into marketable products
- ☞ Helps to integrate agricultural development and industrial growth

- ☞ Allow easy and cheap packaging of products
- ☞ It reduces pests and disease attack to the crops for example grain moth can be controlled by threshing grains

Question 11

- (a) Describe the sustainable soil management methods used to maintain soil fertility.
- (a) Explain the factors influencing crop response to fertilizer application.
- (c) Briefly describe how you can prepare good quality manure tea from fresh cow dung.

Suggested answers

(a) Sustainable soil management methods used to maintain soil fertility.

- ☞ Crop rotation with legumes and a fallow period to maintain sufficient nutrient supply, and control soil borne pests and diseases.
- ☞ Application of manure to increase the level of soil organic matter: SOM has a high capacity to hold and release inorganic nitrogen and other essential nutrients to plants.
- ☞ Use of cover crops to control soil erosion, weeds and provide organic matter to the soil.
- ☞ Use of soil amendments such as lime to maintain optimum soil pH.
- ☞ Supplemental fertilizers should be used when suggested as necessary by soil test results, plant growth observations, or plant tissue testing to prevent plant nutrient deficiencies.
- ☞ Proper timing of tillage operation: breaking up compacted areas and large soil clods and thus increase aeration. Properly timed tillage also increases water infiltration and good drainage.
- ☞ Proper management of irrigation to avoid runoff, erosion, and leaching of soluble nutrients. For irrigation-dependent crops, manage soil moisture between 50% and 100% of field capacity through soil moisture monitoring and moisture retention techniques such as mulching.

(b) Factors influencing crop response to fertilizer application

Stage of the crop growth: different nutrients in the fertilizers are required by plants at different stages of growth. E.g. phosphorous is very vital at root development stage, nitrogen is vital at vegetative growth and sulphur is significant at seed/fruit setting stage.

Soil texture: this affect nutrient retentive and cation exchange capacity of the soil. Coarse soils have low adsorption of nutrients and encourage leaching of fertilizer nutrients.

The type of the soil: some soils such as clay fix nutrients making them unavailable to crops.

Soil pH: extreme soil pH reduces availability of some nutrients to plant roots for absorption. This is because pH affects solubility of many fertilizers and the rate of ionization of many nutrients.

Method of placement the fertilizer: fertilizers applied within the reach of the plant root are more readily absorbed than fertilizers applied far from roots.

Amount of water in the soil: soil water help to dissolve fertilizers and ionize nutrients so that they can be absorbed by crop roots and then transported via the transpiration stream.

Amount of fertilizer applied: optimum amount of fertilizer should be applied for good crop response. Too little fertilizer application reduces crop response. Too much fertilizer may be toxic to crops.

Plant density: proper plant population reduces competition for fertilizers thus ensuring maximum utilization of nutrients from the fertilizer applied.

Rooting habit of the crop: crops with roots spreading near the soil surface utilize fertilizers applied in the soil more readily.

Amount of bioactivities in the soil: some organisms help in the transformation of nutrient to utilizable forms for example transforming ammonia to nitrates. Also mycorrhizal association with plant roots increases plant response to nutrients in the soil.

Health of the crop: healthy crops have their internal processes working well to generate energy to absorb and utilize nutrients from applied fertilizers. Unhealthy crops may not be active enough to absorb and transport nutrients.

Level of weed infestation: weeds compete with crops for nutrients. Thus as the weed infestation increases, crop response to fertilizers reduces.

Solubility of the fertilizer: crops respond readily to fertilizers of higher solubility than those of low solubility.

Good crop management practices: good crop management practices such as pruning, thinning, irrigation and pest and disease control increase crop response to fertilizer application.

Weather conditions: wet and warm weather conditions increase fertilizer solubility and absorption by crop roots.

(c) Preparation of good quality manure tea using fresh cow dung;

- ☞ Obtain a bucket or drum and place it in a warm place,
- ☞ Fill the drum half way with water (about twice as much water as manure),
- ☞ Place fresh dung in the water in the bucket /drum,
- ☞ Stir the manure once a day or so to help mix and aerate the liquid,
- ☞ Let the tea steep for about two weeks. The longer it steeps, the stronger it gets.
- ☞ Then, after two weeks, Strain the leftover organic matter from the liquid using a fine sieve.
- ☞ Then, dilute the sieved liquid (manure tea) to the required concentration.

Question 13

- (a) State the importance of soil and water conservation.
- (b) Outline the effects of soil erosion on the farm.
- (c) Explain how vegetation influences Influence soil erosion
- (d) Describe the different mechanical methods of soil and water conservation.

Suggested answers

(a) Outline the importance of soil and water conservation

- ☞ Helps to reduce soil losses by taking remedies against erosion.
- ☞ Helps to reduce degradation of soil and vegetation.
- ☞ Allows the soil to retain enough water essential for healthy crop and vegetation growth.
- ☞ Helps to maintain chemical, biological and physical properties of soil responsible for increasing soil productivity.

- ☞ Helps to maintain sustainable soil productivity through good management of soil.
- ☞ Helps to reduce soil pollution which would be dangerous to soil flora and fauna and aquatic life.

(b) Effects of Soil erosion on the farm;

- ☞ It leads to loss of applied fertilizers in the soil and loss of essential nutrients such as nitrogen phosphorous, and potassium, removed with eroded soils.
- ☞ It can lead to surface crusting due to the drying of transported materials on the soil surface. This may prevent emergence of seedlings.
- ☞ It may lead to profile invasion where by sub soils from upland may be deposited on top soils.
- ☞ Erosion may remove the agricultural potential soils by exposing sub soils which are hard and less fertile for cultivation of crops.
- ☞ Erosion may cause destruction to growing crops by removing soils around the roots and may end up uprooting the whole plant.
- ☞ In extreme cases of erosion, where gullies have formed, land is deformed and movement of the machines on the land is inconvenienced.
- ☞ It may lead to siltation of water reservoirs such as dams, lakes, and fish ponds.
- ☞ It may lead to the degradation of vegetation which can lead to other related problems such as low organic residues and increase in evaporation of soil moisture.
- ☞ Crops growing in the valley bottoms where deposition of eroded soil takes place may be buried under the eroded soils and debris.
- ☞ Pollution of the water bodies may take place; soils from farmland containing agricultural chemicals such as pesticides and fertilizers may be carried and deposited in the water bodies leading to destruction of aquatic life and eutrophication of the water that can also lead to blossoming of water weeds and algae.
- ☞ Increases the incidence of flooding on the farm.
- ☞ It leads to loss of land for agriculture as heavily eroded lands with huge gullies are almost impossible to cultivate.

(c) Influence of vegetation on erosion;

- ☞ It Covers the soil, stopping rain drops and dispels the impact (or energy) of rain drops on the soil
- ☞ It reduces the speed of water flow and surface run-off thus reducing the ability of the water to erode the soil.
- ☞ Vegetation helps to trap and filter out the soil particles from flowing water thereby restrict soil movement.
- ☞ The presence of vegetation increases soil aggregation and granulation this in turn results in great infiltration and hence reduces run-off and soil loss
- ☞ Transpiration results in the reduction of soil moisture thereby increasing water storage capacity during rainfall.
- ☞ Roots of vegetation and organic residue hold the soil firm, thus making it less liable to erosion.

- ☞ The organic matter produced when vegetation die and decompose help to bind soil particles together and increase water infiltration and storage into the soil.
- ☞ Vegetation improves micro-climate favourable for activity of soil organisms. Soil organisms make tunnels in the soil which improve drainage and water infiltration into the soil there by reducing surface run-off and soil erosion.

(d) Mechanical methods of soil and water conservation

Use of Gabion/porous dams: gabions are wire net baskets filled with stones which are positioned along the sides of a gully or across the gully to prevent erosion of soil by water. The gabions trap and retain soil particles in the water and reduce the speed of the water

Trash and stone lines: trash from plant remains such as stems from cotton, maize or stones are heaped along the contours to trap the soil out of the water flowing down the slope.

Use of bunds: these are heaps of soil or of earth built on a slope to reduce the speed of run-off. Bunds are constructed along the contour lines at 50cm high and grasses are planted on top so as to hold the soils in position.

Cut off drains/diversion channels: this involves reduction of the amount and speed of water run-off flowing down the slope by diverting or cutting it off into a valley or any natural water way such as a river, or into non-erodible stony-rock or onto grassland which has a well-established grass cover.

Use of terraces: terraces are earthworks aimed at reducing the length and gradient of the slope. Terracing reduces the volume and the speed of run-off.

Graded banks: in this method run- off is reduced by dividing the land into smaller pieces of land through the construction of banks which leads the water away from the field to prevailing rivers or valleys.

Use of absorption banks: these are channels constructed across the slope to trap and retain water, encourage sedimentation and reduce the volume of surface run-off.

Construction of barrages (dykes) across the gullies: these are made up of stones or wood constructed across the gullies to reduce the speed of water flow and allow sedimentation of the soil. When barrages are filled with soils the slope gradient is reduced.

Question 14

- (a) Outline the causes of poor drainage on the farm.
- (b) Give the effects of poor drainage on the farm.
- (c) Describe the subsurface methods used in draining farm land.

Suggested answers

(a) Causes of poor drainage on the farm

- ☞ Excessive rainfall and low evapotranspiration rate.
- ☞ High percentage of clay particles in the soil which limit water infiltration.
- ☞ Development of impermeable layers on or below the soil surface which interferers with percolation of water into the soil.
- ☞ Poor landscape e.g. a valley or flat land which protects water movement from the land thus causing accumulation and concentration of water in one place.
- ☞ Excessive irrigation of the soil especially in flood irrigation method soil depth.

- ☞ High water table within the soil.
- ☞ Shallow soil depth.
- ☞ Poor farm planning such as unplanned layout of farm buildings.

(b) Effects of poor drainage on the farm

- ☞ Leads to flooding and submerging of crops, roads, building foundations, and equipment.
- ☞ Poor soil aeration leading to suffocation of roots and important soil organisms.
- ☞ Reduces soil consistency making the soil soft and unable to support building. This results into failure of building foundations and collapse of building.
- ☞ Makes mechanization almost impossible on the farm. The soft ground and water makes movement of machines so difficult.
- ☞ Soils become very cold. This interferes with biochemical processes in the soil.
- ☞ Leads to proliferation of vectors on the farm. Water snails (secondary hosts for liver flukes) and mosquitoes (secondary hosts for malaria parasites).
- ☞ Causes soil erosion and leaching of soil nutrients.
- ☞ Interferes with free movement of farm animals and people.
- ☞ Increases disease incidences on the farm e.g. bilharzia and foot rot, and malaria.
- ☞ Reduces the economic value and use of land.

(c) Subsurface methods used in draining land

Mole drainage system; in this system, a pointed cylindrical plug about 7-10cm in diameter is pulled through the soil at the desired depth creating an underground water channel. The channel formed provides a good mechanism for the removal of excess water.

Perforated plastic pipe; pipes with hole is laid in an open ditch and then covered with gravel and then soil. Water moves into the pipe through hole and is channeled to an outlet ditch.

Clay tile system; this is made up of individual clay pipe units of about 30 – 40cm long, placed end to end underground in a manner that leave some gaps between them so that water can drain into them and flow away. The tiles are installed in an open ditch and then covered with stones, gravel, and then filled with top soil.

Sub soiling; this involves deep cultivation using chisel ploughs and subsoilers, to break hard soil pans so as to increase water infiltration into the ground. In this case excess water percolates deep into the lower layers leaving the surface soil well drained.

Use of deep rooted plants; plants with high transpiration rates and excellent water absorbing capacity are used to provide a cheap means of drainage especially in moderately water logged soils. Also the roots of these plants can penetrate and break the hard soil surfaces in the soil and increase water percolation.

Question 15

- (a) Define the term irrigation efficiency and outline the benefits of irrigation in crop production.
- (b) Give the factors that should be put into consideration when planning an irrigation system on the farm
- (c) Give the advantages and limitations of sprinkler irrigation method

Suggested answers

- (a) Irrigation efficiency refers to the ratio of the water actually consumed by crops on an irrigated land to the amount of water applied from the source.

$$\text{Irrigation efficiency} = \frac{\text{water added} - \text{water lost}}{\text{water added}} \times 100$$

Benefits of irrigation in crops

- ☞ It enables control of the timing of planting and production of crop throughout the year.
- ☞ Control of the quantity of moisture in the soil is possible.
- ☞ It enables cropping in arid and semi-arid regions.
- ☞ It is a mechanism of supplying fertilizers (fertigation) in the field.
- ☞ Irrigation water helps to moderate soil temperature thereby creating more favorable environment for plant growth and soil organisms.
- ☞ Risk and uncertainty regarding water supply to plants are eliminated.
- ☞ Enables planting of varieties of crops in the field.
- ☞ Irrigation water softens the ground for easy tillage operations.
- ☞ It washes out or dilutes salts in the soil.
- ☞ Some irrigation methods may be used to effectively control weeds and pests in the field e.g. flood irrigation.
- ☞ Increases yields and quality of crops.
- ☞ It provides an insurance against food shortage due to drought.

(c) Factors that should be put into consideration when planning an irrigation system

Soil type: physical and chemical properties of the soil should be defined; the texture and structure of the soil affects infiltration rate, water holding capacity and agriculture potential of the soil

Slope and evenness of the soil surface: this is important in selection of the irrigation system design and layout. For rough very steep land where surface irrigation would cause soil erosion, pressurized irrigation methods would be used.

Water resources available: a survey of water resources available in the area should be carried out. The reliability of water supply and the quality of the water in terms of salinity should be investigated.

The type and water requirement of crop to be irrigated: this is important in designing an irrigation system to use in the field. The evapotranspiration potential should be investigated.

Financial and economic aspects: this looks into the following: whether there will be enough funds to complete the project; whether there will be funds to operate the system effectively; and whether the financial and social benefits will make it worthwhile.

Climate of the area: information related to the rainfall, temperature, humidity, sunshine hours, evaporation and wind should be obtained to obtain correct water requirement of the crops in the field.

Social and environmental impact considerations: consider the level of literacy, farming knowledge, existing skills in irrigated farming and farmers' attitude to change. Environmental impact assessment must be carried out to inform the different levels of decision making. All stakeholders should be consulted and informed about the project.

Traditional rights of land and water: these affect irrigation design and operation. Land reform measures (land tenure) can limit irrigated agriculture.

Transport and market potential: evaluation of the existing markets and transport systems to ascertain their potential to handle the high production as a result of irrigation.

(c) Advantages of sprinkler irrigation method

- ☞ It can conveniently be used in hilly areas, or in places where the land is ragged and cannot be easily be leveled for surface irrigation
- ☞ Water is provided slowly and gently to the soil, this encourages more infiltration and reduces incidences of soil erosion.
- ☞ It uses relatively less water and the amount and frequency of irrigation can be regulated.
- ☞ Agricultural chemical such as fertilizers and herbicides can be conveniently and uniformly applied through irrigation water.
- ☞ The method is ideal for soils with high rate of infiltration such as sandy soils, where surface irrigation is almost impossible
- ☞ Cases of flooding are eliminated this maintains aeration in the soil, leaching is minimal and the occurrence of vectors such as mosquitoes and live flukes is controlled.
- ☞ The method is simple and can be operated by even unskilled workers on the farm.

Limitations of sprinkler irrigation method

- ☞ The system requires high initial capital to install the pump, pipes, sprinklers etc.
- ☞ Assembling and disassembling of pipes as well as regular shifting of pipes and sprinklers is labour demanding and tiresome
- ☞ The system may not be efficient to use in windy weather. Wind blows away water in one direction causing uneven distribution of water.
- ☞ Water droplets hitting the soil surface may cause compaction of soil particles which may result into surface crusting as the soil dries.
- ☞ It needs only clean water since dirty water can block nozzle causing failure of the system to perform irrigation work. For impure water, prior filtering or straining of water should be done
- ☞ The system needs a close supervision to monitor performance. This is not only inconveniencing but also costly.
- ☞ The splashing effect of water on the soil and the leaves may encourage the spread of diseases from the soil to crops or from one crop to another.

Question 18

- (a) Outline the advantages and limitation of grafting as a method of propagation of crops
- (b) Describe the procedure of grafting a desired mango scion.
- (c) Explain the factors affecting the success of grafting.

Suggested answers

(a) Advantages of grafting as a method of propagation of crops

- ☞ Grafting can be used to change the plant from being undesirable to desirable. This is done by replacing the undesired shoot with desired shoot.
- ☞ It enables propagation of crop that would be difficult to propagate by other means

- ☞ Grafted crops mature faster than seed propagated crops
- ☞ Grafting can be used to test for disease resistance in some crops. This is done by grafting susceptible scion to a resistant stock and the observing the response.
- ☞ It makes the growing of more than one type of plant on one stock possible. This economizes space required to grow the different types of crops in the garden.
- ☞ Rootstocks with desirable qualities such as disease and pest resistance, drought resistance and resistance to salinity can be harnessed for production of beneficial but susceptible crops.
- ☞ Grafting may be used to repair damaged plant parts; when the stem is damaged either by pests or browsing animal, it can be cut off and replaced with a better health stem.
- ☞ Provides an opportunity of utilizing good qualities of the rootstock and scion of different plants of the same species.

Limitations of grafting as a method of propagation of crops

- ☞ The method requires a lot of skills to carry out.
- ☞ It is not reliable as any slight mistake can lead to total failure.
- ☞ It can only be done in propagation of some few crops.
- ☞ The method requires a lot of time and labour.
- ☞ Grafted crops can easily be damaged by wind.
- ☞ Spread of diseases from the mother plant to the grafted plants may occur.
- ☞ Grafting can only take place in closely related families thus not giving a chance to have different families on the same root stock.

(a) Procedure of grafting a desired mango scion

- ☞ Select a seed from a mother that is vigorous and well adapted to the soil condition to provide the rootstock,
- ☞ Raise the seed in a pot nursery,
- ☞ A seedling is ready for grafting when the stem is pencil thick,
- ☞ Select a dormant shoot from a mother plant with desired qualities and of the same species as the rootstock to provide the scion,
- ☞ Grafting should be done on a cool day or in a cool environment,
- ☞ Use a sterilized razor blade or grating blade to cut the scion and the stock,
- ☞ Make matching cuts on both the scion and the stock. The cuts can be V-shaped or straight slanting cut on both the scion and stock,
- ☞ Remove all the leaves from the scion to reduce transpiration,
- ☞ Join the scion to the stock, making sure that the cambia tissues of the scion and the stock are in contact,
- ☞ Tie the joint with grafting tape and apply grafting wax to prevent infection,
- ☞ Keep the grafted plant in cool humid environment and away from wind until buds starts to sprout,
- ☞ Remove the grafting tape after the joint has healed and then acclimatize and transplant to the main field.

(c) Factors affecting the success of grafting

Compatibility of the scion and the rootstock: the scion and the rootstock should be from genetically related plants (plants of the same species).

Type of plant: grafting is only possible in some plants especially those with woody stems.

Grafting technique used: the cuts made in the scion and rootstock should be matching for the joint to be firm and to encourage maximum cambial contact. This encourages union and quick healing of the joint.

Post grafting care: good care of the newly grafted plants is vital to accelerate union and healing of the plants. Plants should be provided with warm temperature and high humidity and the joint protected from infection.

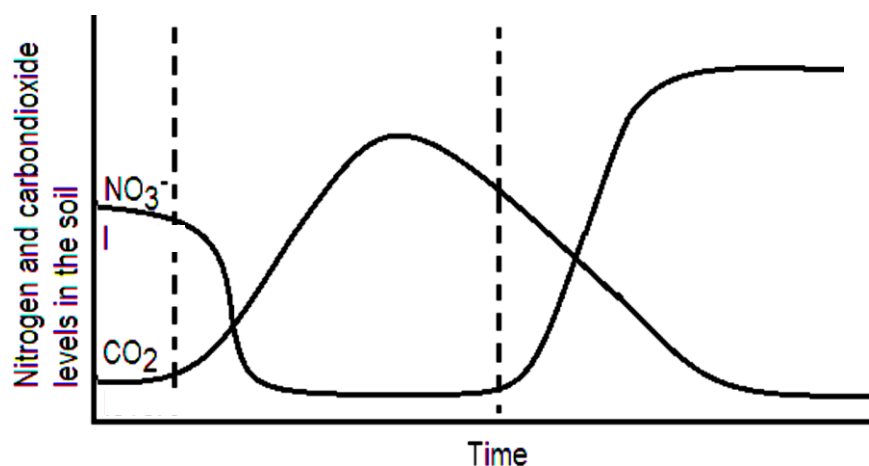
Pest and disease invasion: any pest or disease attack to the grafted plants can lead to failure of the plants..

The quality of the rootstock or the scion: these should be healthy and vigorous. The scion should be dormant and not actively growing at the time of grafting.

Question 17

Figure 1 below shows changes in nitrate level of the soil during the decomposition of low nitrogen crop residues. Study the figure carefully and answer the questions that follow.

Figure 1



- Describe the trend in the changes in the levels of nitrogen and carbon dioxide.
- Account for the changes in the levels of nitrogen and carbon dioxide.
- Explain the factors that affect nitrification process in the soil

Suggested answers

- Nitrate level decreases rapidly at the start of the decomposition process then the level becomes constant and then after, the level increases rapidly and then become constant. Carbon dioxide level increases rapidly at the start of the decomposition process, then, the level decreases gradually and then becomes constant.
- The decrease in NO_3^- level in the soil at the start of decomposition is due to immobilization of nitrogen by high level of soil microorganism during the decomposition of residues. And the increase in the level of NO_3^- is due to final decomposition and mineralization of organic nitrogen in the organic residues.

The increase in the CO₂ level at the start of decomposition is due to the increase in the population and activities of microorganisms which produce a lot of CO₂ in respiration process. The decrease of CO₂ is due to the decrease in the number of microorganisms as a result of death due to reduced energy levels as C:N ratio narrows and food supply diminishes causing intra and inter-specific competitions.

(c) Factors affecting nitrification process in the soil

Level of ammonia: nitrification can take place if there is a source of ammonia to be oxidized. Therefore optimum level of ammonia has to be present for nitrification to proceed well. This is affected by C:N ratio of residues.

Aeration: Soil aeration and optimum drainage is needed to provide the oxygen for the nitrification process. Ploughing of the soil may promote nitrification.

Source of carbon: nitrifiers (autotrophs) use carbondioxide and bicarbonate ions as a source of carbon for their body tissues

Temperature: temperature most favourable for nitrification is 25 – 35°C. Consequently, nitrification is slow in cool soils.

Level of base-forming cations and pH: nitrification proceeds most rapidly where there is an abundance of exchangeable base-forming cations. Soil pH has little influence on nitrification but may have an effect on the prevalence of base-forming cations.

Pesticides: Nitrifying organisms are quite sensitive to some pesticides. If used at high rates, pesticides inhibit nitrification almost completely or slow down the process.

Moisture content of the soil: nitrification is slowed by both very low and very high moisture contents of the soil. Mineralization can still occur under flooded conditions but it stops at the ammonification stage because only aerobic organisms can convert the ammonium compounds into nitrate ions.

Fertilizer salts: small amounts of any kind of salts even those of trace elements stimulate nitrification. Application of large quantities of NH₄ to strongly alkaline soils has been found to replace a certain step of nitrification process. NH₃ is toxic to Nitrobacter but does not affect the Nitrosomonas. Consequently Nitrite accumulation in large quantities may become toxic when NH₄ salts are added to soils with very high pH.

Question 20

- (a) What integrated weed management and give its benefits as a method of weed control
- (b) Outline the adaptations that make weeds more successful in competition with crops.
- (b) Describe the cultural methods of controlling weeds on the farm.

Suggested answers

(a) Integrated weed management

This is a weed management system which combines and integrates biological, cultural and chemical controls to reduce and even eradicate weeds in the field.

Benefits of integrated weed management

- ☞ The system can effectively cope up with weed problems of a wide range of cropping systems

- ☞ The system makes weed control cheaper than using isolated methods intensively
- ☞ The environment is protected from pollution due to over use of chemicals
- ☞ Less labour is required in this system as compared to cultural methods
- ☞ Reduces tillage operations on soil which hastens development of a stable soil structure.

(b) Adaptations that make weeds more successful in competition with crops

- ☞ They produce very many viable seeds which ensure their continued survival and rapid multiplication in the field
- ☞ Weed seeds exhibit long dormancy periods. This ensures that they grow only during favourable climatic conditions.
- ☞ They have short life cycles i.e. they germinate, flower and set seeds in one season. This ensures that they escape harsh conditions such as drought in the field.
- ☞ Most weeds possess well developed rooting systems which enable them to absorb nutrients and moisture from all parts of the soil.
- ☞ They demand less nutrients as related to crops, thus, they are able to grow on infertile soils.
- ☞ Some have underground stems, rhizomes and bulbs that are able to sprout after the tops/shoots have been destroyed.
- ☞ They have good tolerance to pests and diseases as compare to crops
- ☞ They are less palatable and poisonous for grazing animals. Thus, weeds are spared in preference of other plants when animals are grazing.
- ☞ Weeds have a variety of dispersal mechanisms. Some can be dispersed by animals, wind, and others by water. This ensures quick colonization of new areas in a short period of time.
- ☞ Some weeds have protective mechanisms which help to protect them from enemies, such as possession of prickles, spines, thorns, hairy body and thick cuticle around their structures.
- ☞ Some weeds are parasitic and depend wholly or partly on crops for nutrients and water.

(c) Cultural methods of weed control

Burning: This aims at destroying weeds and their seeds. It is commonly used during land clearing to destroy dry weeds prior to cultivation

Proper seed bed preparation: this aims at destroying weeds during seedbed preparation so that planted crops growing in a weed free environment.

Mulching: mulches control weeds by cutting out the light from the soil surface so that weed seeds do not germinate and for any which germinate it is smothered.

Crop rotation: this aims at controlling parasitic weeds which associate with particular crops e.g. *Striga hermontheca* can be controlled by not growing cereals in the field for some time.

Flooding: This is used to control weeds which cannot resist water logging. This method is used to control weeds in rice fields.

Controlled grazing: most weeds are less palatable to live stock so animals will graze selectively. Eating up palatable species and leaving out unpalatable weeds to dominate the

pasture. However controlled grazing e.g. by paddocking ensures that animals graze uniformly leaving no room for weeds to grow.

Proper spacing of crops and use of correct seed rate: over spacing of crops (low seed rate) promotes weed growth. However, when crops are planted at a recommended spacing, little space is left for weeds to grow. Also the canopy produced by the crops which are closely spaced help to cut off sunlight from the soil thus preventing weed germination and growth.

Use of clean seeds or clean planting material: Seeds for planting should be completely free from weed seeds that could introduce weeds in the crop field. Thus prior cleaning of planting seeds or use of certified seeds helps to control spread of weeds

Intercropping: This aims at utilizing the space within the field so that weeds are left with no room for germination. Also intercropping produces a good canopy that cuts off the sunlight from the soil surface so that weeds do not grow.

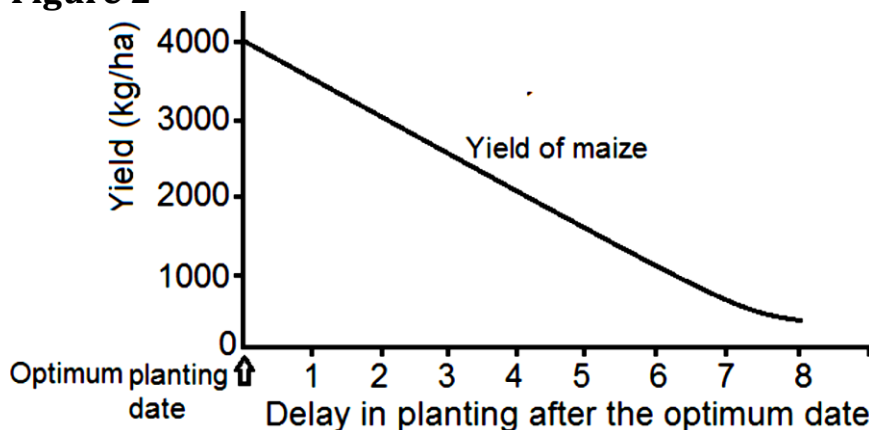
Use of cover crops: Crops such as potatoes, pumpkins and most broad-leaved crops can be grown to provide the soil with effective cover to suppress weed growth.

Fertilizer application: Proper fertilizer application will encourage vigorous crop growth so that, crop are able to suppress weeds. However the fertilizer should strategically be applied so that weeds do not have access to the nutrients.

Question 19

- Explain the agronomic factor that affect crop growth and yield
- Figure 2 shows the decline in the yield of maize in due to delayed planting. Use the information provided on the figure 2 to answer the questions that follow.

Figure 2



- Suggest the possible reasons for the decline in the yield of maize.
- Explain how a farmer can manage late planted crops to obtain optimum yields.

Suggested answers

(a) Agronomic factors affecting crop yields

This is concerned with all crop and soil management practices affecting crop productivity in the field. The practices include; (i) site selection (ii) land preparation, (iii) selection of planting materials, (iv) time of planting, (v) spacing of crops, (vi) weeding, (vii) application of

fertilizers, (viii)weeding, (ix)pruning, (x)pest and disease control, (xi)harvesting, (xii)drying, (xiii)processing and (xiv) Storage. *Explain accordingly*

(b) (i) The possible reasons for the decline in yield of late planted crops are:

- ☞ Shortage of water supply to crops due to the decrease in the amount of rainfall.
- ☞ Reduction in soil aeration after heavy rains which fill soil pores with water. This interferes with germination and growth of seedlings.
- ☞ Heavy infestation and attack from pests and diseases.
- ☞ Increased competition from weeds.
- ☞ Low nutrient supply to crops due to loss of nutrients from leaching and soil erosion.
- ☞ Reduced soil and atmospheric temperature which reduces growth of crops.
- ☞ Reduced solar energy and light for photosynthesis due to increased cloud cover.

(ii) How a farmer can manage late planted crops to obtain optimum yields

- ☞ Irrigation to supplement on the water from the declining rainfall.
- ☞ Application of fertilizers to supplement the low soil fertility.
- ☞ Mulching to conserve the limited water in the soil.
- ☞ Intensifying weed and pest control in the crop field.
- ☞ Pruning to reduce the rate of transpiration.
- ☞ Thinning to ensure optimum plant population in the garden to reduce completion for already less nutrient, moisture and sunlight.

Question 21

- (a) Give the advantages and limitations of growing high value crops on the farm.
(b) Describe how you can cultivate oyster mushroom using the bag bed method.

Suggested answers

(a) Advantages of high value crops

- ☞ Many of them provide food to man and farm animals. This increases food security in homes.
- ☞ They have high productivity and yield per area.
- ☞ They have a wide adaptation to various environment and wide acceptability by many people this makes them highly marketable.
- ☞ Require relatively less space as compared to other traditional crops such as maize.
- ☞ They are easily processed into other products.
- ☞ They offer large scope for specialization.
- ☞ They mature faster and many can be produced twice or thrice in a year.
- ☞ They can be easily integrated in home gardening.

Limitations of growing high value crop production)

- ☞ Lack of improved varieties for most of high value crops.
- ☞ Lack of good quality seed materials for planting.
- ☞ Unpredictable climate characterized by sudden droughts, very low or very high rainfall intensities

- ☞ Most crops require nursery and field management skills which are missing in most crop growers
- ☞ Prevalence of many pests and diseases for high value crops.
- ☞ Lack of quality land for production
- ☞ Limited labour supply for managing the crops during production, harvesting, sorting, packaging and marketing.
- ☞ High post-harvest losses due to perishability and poor handling during harvesting and marketing.
- ☞ Lack of improved storage facilities in production areas leading to high post-harvest losses.
- ☞ Lack of adequate markets to match the production and supply of high value crops.
- ☞ Inadequate quality land for farming; due to competition for land with other sectors such as livestock and housing;
- ☞ Unavailability of appropriate machines and equipment to use in cultivation and processing;

Procedure of mushroom cultivation using the bag bed method:

- ☞ Select a suitable substrate e.g. cotton hulls.
- ☞ Disinfect the substrate by soaking in hot water,
- ☞ Drain the excess water from the substrate,
- ☞ Mix the compost with mushroom spawn,
- ☞ Fill about 10kg of the spawned substrate in a polythene bag and tie the mouth of the bag with a string.
- ☞ Place the bag in an incubation room (warm-dark room) for 15-21 days to stimulate spawn run.
- ☞ After spawn run, usually when the compost is fully covered by mycelia, transfer the bags to the growing room.
- ☞ Make slits on the sides of the bag to stimulate sprout of mushrooms. During this time ventilation is maximized to increase O₂ level and decrease CO₂ level, the temperature is reduced to about 15–17°C and relative humidity kept at 90–95%.

AGRICULTURAL ECONOMICS AND FARM MANAGEMENT

Question 22

- (a) Define the term opportunity cost and give the importance of opportunity cost to a farmer
- (b) Explain the factors that determine the supply of labour on the farm.
- (c) Outline the different ways how a farmer can improve the efficiency and productivity of workers on the farm

Suggested answers

- (a) Opportunity cost:** this is the immediate alternative foregone when a choice is made. When a choice is made it means some wants are left unsatisfied. Opportunity cost is what you miss because you made a choice.

Importance of opportunity cost to a farmer

- ☞ It helps the farm entrepreneur in resource allocation that is, determining what to produce, when to produce, how to produce and for whom to produce.
- ☞ Helps in solving the problems of scarcity of resources through making a choice,
- ☞ It helps the farmer to make consumption decisions i.e. the farmer buys only a commodity from which he derives more satisfaction and foregoes others.
- ☞ It helps a farmer to make production decision i.e. he allocates resources where they earn more profits and foregoes production of commodities where he earns less profits.
- ☞ It is a basis for planning, budgeting and management of resources on the farm.
- ☞ It is used by labourers on the farm to make decision on whether to work or enjoy leisure.
- ☞ It helps the farmer in pricing products and resources on the farm.

(b) Factors determining the supply of labour on the farm

- ☞ The size of the total population around the farm: the bigger the populations size around the farm the greater the labour supply on the farm and vice versa ceteris paribus.
- ☞ Level of wages: the higher the wages on the farm the higher the labour supply on the farm
- ☞ Degree of mobility of labour: when there is ease of workers to move from one area to another or from one job to another, labour supply on the farm will be high as people can move from distant areas to the farm to provide labour and vice versa ceteris paribus.
- ☞ Availability of essential facilities: availability of facilities such as housing, transport allowances, free education, and incentives such as on job training, promotions and increase in salaries, increase labour supply on the farm and vice versa.
- ☞ Nature of the work: heavy and risky jobs will attract fewer labourers while non-risky and non-cumbersome jobs attract more labourers.
- ☞ Level of education: high level of education, skills and experience requirements reduce labour supply on the farm and vice versa. This is because the biggest percentage of the energetic youths is not educated or skilled in modern farming techniques.
- ☞ Attitude of the population towards work: in a situation where the biggest percentage of the population is willing and ready to work supply of labour will be high and vice versa.
- ☞ General social and political conditions in the country: if there is political stability in the country, people will have the will and morale to worker even for longer hours. Public holidays reduce labour supply on the farm.
- ☞ Laws of the country on the working age and hours per day in a country: where the working age is reduced labour supply will be higher, while in a country where working hours are higher, labour supply on the farm will also be higher.
- ☞ Labour discrimination: on a farm where employees discriminate workers on the basis of religion, tribe, language, healthy status, education level, labour supply will be low and vice versa ceteris paribus
- ☞ Rural-urban migration: agricultural production usually takes place in rural areas. High level of rural-urban migration of workers reduces labour supply on the farm especially in rural areas and vice versa.
- ☞ Level of advertisement: Advertisement increase awareness of labourer on the presence of a job thus increasing the number of people willing to provide labour on the farm.

How a farmer can improve the efficiency and productivity of workers on the farm

- ☞ On-job training of the workers in form of seminars, workshops, sending workers for short courses in universities and colleges and attaching of less skilled and experienced workers to more skilled and experienced workers or supervisors. Training increases skills of workers which results into increased efficiency and productivity.
- ☞ Employing of skilled and experienced workers: skilled and experienced workers are more efficient and productive.
- ☞ Increasing wages and other benefits; workers are always motivated by increasing their salaries and wages and other privileges. This increased motivation increases efficiency and productivity of workers on the farm.
- ☞ Ensuring good supervision of workers to ensure that every worker is doing his/her duty and to give immediate help and attention in case of failure of equipment.
- ☞ Encouraging specialization of workers on the farm; specialized workers are more efficient and productive than unspecialized workers. This is because specialized workers develop skills and expertise very fast leading to increased efficiency and productivity on the farm.
- ☞ Improving technology such as use of machines on the farm increase the speed and accuracy of output thus increasing efficiency and productivity of labour on the farm.
- ☞ Improving management of workers such as assignment of workers to specific duties, proper prescription of workers' duties, prescription of working hours, feeding workers on duty and giving them time to rest increases efficiency and productivity.
- ☞ Giving enough time and appropriate load to workers: unlike machines, man tires up very quickly and effectiveness and productivity diminishes as workers do heavy work for longer hours.
- ☞ Timely payment of workers.
- ☞ Provision of job security.
- ☞ Promotions on job to other ranks such as supervisor, managers etc.
- ☞ Deploying workers during cool climate.
- ☞ Maintaining good health of workers.
- ☞ Giving incentives such as overtime allowances transport medical and housing allowances.

Question 24

- (a) Mention and explain the factors an agriculture investor should consider when choosing the location for his agricultural business.
- (b) Outline the problems faced by marketing organizations in marketing agricultural produce.

Suggested answers

(a) Factors an entrepreneur should consider when choosing the location for his agricultural business.

Easy access to the market: for commercial agricultural production the farm should be located near to the consumers so that they can reduce the cost of transport and potential damage to the produce during transportation.

Availability of raw materials (inputs): In most cases, it is better to locate the farm where inputs are readily and cheaply available near the farm.

Easy access to the locality: a good location for establishing a farming enterprise should have access to good means of transport. This could be near a road, railway line, a sea port or airport. Transport is important to bring in inputs, transport farm produce and workers.

Labour supply: labour is an important factor of production. Labour may not be available in every location. Some locations have more and cheaper labour than others. The cost and availability of labour in a particular location is thus an important consideration in choosing a location for farming business.

Climate/or weather: climate is an important factor in both livestock and crop production. Good climate that favours livestock and crops survival is thus an important consideration in choosing a location for farming business.

Soil types: different locations have different soil types. Soils affect the growth of crops and pastures for livestock. Therefore it is important for an entrepreneur to choose a location with fertile soils especially for crop enterprises.

Pests and diseases: most agricultural enterprises are very prone to the effects of pests and diseases. Thus when choosing a location for either crop or animal enterprise, it is better to choose a location that is free from pests and diseases.

Security: insecure areas are generally bad locations for a farm business. The security of a location is very important in deciding a location. The location should be free from robbers, thieves and vandals.

Service providers: banks, veterinary, and extension services are important in selecting a location. Because the farm relates to them, they should be near and easy to access.

Infrastructure and utilities: a good location should be well served with good infrastructure and utilities necessary for production and management. It should be well served with electricity, water, telephone, internet and other facilities that enable the smooth running and operation of the farm.

Room for expansion: in most cases, the long term strategy of the farmer is to expand and enlarge his farm. In such circumstances, the farm should be located in an area where there is a room for expansion. Where there is additional land and space for more expansion.

Other farms: in some cases, it is important to locate a farm near other farms especially if you sell output to them, if you use their byproducts or depend on the same suppliers, e.g. a crop farm should be located near to livestock farm to access cheap manure and to supply plant produce to livestock farm as feeds.

(b) Problems faced by farmers organizations in marketing agricultural produce

- ☞ Many agricultural commodities are bulky as a result transportation of commodities to the market become practically difficult and expensive relative to their values.
- ☞ Most agricultural commodities are highly perishable. The perishability of many products results in wastage in transit. Fresh meat, milk, vegetables and flowers require special transportation. Transport costs are often higher relative to their market values.
- ☞ The scattered producers, each supplying rather small quantities of a particular product, raise the assembly costs and tend to reduce the farmers' share of the final price.

- ☞ The seasonality of production confines the assembler/processors to under-utilization of resources. So processing factories may remain idle, during off-season due to shortage of commodities, creating very serious management problem and disappointment to the consumers.
- ☞ Agricultural production mostly takes place in poorly developed rural areas. Most of these areas lack electricity supply, all season roads, and modern crop stores. This makes it difficult to process, transport and store the assembled products.
- ☞ The seasonality of production affects market supply and demand leading to price fluctuation in the market.
- ☞ Unlike manufacturing business farm production cannot fully be controlled by the farmers due to many hazards such as weather, pests and diseases. All these make planning of marketing much more difficult.
- ☞ The long gestation period of agricultural production makes it difficult for the marketing agents to adjust quickly to changing supply and demand in the market.
- ☞ More frequently there is divergence between planned and actual output of agricultural products. This affects marketing agents' plans resulting into disappointments to the suppliers and consumers.
- ☞ Competition from synthesis which are direct substitutes of some agricultural products. Due to unpredictable nature of supply of agricultural products most suppliers and consumers resort to synthetic products which have ready supply and are more durable.
- ☞ There is also limited market information by potential buyers on the availability of products, the quality, the quantity and the prices.

Question 25

- (a) Differentiate between the following terms;
- (i) Change in demand and change in quantity demanded
 - (ii) Elasticity of demand and price elasticity of demand
- (b) Explain the factors that determine quantity of a commodity supplied in the market.

Suggested answers

- (a) (i) Change in demand** this refers to a decrease or increase in demand due to several factors that affect demand other than price of the commodity. While, **Change in quantity demanded** is the increase or decrease in quantity demanded resulting from a fall or rise in the commodity's own price other factors that affect demand remaining constant.
- (iii) Elasticity of demand** is the measure of the degree of responsiveness of quantity demanded of a commodity due to a change in any of the determinants of demand. While, **Price elasticity of demand** is the degree of responsiveness of a change in quantity demanded of a commodity due to a change in the commodity's price. It is the ratio of the percentage change in quantity demanded of a commodity due to change in the price of the commodity.

(b) Factors that determine quantity of a commodity supplied in the market;

The price of the commodity: The higher the price, the higher the quantity supplied and the lower the price the lower the quantity supplied. Higher prices induce producers to offer more products for sale because producers expect to make more profits at higher prices than at lower prices.

The cost of production: An increase in the prices of factors of production increases the cost of production, making production of commodities very expensive. This discourages producers to produce and, as such supply will also reduce. On the other hand, a decrease in the cost of production makes it cheaper to produce and this encourages more production leading to increase in supply.

Availability of inputs: Readily available inputs increases supply of commodities in the market and scarcity of inputs reduce supply of commodities in the market.

Level of technology: technology influences the capacity of the producers and suppliers. Modern and efficient technology increases output and supply. When technology is not efficient, it results into low supply. A farmer using a hand hoe produces less output than a farmer who uses a plough.

Gestation period: the time it takes to produce a given product. The longer the gestation period, the lower the supply. and the shorter the gestation period, the higher the supply.

The objectives or goals of the firm: some firms aim at sales maximization while others aim at profit maximization. A firm that aims at sales maximization will put more products on market compared to the firm that aims at profit maximization.

Number of producers: the higher the number of producers and suppliers in the market the higher the supply and the less the number of producers and suppliers the lower the supply.

Season or climatic condition: the supply will increase during harvesting season and reduce during planting and growing seasons. Also good climatic conditions that support growth of plants in the field increases yields as such supply also increases

Government policy this may boost or discourage supply. High taxation on a commodity increases cost of production and as such discourages producers and suppliers. On the other hand if the government puts a subsidy on the commodity the cost of production reduces encouraging producers and suppliers to supply more in the market.

Price of jointly supplied commodities: These are products that are supplied together like beef and hides or maize floor and maize bran. When the price of beef increases suppliers are encouraged to slaughter and supply more beef and as a result supply of hides also increases.

Political situation: political stability encourages producers to produce and supplier to supply their commodities freely to the market on the other hand political instability discourages production and as a result reduces supply.

Other factors include; availability of reliable transport, freedom of entry of suppliers into the market, feature price expectations and availability of market information.

Question 26

(a) Discuss the contributions of farming organizations to the development of farmers in Uganda.

(b) State the problems farming organizations in Uganda face today.

Suggested answers**(a) Contributions of farming organizations to the development of farmers in Uganda**

- ☞ Some farmers' organisations supply high quality inputs like seeds to farmers at subsidized prices and this stimulates production.
- ☞ They also provide education and training of farmers including managers at all levels on modern production and management techniques so as to use resources efficiently and improve productivity.
- ☞ They store farm inputs and consumer goods before they are distributed to the farmer s / members.
- ☞ They are involved in processing activities of farmers' produce e.g., milk processing, oil extraction from sunflower, cotton ginning etc.
- ☞ They collect produce from farmers to the markets by sending Lorries to collect the produce directly from the farmers or rural stores.
- ☞ They encourage farmers' unity in issues regarding marketing information, sharing costs of putting up new expensive structures e.g. stores and processing plants e.g., milk cooling plant and purchasing expensive machinery e.g. tractors.
- ☞ They encourage member farmers to save and also get production loans e.g. for store construction, purchasing transport vehicles and setting up processing plants.
- ☞ They help to reduce marketing costs because they are able to handle large volumes of farmers' produce for storage, transport, etc. which enables them to benefit from economies of large scale.
- ☞ They help to stabilize prices by storing excess produce during bumper harvest when market prices are low until market prices stabilize.
- ☞ They provide employment to millions of people worldwide in various fields such as trade, accounting, banking, manufacturing and research.
- ☞ They store agricultural produce before they are transported to the processing centres and markets.

b) The problems farming organizations in Uganda face today.

- ☞ Corruption: embezzlement of organization's funds by some officials.
- ☞ Inadequate competent managers and this hinders proper organization and execution of day-to-day activities of the organization.
- ☞ Inadequate funds to facilitate the day-to-day activities of the cooperatives. This is mainly due to failure of the members to pay subscription regularly and failure to save/keep their money with the cooperatives.
- ☞ Inadequate government support. This is as a result of establishment of the liberalization policy where the government stopped supporting the farmers' organizations financially.
- ☞ Insufficient transport facilities yet most agricultural production takes place in rural areas. Some farming organizations lack enough storage capacity, especially in rural areas where most production takes place.

- ☞ Members have mistrust in the organizations' managers because of past experience they have accumulated.
- ☞ Political instability in some parts of the country has discouraged meaningful farming and operation of farmers' organizations.
- ☞ Smuggling of produce across borders to neighbouring countries, to some extent, limits activities of the farmers' organizations.
- ☞ Tribalism and nepotism which endanger the unity of the farmers.
- ☞ Unstable prices of agricultural produce both at local and international markets.
- ☞ Wide spread illiteracy especially of the rural population about the affairs of the cooperatives. They are not aware of the benefits of joining such organizations. More so, Illiteracy hinders effective communication.

Question 27

- (a) State the reasons for the government effort to undertake land reforms in Uganda.
- (b) Outline the land reform policies in Uganda necessary for increasing agricultural production.
- (c) Describe how the current land tenure system in Uganda affects agricultural production.

Suggested answers

(a) Reasons for undertaking land reforms

- ☞ To increase agricultural output through increased access to land and land consolidation.
- ☞ Reducing income inequalities through enabling many people to own land.
- ☞ To ensure equitable land distribution in the country.
- ☞ To modernize agricultural sector through giving of full ownership and control over the land to farmers.
- ☞ To attain full exploitation of the agricultural potential in the economy.
- ☞ To increase employment opportunities in the agricultural sector therefore checking rural-urban migration.
- ☞ To reduce land conflicts thus increasing security and stability in the country.

(b) The land reform policies in Uganda necessary for increasing agricultural production

- ☞ Abolition of customary and communal land tenure to increase land utilisation.
- ☞ Cooperative ownership to increase production and productivity of land.
- ☞ Encourage leasehold system where individuals can utilize land for a specified period of time.
- ☞ Establishment of land commissions to ensure effective management of land.
- ☞ Formal land registration so that land owners can have legal titles and freedom to give security to acquire loans.
- ☞ Land consolidation to enable use of machines.
- ☞ Land reclamation e.g., land can be reclaimed from swamps and semi-arid areas.
- ☞ Land redistribution to enable effective use of land.
- ☞ Land tax to enable profitable use of land in Uganda.
- ☞ Land tribunals to settle land disputes at various levels.

- ☞ Putting in place an efficient land market to enable the landless to purchase and acquire land.
- ☞ Resettlement schemes to avoid congestion, unemployment and under employment.
- ☞ State ownership to encourage large scale production.

(c) How the current land tenure system in Uganda affects agricultural production.

- ☞ In some areas land is fragmented hence limiting agricultural mechanization. This confines production only to subsistence production.
- ☞ Communal land ownership encourages reckless use of land leading to problems like over grazing and land degradation.
- ☞ Lack of land titles hinders farmers from securing credit from financial institutions. This limits the potential of farmers to invest in production.
- ☞ Investment in agriculture is discouraged due to limited access to land by potential agricultural investors.
- ☞ Lease land tenure system reduces incentive for increased production by tenants as they pay in kind or monetary terms part of their output or incomes.
- ☞ Increase land disputes causing insecurity and reducing farmers' incentive for increased production.
- ☞ Leasehold and communal land ownership discourage long term investments and use of capital intensive production technologies.

Question 28

- (a)** State the roles of agricultural extension in agricultural development.
(b) Give the problems faced by agricultural research organizations in Uganda.
(c) Suggest ways in which the government can improve agricultural extension in Uganda.

Suggested answers

(a) Roles of agricultural extension in agricultural development

- ☞ Collecting agricultural information from farmers for further uptake by researchers.
- ☞ Developing budgets and programs of work for agriculture department at local levels.
- ☞ Guiding farmers on enterprise selection, enterprise mix and farm planning.
- ☞ Guiding farmers on marketing by providing appropriate market information.
- ☞ Inspection and Quality monitoring of agricultural inputs supplied to farmers and providing necessary advice to them.
- ☞ Interpreting information from research agencies to benefit farmers.
- ☞ Stimulating adoption of new/modern technology.
- ☞ Stimulating unity among farmers by initiating group formation, Farmer field schools and farmer-farmer learning visits.
- ☞ Training farmers on modern farming methods.

(b) Problems faced by agricultural research organizations in Uganda:

- ☞ **High cost of research services:** research services are expensive for ordinary farmers: Most farmers cannot afford services offered by research e.g., inputs because of low per capita income.

- ☞ **Inadequate skilled manpower;** credible research requires a number of well-skilled human labour. However, there are few individuals capable of carrying out reliable research. The high staff mobility intensifies the problem.
- ☞ **Limited contact between farmers and researchers;** this has led to development of new technology that don't serve the interests of farmers (irrelevant technologies).
- ☞ **Limited/inadequate funding;** Research is an expensive process requiring huge capital input. Unfortunately, research stations find themselves to rely on external donor support whose priorities may not match with local demands.
- ☞ **Mismanagement of funds** by research officials undermines the completeness of research process / activities.
- ☞ **Most agricultural research is often funded by foreign donors** whose priorities may not be in agreement with national agricultural development objectives.
- ☞ **Political instabilities** may disrupt continuity of the process.
- ☞ **Poor government policies** directed towards the research sector.
- ☞ **Unfavourable agricultural policies;** of recent, researchers have been voicing out their frustration over the lack of laws in the country. This makes them unable to experiment their innovations and propagate new technology to farmers.

(c) Ways in which government can improve agricultural extension in Uganda

- ☞ **Ensuring adequate and efficient transport services:** extension involves extension personnel linking up with farmers at their production sites and proper transport infrastructure and facilities is necessary.
- ☞ **Establishing links to market opportunities:** extension is valuable when it is linked to specific market opportunities, when producers are being equipped to respond to particular market demands.
- ☞ **Increasing the use of information and communication technologies in extension:** The use of ICTs in agricultural extension is that they can ease the collection, processing and transmission of data, resulting in faster extension of quality information to more farmers.
- ☞ **Networking and enhancing the capabilities of extension providers:** Agricultural extension by its nature is a service that relies on linkages and networks. Thus, for extension to succeed, it must enhance its linkages and networks with research, farmers, and among extension providers.
- ☞ **Provision of legal and policy framework** this will help to streamline the confusion currently existing in the effort to transfer agricultural knowledge to farmers, particularly in the areas of service provision and funding.
- ☞ **Recognizing indigenous knowledge:** There is a need to harness indigenous knowledge. Special emphasis should be placed on developing and disseminating local content, improving the relevance of the information to local development, as well as capturing and auditing all relevant local resources.
- ☞ **Target-oriented extension and gender sensitivity:** Targeting is the understanding of who the farmers are in terms in terms of gender, resources, and

culture, and ensuring that only technologies that are relevant to each farmer's capability is targeted at him or her.

- ☞ **Using private extension service providers:** this results into increased private sector participation in those aspects of extension service that are always profit-driven: for example, input procurement and distribution, cash crop extension, and veterinary extension.

Question 29

- (a) State the main objectives of Plan for the Modernization of Agriculture (PMA) and national agriculture advisory services (NAADS)
- (b) Outline measures the government of Uganda is putting in place to promote value addition to agricultural products.
- (c) Explain the challenges the government of Uganda is facing in implementing the NAADS programme.
- (d) Suggest solutions that can be adopted to improve efficiency and effectiveness of the NAADS programme.

Suggested answers

(a) Objectives of PMA

- ☞ To improve household food security.
- ☞ To increase household incomes and quality of life.
- ☞ To create employment through the secondary benefits of PMA implementation such as agro-processing factories and services.
- ☞ To promote sustainable use and management of natural resources.

Objectives of the NAADS

- ☞ To create avenues for financing and delivery of agricultural advisory services for the subsistence of farmers, women, youth, disabled and those living with HIV/AIDS.
- ☞ To create options for delivery of advisory services for different types of farmers.
- ☞ To develop private sector capacity and professional capability to supply agricultural advisory services.
- ☞ To empower all farmers, more so the women, youth, disabled and other marginalised groups to access and utilize Agricultural Advisory Service Providers for extension services and market information.
- ☞ To improve food security.
- ☞ To improve nutrition and household incomes through increased productivity and market-oriented farming.
- ☞ To promote farmer groups to develop capacity to manage their farming enterprises.
- ☞ To shift from public to private delivery of extension services.
- ☞ To develop systems to ensure quality advice and to stimulate the participation of the private sector in funding agricultural advisory services.

(b) Measures the government is putting in place to promote value addition to agricultural products.

- ☞ Developing infrastructure and providing of low cost energy sources and water.
- ☞ Establishing of appropriate grades and standards for agro-industrial products.
- ☞ Establishment of appropriate policies and laws to support investor in the agro-processing sector.
- ☞ Promotion of agro-industrial sector through training and support to processors.
- ☞ Promotion of rural electrification through the provision of a Rural Electrification Fund as provided for under the electricity law.
- ☞ Reducing taxes for the agro-processing industries.
- ☞ Strengthening market information on production, supply and demand for products.

(c) Challenges the government of Uganda is facing in implementing NAADS programme

- ☞ **Corruption:** NAADS officials and some local officials in the procurement departments of the districts connive with the suppliers to provide either 'air-supply' or substandard inputs.
- ☞ **Fraud:** some farmers compromise with NAADS officials and sometimes with the procurement departments.
- ☞ **Inadequate funds to establish and maintain** viable arid sustainable demonstration projects at sub-county and parish levels.
- ☞ **Inadequate transport facilities:** this has made reaching out to farmers all over the country very difficult and tedious.
- ☞ **Inefficient skills among NAADS officials:** since NAADS was put in the hands of the army, many of them do not have efficient skills to help farmers out of their farming problems.
- ☞ **Insufficient staff:** NAADS does not have sufficient staff to provide extension services to all the sub counties in the country.
- ☞ **Lack of motivation and commitment by farmers:** So many complaints about farmers' commitments to properly manage technology disbursed to them and non-attendance of Advisory training meetings have had a negative bearing on performance of NAADS.
- ☞ **So many risks experienced by the farmers** at farm level e.g. Theft, natural disasters such as weather affecting output, pests and diseases causing livestock mortality or yield failure, accidental disasters such as fire.
- ☞ **The expectations of the public are sometimes outside NAADS mandate:** NAADS mandate is mainly to provide extension services. The inputs that are provided by NAADS are supposed to be strictly for demonstration. There are people who ask NAADS officials for free seeds and machinery. Some farmers also ask for money to buy land that NAADS does not provide for.
- ☞ **Interference by politicians:** right from parish level. Negative comments from politicians that demotivate farmers.

Solutions that can be adopted to improve efficiency and effectiveness of the NAADS programme:

- ☞ Encouraging farmers to carry out cooperative farming so as to reduce costs of production and marketing.
- ☞ Setting up more demonstration sites to act as learning sites for farmers.
- ☞ More service providers (extension workers in particular) should be employed in order to teach farmers new technologies in farming.
- ☞ Retooling extension workers with new skills related to the recent technologies. This is likely to improve their relevance in developing farmers.
- ☞ Sensitization of the farmers about the importance of attending NAADS meetings.
- ☞ Strict laws on corruption and fraud should be reinstated to discourage other potential perpetrators of the vice.
- ☞ The government should also make sure that it pays the service providers in time and above all, relatively good pay.
- ☞ The government should be in position to provide motorcycles to the service providers so that they could be in position to reach out to many farmers in remote areas.
- ☞ The government should improve on infrastructure like roads, railways to ease transport and communication between the farmers and the service providers.
- ☞ The government should open up new markets to absorb the likely increase in output due to NAADS intervention.
- ☞ The government should provide subsidies to the farmers in order to motivate them in their agriculture activities.

Question 30

- (a) State how good agricultural policies may help to speed up agricultural development in Uganda
- (b) Give the factors that affect women's participation in commercial agricultural production
- (c) Outline the different ways how women participation in commercial agriculture can be improved

Suggested answers

- (a) How good agricultural policies may help to speed up agricultural development in Uganda
 - ☞ Create opportunities for establishing agro-processing and agro-based industries.
 - ☞ Develop human resources for agricultural development.
 - ☞ Protect interests of the small, marginal and tenant farmers.
 - ☞ Develop marketing system to ensure fair prices of agricultural commodities.
 - ☞ Enhance the potential of agriculture to provide employment opportunities to nationals.
 - ☞ Ensure a profitable and sustainable agricultural production system and raise the purchasing power by increasing real income of the farmers (to increase incomes of households from agribusinesses).

- ☞ Establish agriculture as a diversified and sustainable income generating sector through strengthening of 'farming system' based agricultural production and agro-forestry programs;
- ☞ Increase production and supplies of more nutritious food crops and thereby ensuring food security and improving nutritional status;
- ☞ Introduce an appropriate institutional system of providing credit to ensure the availability of agricultural credit in time;
- ☞ Preserve and develop land and water productivity for sustainability;
- ☞ Preserve existing bio-diversity of different crops;
- ☞ Produce and supply agricultural commodities as required by the industrial sector;
- ☞ Promote development of agricultural research, information dissemination for quick responsiveness to agriculture problems such as productivity, pests and diseases; and weather.
- ☞ Reduce excessive dependence on any single crop to minimize the risk.
- ☞ Take appropriate steps to develop an efficient irrigation system and encourage farmers in providing supplementary irrigation during drought with a view to increasing cropping intensity and yield.
- ☞ Take effective steps to ensure input supplies to the farmers at fair prices in a competitive market and remove difficulties at the farmers' level which have arisen out of the privatization of input distribution system.
- ☞ Take necessary steps to ensure environmental protection as well as 'environment -friendly sustainable agriculture' through increased use of organic manure and strengthening of the integrated pest management programs.
- ☞ Develop contingency management system to combat natural disasters;

(b) factors affecting women's participation in commercial agricultural production

- ☞ Gender blindness/invisibility of women's roles in food security.
- ☞ Agricultural development policies and research do not address the needs of the women. e.g., scientific researches focus on export-oriented crops,
- ☞ There is also lacking participation of women in policy making and decision making at national and international levels.
- ☞ Lack of or limited access to land for production in most communities,
- ☞ Shortage of good quality agricultural land: This is due to customary practices that limit women's land rights, environmental degradation and land fragmentation. Husbands may allocate more land to cash crops that they control and leave marginal land for crop production, a domain for women,
- ☞ Limited involvement of women in farming organizations limits access to inputs, credit and information.
- ☞ Lack of access to credit due to lack of collateral like land.
- ☞ Inadequate access to agricultural inputs and technology: This is due to their lack of access to credit and membership to farmers' organizations,
- ☞ Dismantled markets due to trade liberalization and poor transport network in rural areas e.g. feeder roads. Sometimes there are long distances to markets

- ☞ Feminization of agriculture: this refers to the dominance of women in agriculture and the associated decrease of men in the same sector. This is due to Rural-urban job-based movements of men leaving the women as household heads. It places huge burdens on the women to meet food and other demands of the family and these may abandon large scale cash crop production.
- ☞ Women have additional reproductive and child rearing roles: Women's reproductive and child rearing roles are time consuming and in most cases lead to ill health. This derails their participation in food production.
- ☞ Rapid population growth leading to land fragmentation.
- ☞ Poor preservation and storage facilities: About 20% of all harvested food is lost due to poor handling and storage. This reduces their quantity and quality leading to economic losses and famine.
- ☞ Low education of women (Illiteracy) is another obstacle to women's contribution to development. It leads to low adoption of modern agro- technologies and limited access to agricultural credit.
- ☞ Inferiority complex: i.e., Women underestimate their worth (values and abilities).
- ☞ Inability to operate large machines because majority are weak and timid.
- ☞ HIV/AIDS pandemic; women are the chief caretakers in families and this significantly reduces available time for agricultural production.
- ☞ Inadequate socio-economic and good agricultural policies.
- ☞ Insecurity due to wars and social strife, which disrupt agricultural production.
- ☞ Middle men that deal in crop produce are usually males who are unscrupulous and dishonest to women farmers. They leave the women with a smaller profit margin compared to that of the men.
- ☞ Inequalities in sharing benefits frustrate women farmers; while the women may harvest, dry and thresh the produce, the men dominate marketing and may not return the proceeds home. At times the men may use it to buy alcohol, marry or entertain other women.
- ☞ There are few women extension agents yet women farmers would learn better from fellow women.
- ☞ Low incomes or lack of income by women to afford inputs for commercial farming.
- ☞ Women occupy subordinate positions in society, which prevents them from making decisions that would improve agricultural development.
- ☞ Women have limited access to information or knowledge and skills on the appropriate agro-technologies compared to men. Unfortunately, it is the women that are more involved in a wide range of crop cultivation activities.

(c) Ways of improving women participation in commercial agriculture

- ☞ Women must own the land on which they grow crops. They should also inherit land and have rights to use it after the death of the husbands.
- ☞ Giving priority to women's access to education, information, science and technology, starting with the girl child education.

- ☞ Training of more female agricultural extension agents in higher institutions of learning.
- ☞ Strategies to increase women's access to credit e.g., through concessions like extending credit to women even in absence of collateral as long as they are married.
- ☞ Women need increased attendance of extension meetings together with their husbands or even in their absence.
- ☞ There is need for support to women's income generating activities and the reinforcement of Women's Organizations and Networks.
- ☞ Women must participate actively in new technology development including taking decisions on which technologies need to be tested on-farm and participate in this testing.
- ☞ Women should participate more in farmer-to-farmer extension visits and Farmers Field Days as well as Farmer Field Schools so as to increase their ability to learn from others.
- ☞ Fabrication of light and friendly tools and equipment for women farmers, who are the weaker sex.
- ☞ Women should be allowed to participate more in marketing so as to motivate them.
- ☞ Sensitizing women to influence positive change of their psychology towards commercial agriculture.
- ☞ Both men and women should have equal opportunities to control finances so that each sex can use it profitably. Exploitation of indigenous knowledge, skills and experience in the production of food and the conservation of biodiversity possessed by women to generate new but locally adaptable technologies.
- ☞ The women should be well fed in order to carry out the numerous agricultural and other tasks conferred upon them by tradition.
- ☞ There should be support for public services and investment in rural areas in order to improve women's living and working conditions.
- ☞ There is need for proper assessment of the negative effects and risks of farming practices and technology, including pesticides on women's health, and taking measures to reduce use and exposure.

AGRICULTURE ENGINEERING AND FARM MECHANIZATION

Question 31

- (a) State the desirable qualities of a draft animal.
- (b) Explain the factors that affect power output from draft animals.
- (c) An apple crate of mass 40kg is pushed with a force of 140N up an inclined track of length 10m onto a lorry floor at a height of 2m from the ground. (Take $g = 10\text{N/kg}$)
Calculate the;
 - (i) Work done by the force of 140N,
 - (ii) Work done if the box was lifted vertically upwards.

Suggested answer**(a) Desirable qualities of draft animal;**

- ☞ Short stout legs to provide good traction.
- ☞ Juvenile at least two years of age; at this age the animal is still young to learn but also old to produce some reasonable power. Also, to benefit from a longer working life of the oxen.
- ☞ Cool temperament and good discipline to reduce disturbance when working in the field.
- ☞ Freedom from disabilities good sight, good heaving and sound legs to be able to move properly and follow commands.
- ☞ Should preferable be a male. Males have good muscling and high power output in than females.
- ☞ Should be castrated; castrated males have low libido and conserve more energy.
- ☞ Good food conversion into energy and muscles.
- ☞ Well-developed hump for easy yoking and hitching of equipment.
- ☞ Good adaptability to the local environment such as high temperature or very low temperature and water shortage.
- ☞ Short horn or polled condition is desirable for inter-row cultivation to be able to part freely between the crop rows.
- ☞ Intelligence/ability to learn faster: some species have good ability to be trained and learn faster.

(b) Factors that affect power output from draft animals

Animal species or type: different special/types of animals produce different amount of power output for example water buffaloes produce more power (fraction) than the ox; also donkeys can carry more load than horses.

Health condition of the animal: draught animals in good health conditions produce more traction than sick animals.

Level of nutrition: good feeding of the animal allows proper development of the animal's body prevents notification related diseases and increases power output. Animal feeding on high quality carbohydrates is likely to produce more power than an animal feeding on diet low in carbohydrate.

Condition of the equipment used: animals can easily pull a heavy load on wheels also the quality and condition of the plough used will affect power output and the quality of work done by the animal.

Climate: cool climate increases power output and the length of working of the animals. Hot climate increases sweating, panting and weakens the animals.

Age of the animal: power output from draught animals increases with increase in age up to the climax (youthful age) and then decreases as the animal over ages (senile age).

Level of training and experience attained by the animal: power output is highest in a well-trained (experienced) animal than in a poorly trained (inexperienced) animal. Training brings about good muscle development and imparts good discipline in an animal.

Length of time of working: longer periods of working reduce power output due to fatigue. It can also lead to damaging of the body muscles which weaken the animal in the due course.

Type of the soil: very loose soils or clay soils and water logged soils reduce traction by the animal due to feet slippage and sinking into the soil thus reducing power output. Dry stable soils improves traction thus power output from the animal.

Number of animals: power output increases with the increase in the number of animals working together as a team. Thus paired animals produce more power than a single animal of the same species.

Skills and experience of the operator: keeping other factors constant, when the operator is highly skilled on how to handle and use the animal and how to hitch the implement on the animal, power output is increased.

Amount of vegetation: dense vegetation interferes with free movement of the animal and as a result reduces power output.

Freedom from body disabilities: animal which is free from disabilities of the body such as sound legs, proper sight and hearing are likely to produce more power than disabled animals.

Topography of the land: power output is low as animals move up the slope. However, power output is high as the animal moves down the slope or on flat surface.

Evenness of the land surface: smoothness of the land makes movement of the animal easy. Very rough ragged terrain interferes with free movement of the animal and makes it difficult for the animal to pull equipment.

The yoke used for hitching: poorly designed yoke providing only limited contact with the neck and hump decreases power output. Well-designed yoke with encircling at the neck and breast strap harness, increases power output from the animal.

(c) (i) Work done by the force of 140N

$$\begin{aligned} W &= F \times d \\ &= 140 \times 10 \\ &= 1400\text{J} \end{aligned}$$

(i) Work done if the box was lifted vertically upwards

$$\begin{aligned} W &= \text{weight of box} \times \text{gravitational force} \times h \\ &= 40\text{kg} \times 10\text{m/s}^2 \times 2\text{m} \\ &= 800\text{J} \end{aligned}$$

Question 32

(a) Explain the factors that affect the efficiency of farm machines.

(b) A machine with a velocity ratio 8 is used to lift a load of 300N. The effort required is 60N.

(a) What is the mechanical advantage of the machine,

(b) Calculate the efficiency of the machine.

Suggested answers

(a) Factors that affect the efficiency of farm machines

Friction: this is the resistance to movement when two surfaces are moving against each other. Some power is lost as the result of friction. Thus when the friction is high the

efficiency of the machine is lowered. Frictional power losses can be overcome by lubrication and making the moving surfaces as smooth as possible.

Load: too much load on the machine reduces the efficiency of the machine. Machines should be loaded lightly as per manufacturers' recommendation.

Condition of the machine: good mechanical conditions of the machine increases efficiency. Faulty machines require more power to do the same work than machines in good condition.

Skills of the operator: operator's skills to use the machine properly as per the instructions. Following of the desired steps and good machine handling during operation increases efficiency of the machine.

Type of the machine: some machines because of their designs and the points of application of force and the load have more efficiency than others. In levers, first class lever has higher efficiency than second and third class levers.

(a) mechanical advantage

$$= \frac{\text{load}}{\text{effort}} = \frac{300}{60} = 5$$

$$(b) \quad \text{efficiency} = \frac{\text{M.A}}{\text{V.R}} \times 100\%$$

$$= \frac{5}{8} \times 100\%$$

$$= 62.5\%$$

Question 33

- (a) Explain the factors to consider when selecting wood for construction work on the farm
- (b) Outline the procedure of air seasoning timber.
- (c) Describe the hot and cold treatment of wood with preservative.

Suggested answers

(a) Factors to consider when selecting wood for construction work on the farm

Strength: the strength of the wood is its ability to resist breaking under different loads. This characteristic is important in wood to use in beams and column.

Hardness: the hardness of the wood is its ability to resist wear and denting. Hardwood is commonly used in flooring and in making of tool handles.

Resistance to decay: This is important in humid climate and in a situation where wood is to be used in the open or where wood is to touch the ground.

Paint holding ability: the wood should allow painting and should provide a strong bond with different types of paints and varnishes.

Nail holding ability: good wood should allow penetration by the nail without splitting and should be able to firmly hold the nail in position.

The final look of the wood after finishing: different wood possess different colours and textures when finished. The look should be impressive and should conform to the farmers taste.

Workability: a good wood should be easy to saw, shape and nail and also should have high polishing ability

Ability to bend/deflect without breaking: good wood should deflect considerably before breaking. Even after fracturing, the fibres should hang together and resist separation.

Resistance to warping: a good wood should be resistant to twisting bending and bowing distortion. .

Resistance to pest and fungal: the resistance to pest and fungal attack increases durability of wood and make wood more suitable to use on permanent structures. Wood can be treated with preservative to enhance this properly.

Freedom from defects such as shakes, knots, sloping grains and upsets such defects reduces the strength of the wood and make the finishing less attractive.

Ability to withstand the effects of weather such as strong sunshine, snow and rainfall.

(b) Procedure of air seasoning timber

- ☞ Clearing and leveling the ground.
- ☞ Use brick or timber joists to keep the bottom of the stack well above the ground to avoid moisture from the ground from rising into the timber and to ensure good air circulation underneath.
- ☞ Lay timber on the joists horizontally, largest at the bottom, smallest at the top one piece above the other
- ☞ Board column are spaced at about 22mm apart
- ☞ Place rods in between each board spaced evenly to effectively support the boards and to allow free air circulation around the boards.
- ☞ Paint the ends of the boards or cover with strips of timber to prevent them from rapid drying and splitting.
- ☞ Provide a shade to keep away rainwater and sunlight. The shade should be well raised and should allow inflow of air from all directions.

(c) Hot and cold treatment of wood with preservative;

Seasoned peeled posts or sawn timber of desire sizes and lengths is placed in a drum containing a suitable preservative. The drum is then fired until the preservative is about to boil for one to two hours and then allowed to cool. During heating, air in the wood cells and conducting tubes expand and some of the air is expelled from the cells and conducting tubes. As the preservative cools down, the air in the wood cells and conducting tubes contract creating a vacuum inside the cells and the tubes. This vacuum draws the preservative into the wood cells and conducting tubes.

The Struggle Continues