FPY/SIWES COURSE COMPONENTS FOR STUDENTS OF FACULTY OF AGRICULTURAL SCIENCES

200			
S/N	**Course Code**	**Course Title**	**Credit Units**
1	ARD401	Extension Practices	1
2	CRP401	Crop Production Practices (Arable and Horticultural Crops)	2
300			
3	ANP403	Animal Husbandry Techniques-Non-Ruminant	2
4	SLM403	Farm Design Survey and Land Use Planning	1
5	CRP405	Agricultural Processing and Storage	2
400			
6	AGM401	Farm Mechanisation Practices	1
7	AEA 403	Farm Project Appraisal	1
8	SLM405	Agricultural Meteorology	1
9	AFS401	Fisheries	1
10	SLM401	Soil Fertility and Water Management	1
11	AGM403	Workshop Practices	1
12	AEC401	Farm Management Records and Accounts	2
13	ANP407	Animal Health Management	1
14	CRP407	Crop Protection and Pest and Disease Control	1
15	ANP401	Animal Husbandry Techniques-Ruminant	1
16	ARD403	Extension Strategies in Pilot Rural Development Projects	1
17	SLM 407	Soil Site Classification	1
18	AGR401	Report Writing (Book form)	3
		Total Credit Units	24

SECTION 1

(200 LEVEL)

NATIONAL OPEN UNIVERSITY OF NIGERIA

FACULTY OF AGRICULTURAL SCIENCES

DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION

FPY/SIWES PRACTICAL GUIDE MANUAL

ARD 401: EXTENSION PRACTICES

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THE EXTENSION FIELD TRIP

1.0 INTRODUCTION

Field trip is an important component of science teaching. This method involves taking learners/students out of the classroom or out of the school environment for on-the-scene learning experiences. It is a planned visit to specific places outside the regular classroom activities to obtain first-hand information and directly study real situations. The method aims at broadening learners' general experience and knowledge in various directions. Field trips are usually undertaken either to enable students see practically what has been taught during the class or to let them discover things by seeing, touching, smelling or even tasting.

Agricultural science students may be taken on field trip to places like Root crop Research Institute, Umudike, Micheal Okpara University of Agriculture Umudike, Institute of International Tropical Agriculture (I.I.T.A.) Ibadan, Fertilizer Factory, Plantation farms and so on. Field trip is useful especially when most of the material resources and equipment needed for a particular lesson are not available in the school environment. The class teacher or lecturer usually leads students on field trips. Field trip may last for more than five days depending on the distance and the objectives of the trip. If properly planned, field trips afford the students opportunity to become actively engaged in observing, collecting, classifying, studying relationships and manipulating objects. It is one of the most enjoyable and exciting experiences for students studying science.

2.0 OBJECTIVES

By the end of this field trip, you should be able to:

- Appreciate and understand the planning and preparation of field trip.
- Be involved and exposed to field trip discussion stage.
- Exposed to review field trip session in line with its objectives.
- Identify the guidelines for field trip.
- Appreciate the advantages and disadvantages of field trip.

3.0 PROCEDURE FOR CONDUCT OF FIELD TRIP

a. Field Trip Planning, Preparation and Discussion Stage

i. The teacher/lecturer should decide on the place to be visited based on its relevance to the topics in the syllabus and scheme of work.

ii. The date and day of trip should be planned and fixed at a period when the school timetable will be least disrupted.

iii. Arrange the visit with the relevant institutions and obtain permission before the trip is embarked upon.

iv. The institution/school administrator should be consulted and permission obtained before notifying the students' parents.

v. Discuss the purpose of the field trip with the students. Emphasis specific points to be observed, what to look out for, what to learn and general conduct required of them during the trip.

Undertake a preliminary visit to the place so that you can anticipate problems, hazards and risks that may be involved in the trip and plan the details of the trip. Adequate arrangements should be made for transportation, feeding and accommodation before the trip.

b. The Field trip Stage

- Very adequate joint transportation arrangement should be made and the teacher should lead students on the field trip.
- Ensure that the students are not distracted but concentrate on the objectives of the trip.
- Ensure the students are observing and jotting down important points, which they should be encouraged to develop into post-field report.
- Thoroughness of preparation as well as cooperation of the students will ensure the success of the trip.
- The teacher should always be available to solve unforeseen problems and emphasize particular aspects of the visit that are worth being noted by the students. The teacher should be alert to the safety, comfort and welfare of all participants throughout the journey or excursion.

c. Field Trip Review Session

Organize a field trip review session in which evaluation of the trip in line with its objectives are discussed in the class. The teacher may request students to submit individual reports on the trip. The teacher should evaluate the reports and use them as basis for planning more successful and result-oriented field trips in the future. Reinforcement should be given to students who present excellent reports.

Guidelines for Field Trips

1. The first rule on the field trip is that the teacher should first make the trip so that all opportunities and dangers are known before hand.
2. In planning field trips to either industries or community resources centres, the agricultural teacher should first tell the class concerned what to look out for and how to obtain the information that occasions the visit.
3. The teacher should carry first-aid kit in case of accident.
4. Advise the students about materials they will need like notebooks, pencils, hand lens etc.
5. Make firm arrangements for transportation.
6. There should be students' report on the trip and class discussion on the activities during the field trip.

Advantages of Field Trip

1. Field trip is the only lesson format that can sharpen the keenness of observational abilities and nurture the habits of appreciating the orderliness of natural occurrences or events and phenomena.
2. Learners acquire first-hand information and educational experiences.
3. It reduces the usual classroom boredom or monotony.
4. It helps students to learn by doing and the facts acquired last long in the memory.
5. Good human relationship is enhanced between the students and teachers.
6. Free and unrestricted discussions are encouraged in the trip during which hidden talents are revealed.
7. Concrete things or materials, if brought from the trip may be of immense benefits in subsequent farm practical lessons.

Disadvantages of Field Trip

1. The method may be very expensive in terms of require time, financial and material resources.
2. The risk involved may be very great. For example, the event of accident or sickness may claim the lives of either students or teachers. If not well handled, it can mar the reputation of the teacher.
3. The method could encourage immoral practices among opposite gender if appropriate care is not taken.
4. Field trips may encroach or paralyze other classroom activities if the trip lasts. The school timetable may be disorganized.
5. Field trips are difficult to administrate.

4.0 CONCLUSION

The following conclusion should serve as guidelines for agricultural science teachers:

1. There is no method of teaching farm practice that can be considered superior to all others.
2. Students' readiness for learning varies from day to day and from one learning task to another.
3. The condition under which practical teaching is done varies from institution to institution.
4. The teachers even differ and so the students they teach.
5. Therefore, the methods by which the teacher does his work should be flexible.

5.0 PRACTICAL ASSIGNMENT

1. As a student of agricultural science in the Faculty of Agricultural Sciences, write an individual report on your field trip to I.I.T.A.) Ibadan and Root Crop research Institute, Umudike which took place on Monday 8th – Friday 12th May, 2017 and submit to your farm practice teacher for evaluation.
2. Identify five important points you observed and jotted down during your field trip which could be developed into post-field trip report.
3. Discuss five benefits of a field trip.

6.0 REFERENCES

Olatunji, S. O. (2005). Effective Teaching and Extension of Agriculture in the Tropics: 56 – 57.

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MASS MEDIA AS CHANNELS OF COMMUNICATION

1.0 INTRODUCTION

One of the major objectives of agricultural extension is educational objective which aim at transmitting knowledge, skill acquisition and change in attitude. Different methods can be employed by extension to realize its objectives, these are:

i. Individual contact method
ii. Group contact method
iii. The mass media method

The individual contact method includes farm and home visits, office calls, telephone calls, correspondence.

The group contact method includes method demonstrations, general meetings, lectures, group discussions, workshops, field trips/farm works.

The mass media method includes publications, bulletins, circulars, newspapers, exhibits, posters, agricultural cinema vans, radio, television.

2.0 OBJECTIVES

By the end of this lesson the students should be able to:

- Identify and explain the functions of mass media as extension method.
- Identify various types of mass media and their classification based on the channels which messages are conveyed to the end users.

3.0 PROCEDURE FOR MASS MEDIA AS CHANNELS OF COMMUNICATION IN AGRICULTURE

3.1 Functions of Mass Media as Extension Method

The functions of mass media are classified by Van Den Ban and Hawkins (1992) into four:

i. **Setting the Agenda of Important Discussion topics:** The media can have an important influence on what we think and talk about. Even though they cannot decide what we must think. Farm magazines and rural radio programmes can play an important role by stimulating farmers to discuss point with the extension agent.

ii. **Transforming knowledge:** We learn only part of what we know about the world through our observations and direct experiences but we gain about what we know from the media.

The media specialize in news, extension agent will sometimes try to create news in order to win media attention and coverage.

iii. **Forming and changing opinion:** Mass media may play an important role in developing opinion particularly when members of the public do not have a strong view about a particular issue.

iv. **Changing Behaviour:** Mass media may be used to change the patterns of behavior. Advertising is very successful in this way. Cleverly worded advertisements draw consumer's attention to certain commodity. Important behavioural changes can take place when the media show the people how to fulfill their wishes.

3.2 Types of Mass Media used in Communication of Agricultural Information

The various media are classified based on the nature through which messages are conveyed, that is, the channels. The media can be grouped as follows:

(a) **Printed media:** This includes newspapers, journals, magazines, research papers, newsletters, leaflets, pamphlets, bulletins, hand bills, fact sheet.

(b) **Audio Tapes Media:** This includes radio, tape recorder.

(c) **Visual Media:** Television set, videotext are included.

(d) **Projected Visuals:** These comprise slide overhead transparent motion, mobile cinema.

(e) **Static or Non-projected Visuals:** These are posters, wall charts, maps, chalkboards and flop charts.

3.2.1 Printed Media

i. **Newspapers and Magazines:** Newspapers are printed publications usually issued everyday while magazines are publications that are usually for specific target audience. For example, magazine of the raw materials society of Nigeria. Magazines are usually weekly or monthly. Agricultural messages are conveyed as articles in newspapers and page on Tuesdays captioned "AGROCARE" to discuss on matters relating to agriculture. These sources are very important as they can be documented and referred to whenever the need arises.

ii. **Journals and Research Papers:** Journals are professional publications for particular vocations and profession. They are directed at members of a particular professional organization or society. They are technical in content, they are report of specific indepth study on a subject matter documented for other users. For example, Journal of Agricultural Economics, or Journal of Rural Sociology while research papers are papers, presented to convey the understanding of research messages and for quicker adoption.

iii. **News Letters:** Theses are publications containing news. Agricultural newsletters contain news about an organization.

They can also be used to spread news of various agricultural bodies.

iv. **Leaflets, Handbills, Pamphlets:** Leaflets are single sheet publication that carry information. Handbills also inform and enlighten the public on a particular issue. Pamphlets can vary from a sheet of paper to a few sheets. They may have sketches and drawings to illustrate the issue at hand, they do not usually contain pictures.

v. **Bulletins:** A bulletin is like a journal, it is very scientific containing different articles written by different experts within the professional body or organization. It is a good source of disseminating agricultural information, for example CTA, EC Fisheries Cooperation Bulletin.

vi. **Fact Sheet:** This is a sheet of paper that contain facts. They are professional sheet containing facts about a profession, for example, a fact sheet can be used to tell farmers how to cultivate soyabeans (including the steps).

3.2.2 Audio tapes Media

Radio is widely used by farmers in developing nations including Nigeria. This is due to some reasons; chiefly among them is that is easily affordable by many farmers. According to Nielsen (1999), who argued that radio communication is cost effective, efficient means of instantaneous communication. Radio waves take message across a wide span of areas without the problems of good network of roads, fuel supply or serviceable transport nor do they demand high levels of literacy in order to reach farmers in remote areas. The tape recorder is also useful for transfer of agricultural information.

3.2.3 Visual Aid – Television

Television has the advantage of combining audio and visual display of information. Television broadcast can be in these forms.

(a) Open broadcast – This is broadcast to all at home.

(b) Closed circuit – This is transmitting to some set of people, for example a university community.

(c) Instructional television – These are used for workshop, conferences, seminars.

3.2.4 Projected Visual

i. **Slide, Overhead Transparent Motion:** These are used in large halls. It affords the audience to have full concentration while the presenter explains some information shown on slides.

ii. **Mobile Cinema:** Mobile cinema is particularly very useful in remote areas. It allows the people in such areas to have access to information which would have eluded them. They are usually shown in vans.

3.2.5 Static or Non Projected Media

These media have no sound or motion of elements. They are fastened against a support. They can easily be replicated and can be made from easily available materials. They are displaced in public places.

4.0 CONCLUSION

This lesson has attempted to discuss the role of mass media in projecting agricultural technology and increase production in Nigeria. Mass Media assuredly are of great significant in projecting technological innovations. It has been shown that large number of farmers can be made aware of innovations by mass media but adoption will depend on the initial message being reinforced through personal contact with opinion leaders within the social system.

In order to be able to fully meet media objectives, the following recommendations would serve as a guide to the instructional facilitators/ teachers:

1. Media agricultural resources centre should be made accessible to farmers so that such can be used as demonstration centres and laboratory.
2. The fore-knowledge of target, socio-cultural systems will guide the choice of media and its credibility as appropriate tools.
3. Low cost media information materials can be invested which will serve as motivation for farmers.
4. Most of the agricultural programmes in radio and television should be aired with the local dialect or language.
5. Extension agents should be advised and made to do proper follow up of the message conveyed through mass media in rural areas.

5.0 PRACTICAL ASSIGNMENT

1. Identify five types of mass media with specific examples which are commonly used in your FPY/SIWES research institute/organization or farm.
2. People in less industrialized counties or rural areas of Nigeria have less or limited access to mass media for several reasons. Discuss.
3. Radio is an audio tape media widely used by farmers in developing nations including Nigeria. This is due to some factors. Discuss the factors as a student of Agricultural Science.

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BROADCASTING (RADIO AND TELEVISION)

PREAMBLE

The role of electronic media is not confined to provide information, education and entertainment. It has to play a greater role to promote citizens right to information. Further to secure the citizen's civil, political and social rights, it also has to act as a public watchdog to reveal state abuses. Public Communication System has been recognized as a public sphere, where widespread debate and discussion can take place. This will provide people information necessary to make informed decisions, and facilitate the formation of public opinion and can thus enable the citizens to shape the conduct of government by articulating their views. The role of electronic media, both radio and television is to be conceived in terms of representing adequately different social interests also. They have to give adequate expression to the full range of cultural-political values in society, socialization, cultural promotion and national integration for creating better understanding and appreciation of others viewpoints and aspirations. Media can help to democratize the relationship between governments and governed.

Broadcasting is the distribution of audio and/or video content or other messages to a dispersed audience via any electronic mass communications medium, but typically one using the electromagnetic spectrum (radio waves), in a one-to-many model. Radio and Television are primary means by which information and entertainment are delivered to the public in virtually every nation around the world. The term *broadcasting* refers to the airborne transmission of electromagnetic audio signals (radio) or audiovisual signals (television) that are readily accessible to a wide population through standard receivers.

A. RADIO PRODUCTION

1.0 INTRODUCTION

Radio production is the various means of recording and transmitting the human voice and other sounds for instructional purposes. These include the varieties of teaching and learning devices, equipment's that evoke the sensory modalities of hearing. In this group are; records, audio cards, radio and telephone instructional programmes, public address systems, tape recorders, human voices which are directed towards teaching and learning.

Radio programmes can be live, pre-recorded or a combination of both. Live production involves the risk of production errors, as there are no "second chances". It has to be right the first which is the only time. However, live production is cheaper than recorded production techniques and sometimes easier and quicker. Recorded productions allow supervision and control over quality. In this method, first recording of programmes is done. Local live production employs station's own announcers or newscasters locally and plays records and tapes, which they themselves own. In semi automation production a local radio station relies on the services of the syndicated programme producer. Editing and postproduction are done at a later time.

Production can also be done at a temporary remote location. A unique setting can be achieved by thoughtful selection, planning and full use of a remote outside location. The basic equipment to produce audio programme include: The studio desk (mixer console or control board or control panel), Microphones, Turntable, Compact Discs and Records, and Audiotapes.

2.0 OBJECTIVES

By the end of this lesson students should be able to:

- Explain the various radio production formats
- Study about equipment's for radio production
- Identify the stages of radio programme production
- Explain the guidelines for different types of agricultural radio programmes and;
- Write for radio especially on agricultural oriented issues and appreciate the merits and demerits.

3.0 PROCEDURES FOR RADIO PRODUCTION

Radio productions are planned in three stages.

i. **Pre-Production:** This is the planning and development stage. This begins with the generation of a script. Unless a script is developed it is difficult and there will be confusion on what type of programme you are producing. The script contains instructions and guidelines for the production of the programme.

ii. **Production**: The second stage is production. All the material for the programme are recorded or organized at this stage. Selecting and positioning of the microphones, the type of tapes to be used, and selection of various sources of sound through the mixer are all part of this stage.

iii. **Post Production**: This stage generally includes editing. Sounds recorded during production and dubbing if required, are the principal focus of post - production. Putting together the previously recorded sound and selection of sound are important. The purpose of editing can be summarized as:

   a. To arrange recorded material into a more logical sequence.

b. To remove the uninteresting, repetitive, or technically acceptable portion.
c. To compress the material in time.
d. For creative effect to produce new juxtaposition of speech, music, sound and even silence.

Guidelines for Radio Production

i. The first guideline for radio production is that radio production is highly technical so the instructor should make the sessions implicit for learners.
ii. The instructor should make sure that all facilities to be used for learning are in good condition.
iii. The teacher should ensure that there is sufficient electricity power supply for light control.
iv. Studio settings should offer personnel and temperature control for conducive learning and production.

Advantages of Radio Production

i. Programmes produced are easily accessible to target audience.
ii. Radio programmes have greater number of audience.
iii. Some of the equipment's used in radio production such as microphone; public address systems are easy to use for agricultural programmes.
iv. The equipment's are portable.
v. Good radio programmes are always stimulating.
vi. The programmes serve as teaching functions
vii. The programmes have great interactivity.
viii. It has imaginative potential to listener to add to his/her own visual interpretation.
ix. As a major news source it is widely heard and acceptable. It has massive, immediate distribution.

Disadvantages of Radio Production

i. Programmes aired may not be of target audience interest.
ii. Religious and cultural factors may impede listening.
iii. There is no room for the listening audience to ask questions on the subject matter relayed.
iv. Some equipment's used in production may need specialists in their operations.
v. It is a friendly, personal medium but not conducive to detailed information.

4.0 CONCLUSION

The following conclusions should serve as guidelines for the facilitators/ teachers;

i. Most of the radio programmes are not agricultural oriented.

ii. The subject matter taught will be based on individual rate of assimilation.
iii. There should be flexibility in the mode of practical teaching.
iv. A "Theater of Mind" can be created using sound only.

5.0 PRACTICAL ASSIGNMENT

As a student of agricultural science in the Faculty of Agricultural Sciences;

1. Write a detailed note on radio programme production.
2. Discuss the equipment used for radio programme production.
3. What are the various formats of radio programme production?

TELEVISION PRODUCTION

1.0 INTRODUCTION

The word television means "to a see at a distance". In TV broadcasting system, the visual information is recorded and converted in to an electric signal, which is transmitted to the receiver. At the receiving end, the video signal is converted back in to the images on the screen of the picture tube (TV set). Much similar to radio broadcasting, television originally was conceived as another method of broadcasting entertainment and news programmes but with pictures. Commercial broadcasting turned out to be the largest field in the application of television. The ability to reproduce pictures, text material, graphics, and visual information has become so useful that we can watch a programme from a foreign country relayed by satellite or play back a video cassette recorder (VCR), or a video game can be connected to the TV receiver. Presently, some TV stations in the country has gone digital thereby adding value to viewers through subscriptions.

New interface technologies have been developed and transfer of image from TV to film or vice versa are easily carried out. A growing trend is that programmes are shot in film and the editing is done in videotape. Computer animation, another technological advancement, is extensively used by both film and television. A combination of all the three has started producing seamless effect of elaborate and sophisticated pictures which can be in agriculture.

2.0 OBJECTIVES

By the end of this lesson, students should be able to:

- Study about the Pre-Production Stage of television production.
- Study about the Production Stage of television production.
- Study about the Postproduction Stage of television production.
- Conversant with some Video Formats and;
- Abreast with some Terminologies used in Television Production.

3.0 PROCEDURES FOR RADIO PRODUCTION

Television productions are planned in three stages.

i. **Pre-Production Stage (Script Writing):** The concept is also called the idea, premise, or synopsis. Write a script describing the basic idea of the programme story. Present a thumbnail sketch of the story to provide the producer or the director with a quick means of evaluating the overall scope of the programme story. Draw the scene outline in numerical order of all the scenes without dialogues or elaborate descriptions. Make a treatment which is a prose description of the story, describing the action in detail and provide the kind of visual imagery.

ii. **Production Stage (Producer):**

a. The producer assumes responsibility for the entire television production. Depending on the type of production and facility involved, these responsibilities are combined with those of the director, the writer, or both.

b. The Director: The director coordinates the efforts of the technical crewmembers and the performance of the television talent. The director executes the production designed by the producer and conceptualized by the writer.

c. The Writer: Basically, the writer conceptualizes and formulates the essential television elements into proper script to accomplish specific objectives.

iii. **Post Production Stage:** Edit in the early days of the movie image at first it will be done by turning the camera off after one shot, then repositioning and turning it back on for the next shot. Real editing will begin when they turned the camera off and on several times in one reel. Process the film, and then cut the shots apart and glued material back together in a shorter form or different order. Finally video editing or compact disc commences.

Guidelines for Television Production

i. The first guideline is that television production requires multimedia facilities to function.

ii. The instructor should ensure that all facilities to be used for learning are in good condition.

iii. Steady power supply is needed to air edited programmes.

iv. Provide a precise and accurate measurement of different colours of light for viewers.

v. Sound is also an essential element and should be given much thought and care because sound waves travel in well-defined cycles

Advantages of Television Production

i. Television programmes produced are appealing to the audience due to the colour.

ii. It is a friendly, personal medium.

iii. It does not respect territorial limits.

iv. It is the best medium for demonstrating any agricultural technology to farmers.

v. It helps in increasing viewers' retention ability and creative production.

vi. It has immediate distribution which can be massive.

vii. As an entertainment medium, it is very accepted psychologically.

Disadvantages of Television Production

i. Multimedia facilities used in production are too costly
ii. Religious and cultural factors may impede viewing.
iii. There is no room for the viewing audience to ask questions on the subject matter conveyed.
iv. Most equipment's used in production may need specialists in their operations.
v. The time allotted for some agricultural programmes may not be convenient for the farmers.
vi. It requires power to view programmes.
vii. Requires a fully developed TV network.
viii. Television receivers are expensive.

4.0 CONCLUSION

The following conclusions should serve as guidelines for the facilitators/teachers;

i. Most of the television programmes are not agricultural oriented.
ii. Students vary in understanding the subject matter taught.
iii. Teaching should be made simple for the students.
iv. Adjustments should be accommodated whenever there is need.

5.0 PRACTICAL ASSIGNMENT

1. Briefly discuss the process of television programme editing.
2. Applying what you have studied, write a script using the basic idea of any agricultural crop.
3. Write a brief note on the postproduction stage TV programme production.

SCRIPT WRITING

1.0 INTRODUCTION

A script is a manuscript or typescript to be acted in case of drama or to be broadcast. A script writer therefore is someone who writes scripts for films or broadcast programmes. Understanding the process involved in developing a script for performance is important for learners who wish to pursue a career in writing or to develop their writing through higher qualifications. It is also a useful tool to accomplish to aid the creative process of devising original dramatic work. It is also a useful tool to accomplish to aid the creative process of devising original dramatic work. Script writing allows learners to experience some of the pre-production creative processes that take place in the performing arts industries. A good script should be well developed and attractive, formatting consistent, have adequate response and active participation of listener's required.

2.0 OBJECTIVES

By the end of this lesson you should be able to;

- Identify styles and forms of writing for performance
- Research and explore different writing forms and topics used in radio, film and television stages.
- Present ideas in a written format appropriate to performance medium that can be interpreted by others
- Appreciate and explain the effectiveness of script writing, their advantages and advantages.

3.0 PROCEDURES FOR SCRIPT WRITING

The following are the procedures for script writing:

i. Make explicit the agenda for the lesson- the expected learning outcome. Relationship between the lesson and the real life situation outside the classroom.
ii. Break the concept/skill into small steps that can lead to its mastery. Note the steps that may form stumbling blocks and threat them positively.
iii. Provide a variety of activities both teacher/presenter-lead and learner-lead that are motivating, meaningful and as close to real life as possible.
iv. Use stimuli (words, pictures, images, activities) which relate to students background, but yet intellectually challenging.
v. Use notes, diagrams, captions as aids.

vi. Use pictures and other visual stimuli actively for exploration as well as information.
vii. All lesson/learning activities should emphasize constructive participation and should arouse the interest of the students.
viii. Suggest follow-up activities for application and consolidation of what has been learnt.

Guidelines for Script Writing

i. Divide programme elements into those that are under your control and those that are not.
ii. Write narration involving the audience.
iii. Provide narration that sounds natural and conversational.
iv. Avoid long lists, unnecessary statistics, complex terms and jargons and hackneyed expressions.
v. Make narration clear, precise, and easy to understand.

Advantages of Script Writing

i. It is a useful tool to accomplish to aid the creative process of devising original dramatic work.
ii. Script writing allows learners to experience some of the pre-production creative processes that take place in the performing arts.
iii. Helps learners develop scripts for performance, starting from initial concepts and rough drafts, through a process of editing, revising and refining to produce completed scripts.
iv. Help students explore different kinds of scripts used in radio, film and television and stage.
v. Helps learners cover a wide range of writing forms and styles, giving an overview of the sector so that they have a clear idea of how their work fits in with that of the professional world of script writing.

Disadvantages of Script Writing

i. Topics or stories written may not be of interest to listeners due to cultural or religious factors.
ii. There may be scripts written that will be a threat to the security of the nation.
iii. Styles in writing scripts may affect a future script writer because of inconsistency.
iv. Scripts written today might not be useful in future if not properly documented.
v. Some scripts are highly classified, making them inaccessible for users.

4.0 CONCLUSION

The following conclusions should serve as guidelines for the facilitators/teachers;

i. The teacher should emphasize that ambiguous words should be avoided completely.

ii. The teacher should note that proficiency in writing among the students varies from one another.

iii. The teacher should properly vet scripts before final presentation.

iv. A good teacher seeks as many ways as possible to present information and ideas to students.

5.0 PRACTICAL ASSIGNMENT

As a student of agricultural science:

1. Prepare a detailed script writing using the stated guidelines of the mandate of any Agricultural Research Institute in Nigeria,
2. Briefly explain the merits and demerits of script writing
3. With the practical skills gained, edit your fellow student written draft script before presentation.

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WEB SITE DEVELOPMENT

1.0 INTRODUCTION

Web development comes in two flavors - front-end development and back-end development and is broadly refers to the tasks associated with developing websites for hosting via intranet or internet. The web development process includes web design, web content development, client-side/server-side scripting and network security configuration, among other tasks. Web design is a process of conceptualizing, planning, and building a collection of electronic files that determine the layout, colors, text styles, structure, graphics, images, and use of interactive features that deliver pages to your site visitors. It encompasses many different skills and disciplines in the production and maintenance of websites.

The different areas of web design include web graphic design; interface design; authoring, including standardized code and proprietary software; user experience design; and search engine optimization. Often many individuals will work in teams covering different aspects of the design process, although some designers will cover them all. The term web design is normally used to describe the design process relating to the front-end (client side) design of a website including writing mark up. Web design partially overlaps web engineering in the broader scope of web development. Web designers are expected to have an awareness of usability and if their role involves creating markup then they are also expected to be up to date with web accessibility guidelines.

It requires an effective, sustained marketing strategy beyond presenting a collection of products, services, images, videos or other files. The website design should be focused on specific goals, along with measurable objectives to attain them. Marketing goals will differ depending on the nature of your business.

2.0 OBJECTIVES

By the end of this lesson, you should be able to:

i. Explain how to gather Information.
ii. Appreciate and describe how to Plan: (Sitemap and Wireframe Creation).
iii. Prepare and design page layouts, review and approve cycle.
iv. Gather and assemble content writing.
v. Describe how code data and information.
vi. Test, review and launch web site.
vii. Maintain, opinion monitoring and regular updating of information and;

viii. Identify and explain guidelines for merits and demerits of web design development.

3.0 PROCEDURES FOR WEB SITE DEVELOPMENT

The following are the procedures for Web Site Development;

i. Design Process and Evaluation

a. Set and State Goals.
b. Determining the purpose of a web application.
c. Prioritizing different design goals.
d. Use an Iterative Design Approach.

ii. Evaluate Websites Before and After Making Change

a. Understand and Meet Users' Expectations.
b. Establish User Requirements.
c. Analyzing the target user groups and their goals.
d. Use Parallel Design.
e. Consider Many User Interface Issues.
f. Focus on Performance before Preference.
g. Set Usability Goals.
h. Select the Right Number of Participants.
i. Be Easily Found on the Web.

iii. Optimizing the User Experience

a. Display Information in a Directly Usable Format.
b. Units of measurement and currency.

iv. Accessibility

a. Do Not Use Color Alone to Convey Information.
b. Design Forms for Users Using Assistive technology.

v. Hardware and Software

a. Design for Common Browsers.
b. Account for Browser Differences.
c. Design for Popular Operating Systems.
d. Design for User's Typical Connection Speed.
e. Design for Commonly Used Screen Resolutions.

Guidelines for Web Design Development

i. The first step in designing a successful web site is to gather information. Many things need to be taken into consideration when you design the look and feel of your site, first ask a lot of questions to help you understand your business and your needs in a web site.

a. **The first role is for the teacher to know the purpose of the site to be designed. Also to provide**

information, promote service and hoe to sell the product.

b. What to accomplish by building this web site, either to make money or share information.

c. The specific groups of people that will help you reach your goals. Consider their age, sex or interests – this will help you determine the best design style for your site.

d. **The** type of information target audience is looking for on your site, a particular product or service.

ii. Use the information gathered from step one and put together a plan for your web site. Here you develop a site map – a list of all main topic areas of the site, as well as sub-topics (if applicable). This gives you a guide as to what content will be on the site, and is essential to developing a consistent, easy to understand navigational system. This is also the point where you decide what technologies should be implemented – interactive forms, CMS (content management system) such as Word Press, etc.

iii. Draw from the information gathered, to determine the look and feel of the site. Target audience is one of the key factors taken into consideration here. A site aimed at farmers, for example, will look much different than one meant for a financial institution. You should also incorporate elements such as the agricultural components to help strengthen the identity of the profession.

iv. Once you've designed a prototype, you are given access to the Client Studio, which is a secure area of your web site. The Client Studio allows you to view your project throughout the design and development stages. In this phase, communication is crucial to ensure that the final web site will match your needs and taste.

v. This is where the web site itself is created. You take all of the individual graphic elements from the prototype and use them to create the functional web site. You should also take your content and distribute it throughout the site, in the appropriate areas. This entire time, you will continue to be able to view your site in the Client Studio, and suggest any additional changes or corrections you would like to have done.

vi. At this point, we attend to the final details and test your web site. You should test things such as the complete functionality of forms or other scripts, we test for last minute compatibility issues (viewing differences between different web browsers), ensuring that the site is optimized to be viewed properly in the most recent browser versions.

vii. Once the final approval is received, it is time to deliver the site. You should upload the files to your server – in most cases, this also involves installing and configuring Word Press, along with a core set of essential plugins to help enhance the site. Here quickly test again to make sure that all files have been uploaded correctly, and that the site continues to be fully functional. This marks the official launch of your site, as it is now viewable to the public.

viii. The development of your web site is not necessarily over, though. One way to bring repeat visitors to your site is to offer new content or products on a regular basis. Update the information on your web site.

Advantages of Web Design Development

i. Static Websites are not very expensive and it takes less time to develop them.
ii. Hosting a static website is also cheap.

Disadvantages of Web Design Development

i. Webmasters need to have knowledge of *HTML/CSS*/Photoshop and among others to keep their websites updated or they need to hire a website design agency for maintenance of their website.
ii. Static websites are not interactive - website visitors cannot search within your website or interact with website owners.

4.0 CONCLUSION

The following conclusions should serve as guidelines for the facilitators/teachers:

i. The teacher should consider computer proficiency of the students before embarking on the practical training.
ii. The condition where the practical training is to be executed influences rate of assimilation of the students.
iii. The teacher should consider the simplest method of teaching to be adopted for effective learning.

5.0 PRACTICAL ASSIGNMENT

As a student of Agricultural Science in the Faculty of Agricultural Sciences in National Open University of Nigeria:

1. Enumerate the procedures for designing a web site.
2. Design a web site that showcases the various departments in your faculty.
3. Design a web site for an oncoming agricultural science exhibition scheduled to hold in the Faculty by end of this semester.

NATIONAL OPEN UNIVERSITY OF NIGERIA

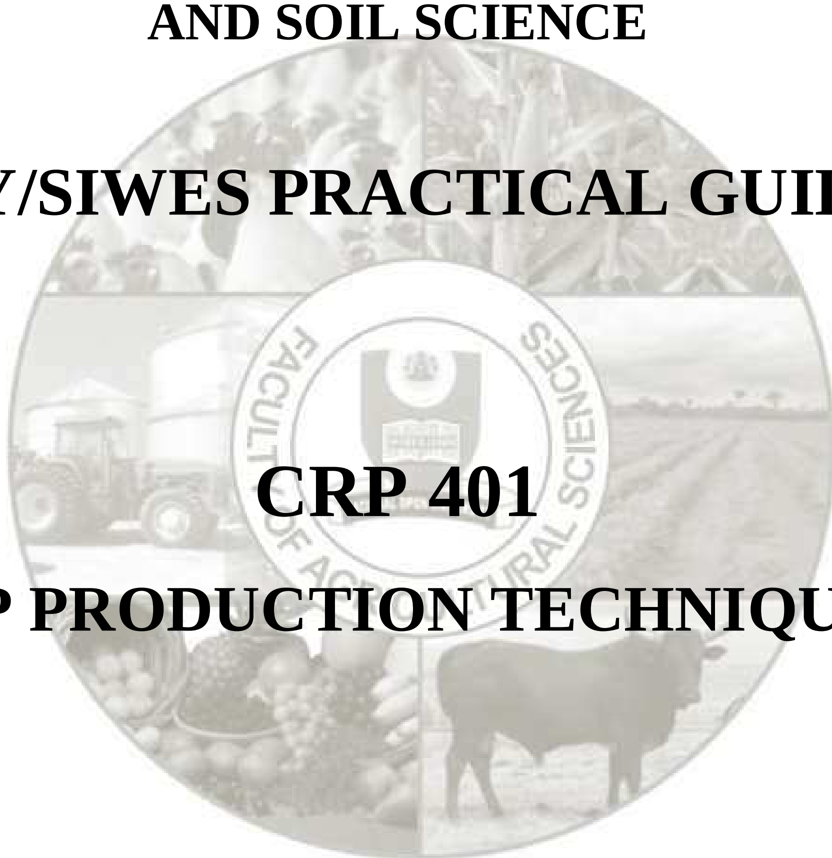
FACULTY OF AGRICULTURAL SCIENCES

DEPARTMENT OF CROP AND SOIL SCIENCE

FPY/SIWES PRACTICAL GUIDE

CRP 401

CROP PRODUCTION TECHNIQUE 1



Writer: DR. A. M. Petu Ibinkunle

NATIONAL OPEN UNIVERSITY OF NIGERIA

FACULTY OF AGRICULTURAL SCIENCES

DEPARTMENT OF CROP SCIENCE.

FARM PRACTICAL GUIDE: CROP PRODUCTION TECHNIQUE 1 (CRP 401)

INTRODUCTION

As an agric student you should by now have covered most related courses in crop prodution. You will however agree with me that most of your experience by in the last 2-3 year ago were either class room base or resticted to class room activities.

You need to appreciate the fact that agriculture in general and specifically crop production is not exclusively a book reading business. Effort in this study will increase your knowldge by engaging you in alot of farm activities to transform your knowldge from virtual to real activities.

You are requested to get attached to an environment where active farming activities are going on and be active in participating in all the activities for the period of on practical year**.**

OBJECTIVE

At the end of the practical year, you are expected to have upgraded your knowldge of crop production cultural practices beyong ordinary definations. Other objectives of this study encompasses affording you to physically enterpise with crop species and varieties. You will also have the opportunity of being competent in taking decision on where, to grow, when to grow, what to grow and how to grow crops. You will be prepared to be competent in managing the farm with a sand knowldge of crop production cultural pracices.

PROCEEDURE

Enteprice of importance:

Grain legumes (Cowpea, Ground nut and soybean) **leguminous**. adjective. of, relating to, or belonging to the Fabaceae (formerly Leguminosae), a family of flowering **plants** having pods (or legumes) as fruits and root nodules enabling storage of nitrogen-rich material: includes peas, beans, clover, gorse, acacia, and carob.

Cereal crops (Maize, Sorghum and Milet) **Cereal** is any grass cultivated for the edible components of its grain (botanically, a type of fruit **called** a caryopsis), composed of the endosperm, germ, and bran.**Cereal** grains are grown in greater quantities and provide more food energy worldwide than any other type of crop and are therefore staple crops.

Root and Tuber Crops (Yam, Cassava and Potetoes) Root and **Tuber Crops**. Root and **tuber crops** (**Crop**Groups 1 and 2) consist of root **crops**, such as beets and carrots, and **tuber crops**, such as potatoes and sweet potatoes, and the leaves of root **crops**, such as beet tops

Vegetable crops (Pepper, Tomatoes, Onions And Spinach) any plant whose fruit, seeds, roots, tubers, bulbs, stems, leaves, or flower parts are used as food, as the tomato, bean, beet, potato, onion, asparagus, spinach, or cauliflower. 2. the edible part of such a plant, as the tuber of the potato. 3. any member of the **vegetable** kingdom

Site selection

Now let us look at the points to consider in site selection for farming purpose.

1. Climatic factors

By this, we are referring to rainfall, humidity, wind pressure and direction, temperature etc. These factors must be favourable to the farming enterprise you choose be it crops or animals. Different types of crops do well under a certain range of climatic conditions, likewise certain animals. It is, therefore, relevant to consider the factors that will promote your farming enterprise and avoid those that will not. (Rainfall characteristics, Photo period, Temperature regimes)

2. Socio-economic factors

These factors include infrastructure, population, settlements, market, labour and others. Infrastructure, includes access roads, electricity, water, telecommunication, health facilities, police station etc. The presence of these makes it suitable to site a venture like a poultry farm. However, proximity to the urban settlement may make it unsuitable. Another example is security and health considerations which will require the presence of health facilities and police presence, respectively. You may need a market close to your farm and available labour. Careful thought and research must be carried to assess the suitability of a farm site in the presence or absence of all or a combination of the socio-economic factors.

3. Edaphic factors

These are related to soil conditions like structure, fertility, texture, porosity, consistency etc. These soil factors determine the suitable farming enterprise be it crops or animals. Lands with clayey soils may be suited for fish farming, with all other factors favourable. Some lands a prone to flooding and/or erosion. These lands, depending on your resources may be managed to set up a profitable farm eg. fish farming. However, with a crop farm like vegetables and tree crops in mind, avoid such areas as it will not favour the crops.

4. Environmental factors

Your farming operations should not have a negative impact on the environment. Some farming activities, when exposed to human or animals, can be harmful. This is usually the case when farms are site close to the urban area. On the other hand, the environment may also have a negative impact on your farm, reducing productivity. Some farms are forced to move or change operation and the urban developments catch up. It is therefore very important to consider this factor in the selection of your site for farming.

5. Government policies

Various government make policies that help them to achieve growth in agriculture. Take advantage of it and set up your farm in a location likely to benefit from the implementation of the policy. For example, the government may decide to cut taxes for farms in a particular area or zone of the country. Also, the government may increase the allocation of subsidised fertilizer and other agro- inputs for certain areas of the countries. You may build a farm in such areas to take advantage of it. You must consider Government policies in your site selection for farming purpose.

6. Biotic factors

This is relating to the presence or absence of some harmful or beneficial organisms. In site selection for farming purposes, you may consider the natural population of certain organisms like bees and other pollinators. and less pest and disease-causing organisms. Where the farming venture involves tree crops, farmlands in forest areas are preferred. However, places with a long history of pests and diseases may be avoided. Also, you should be careful in choosing a site with certain dominant weeds which are difficult to control.

7. Economic factors

If you want your agricultural business to thrive, then this factor is the most important to consider. It includes the cost, benefits and terms of lease or acquisition. You need to carry out a feasibility study of the site to make sure that it will yield enough returns to sustain your farm. This will give you an idea and better understanding, at the time of site selection, the site that will give you the highest returns, taking into consideration all the other factors.

In summary

The site may determine the suitable farming enterprise and vice versa. Before you reach a decision on the site for your farm or the right enterprise for your site, use all available expertise

Land clearing and preparation techniques

Removal or clearing the existing herbaceous and woody vegetation (grass, shrub, bush or trees). This can be either done with or without root extraction;

- Disposal of vegetative debris by windrowing, chopping and mixing with soil or burning;

- Soil cultivation either on strips or entire areas in conjunction, where necessary, with soil and water conservation techniques.

Mechanized removal of woody vegetation by felling operations. Felling single trees by bulldozer blade

1. Definition and description

This operation uses crawler bulldozers equipped with front-end sharp angle or straight blades to cut and fell single trees at or near ground level.

2. Objectives

- To eliminate or minimize the competition for nutrients, moisture and light between the existing woody vegetation and the new plantation.

- To quickly achieve medium-scale land clearing.

3. Locations and conditions for use

- For medium-scale clearing operations in upland wood or brush country with sparse standing trees. The bulldozer blade can be used for various purposes, and can be immediately turned to a new task after felling the trees.

- Where manual felling is expensive and the necessary machinery is available.

- Where the topography and soil conditions are suitable for a mechanized operation.

Clearing of bushy vegetation by mechanized choppers

1. Definition and description

This operation entails the extensive felling of brush or thicket growth using heavy rolling choppers which consist of a large drum with cutting blades towed by a tractor (Chapman and Allan, 1978).

2. Objectives

- To improve the nutrient balance and physico-chemical properties of the soil by chopping the woody vegetation into small pieces and mixing the debris into the soil.

- To destroy the competing vegetation and facilitate root penetration.

- To increase the organic content and infiltration capacity of top soil, and facilitate the penetration of rain-water into the deep rooting zone by subsoiling (Donmez, 1984). In many cases, the chopping operation leaves a mulch of chopped vegetation on the ground surface which protects the soil from the beating action of rain drops and splash erosion.

3. Locations and conditions for use

- On sites where a dense growth of shrubs is the dominant competing vegetation and needs to be cleared.

- On dry and poor sites with shallow sandy soils where a bushy, vegetation dominates.

- Where bushy vegetation, such as maquis in the Mediterranean region, or chaparral in north America, covers large areas.

- Where manual labour is expensive.

Burning - This is done during dry, sunny days. Burning, despite various raised concerns, is a conveneient, fast, and inexpensive practice that marginal farmers are used to in land clearing. It is usually commenced starting from low elevation at a time of the day when there is wind. As the burning progresses, the farmer is always alert to contain the fire to prevent damage to standing crops and to prevent the fire creeping outside of the intended area to be burned.

d. **Spraying herbicide -** A day after burning, the area may be planted to corn. However, if the same area had thick growth of cogon and has not been cultivated before, the farmer applies herbicide to further reduce root mass and ensuing growth of weeds. A week or two are commonly allowed to pass until the grass weeds have regrown and then herbicide is sprayed.

Adopting the above into an approximately one-hectare portion of our farm, land preparation was completed in two weeks. The activities included blanket slashing, raking, burning, and herbicide spraying. Labor requirement was as follows: slashing- 8 man-days (MD), raking- 2 MD, burning- 1 MD, and herbicide spray- 1 MD for a total of 12 MD.

Crop selection

Proper Crop Selection is a Factor in Successful Crop Farming

In addition to the purpose of farming, the major factors to be considered in crop selection include the following**:**

Prevailing farm conditions. know your farm first then select the right crop.The biotic factor refers to living organisms including ruminant animals, insect and other pests, disease pathogens and weeds, as well as organisms having beneficial effects like civet cat population for the production of *civet coffee* and the abundance of pollinators. Where there is prevalence of a disease in a locality, susceptible crops may be excluded or a resistant variety may be selected.The topographic features of the land like elevation, slope, and terrain as well as the physical and chemical properties of the soil such as texture, color, organic matter content, pH and fertility levels will determine the crops that are naturally suited. Also, the various climatic factors, such as prevailing climate type, temperature, rainfall, relative humidity, incidence of light, and frequency of typhoons will limit the choice of crops. A stable supply of water within the farm will allow wide possibilities in crop selection.

In addition, the accessibility of the farm to and from the market will influence the choice of crops. For example, cassava and oil palm should be preferably grown in farms with good roads and as close as possible to the market because the harvest is bulky and must be transported immediately due to rapid rate of degradation.

2. **Crop or varietal adaptability.** The crop(s) and the variety (ies) to be grown should be selected based on their adaptability to the prevailing conditions in the farm. A useful guide is to identify the crops growing in the farm and in the neighborhood. An interview of the neighboring farmers will also provide valuable information as to the probability of success, or failure, of growing certain preferred crops. Furthermore, it is an advantage to have access to lists of different crops under the various plant classification based on natural adaptation or habitat.

3. **Marketability and profitability.** For those who want to engage in cash crop farming or, at the least, ensure financial sustainability, crop selection must consider marketability and profitability. In general, this means that the crop to be selected must be high yielding. The product, be it the fruit, seed, modified root or stem, flower or foliage or any part, must have an accessible, stable and robust market. With efficient labor and use of inputs, the harvest will realize profit to finance the suceeding farm activities or generate substantial return on investment. However, market and price are dictated by many factors such as the number of competitors, supply and demand, development of new products, promotional campaign, and agribusiness cycle.

4. **Resistance to pests and diseases.** Regardless of the purpose of farming, it is important to be able to select a crop and variety with wide resistance to important pests and diseases. The use of susceptible varieties may result to high cost of production or, worst, total crop failure.

5. **Available technology.** The technology for the growing of the crop must have been well established or easy to learn and apply. Likewise, certain crops are preferred because technical assistance is available locally.

6**. Farming system.** Crop selection is affected by the system of farming employed, that is, whether purely crop farming or integrated with livestock animals. Likewise, the particular crop species to be grown will depend on the crop production practices such as monoculture, multiple cropping, hedge row-strip cropping, and planting patterns.

If there is a plan to integrate crop production with free-range livestock, or where entry of astray animals is unhampered, it would be wise to install tree guards or fences. However, additional cost can be eliminated or minimized by selecting crops that are less susceptible to nibbling. Some crops, likesoursop (or guyabano) and sugar apple (or atis) have anti-herbivory properties. In intercropping, it is desirable that the component crops have complementary or mutualistic relation.

7. **Security.** In the absence of security personnel or where there is no fence that will exclude intruders, crop .

Before selecting crops for the upcoming season, review records for last season. Did you have any persistent disease issues in a particular crop? Did one crop do exceptionally well or very poorly? Did some varieties of lettuce bolt a lot earlier than others, leaving you without enough volume? By assessing where you‘ve been, it‘s easier to plan for where you want to go.

Soil basics

The first step is to test your soil. ―Identify which crops you plan to grow, and the soil lab will give recommendations based on your soil and crop needs,‖ advised Katie Campbell-Nelson of the University of Massachusetts Extension and Stockbridge School of Agriculture. ―Each crop has specific fertility needs.‖

Matching crops to the existing limitations of your soils is a smart step. Soil texture, compaction, cation exchange capacity and organic matter content are just a few of the variables that can impact the crop. Planting crops that are well-suited to your soil characteristics gives you a better chance of success. Growers can have an impact on soil characteristics through cultivation practices, by adding amendments, using certain planting methods, or employing techniques to alter factors such as soil temperature, moisture retention or compaction. However, working with a soil that already meets most of a given crop‘s needs increases the chances of success.

Mineral nutrition issues can be difficult to remedy and can have a major impact on certain crops. ―For example, boron is toxic to beans, but prevents hollow heart in brassicas. So if a soil is high in boron, grow brassicas,‖ Campbell-Nelson said.

Local adaptability

Different varieties of the same species can have different nutrient requirements. Select varieties that are suited to your soil‘s fertility levels.

―What should be growing in your area? It may not be what you expect, and it certainly won‘t be what your customers expect,‖ Ames said. Common cultivars are not always the best choice. Those that have been bred for local production may not be widely known, but will be most adaptable to the environmental stresses present in any given locale.

Disease resistance

Diseases arise due to the right combination of pathogen, host and environmental conditions. Choosing crops and varieties that are resistant to known disease issues, along with having a good crop rotation plan to break disease cycles, can help to minimize soilborne pathogens. ―Selecting crops with disease resistance is really important,‖ Campbell-Nelson emphasized. Properly identifying diseases will not only help with disease control for the current crop, but also with ongoing crop planning. Services such as the University of Massachusetts diagnostic lab can assist growers with this step.

Likewise, some species of plants are more tolerant of certain insect activity than others. Planting crops or varieties that have insect resistance is important if a pest issue is already known to exist. Planting different varieties in succession can be possible, using the most insect-resistant varieties when pressure is the highest and switching to a variety with better flavor or storage characteristics once the pressure abates.

Environmental factors

Daylight hours are another concern. Onions, for example, are influenced by day length and must be selected so that the plant‗s needs match the actual growing conditions. Proper timing of seeding is important, as bulbs need an increase in day length to develop. Similarly, the timing of seed sowing for overwintering carrots is important. If they aren‗t sown by November 1 in New England, you‗ll end up with woody carrots instead of sweet ones, Campbell-Nelson said.

Crops that need significant light and warm temperatures for growth and optimal flavor, such as melons, require special attention. Where the growing season is short, choosing a melon variety that matures a week or so earlier than other varieties can make a difference in the crop‗s success. Choosing crops with planting and sowing needs that make sense for your farm is important.

If a field is prone to wind damage, select wind-tolerant crops, or find a compatible field crop to serve as a windbreak. If your region experiences regular heavy rains in late spring, choosing a crop that is seeded after the rainy period can minimize headaches. If summer drought is an issue, a crop whose water needs are at their maximum during this time is going to require more irrigation and other inputs than crops with minimal water needs. The water needs of any individual crop vary depending on growth stage. Planning for this can minimize stress for both the plant and the grower.

Companion planting

Planting crops that are mutually beneficial is another method that can increase quality and yield while decreasing negative effects of insects and diseases. While beets and beans are compatible and do well together, beets and pole beans suppress one another‗s growth and shouldn‗t be planted in proximity to each other. Planting chives within, near or alongside carrots can improve the flavor of the carrots and increase their growth. Planting crops that can serve as a trap, diverting insects or wildlife from the cash crop, is another consideration.

Markets

Planting a crop to meet a market demand can mean altering conditions through cultivation practices, adding infrastructure such as irrigation or a hoophouse, or utilizing chemical inputs to control intense pest or disease concerns. Meeting the demands of the market might mean choosing particular traits, germination times or maturity dates. Desired traits may be different for wholesale distribution, farm markets, restaurants or other outlets. While ability to withstand packing and shipping is a must when selling to distributors, flavor and taste is going to win out for farm-to-table chefs, and easy-to-harvest, tasty varieties might be the best choice for pick-your-own locations. Pick-your-own turnips may not be a hit with customers, but a wholesale market might exist.

For winter markets in colder areas, planting crops that are less susceptible to freeze damage can extend the season. Kale, beets, Brussels sprouts, parsnips and rutabagas are able to withstand freezing and can still be harvested after cold weather arrives, making them good selections for season extension.

A nursery is a place where plants are propagated and grown to usable size.

They include retail nurseries which sell to the general public, wholesale nurseries which sell only to businesses such as other nurseries and to commercial gardeners, and private nurseries which supply the needs of institutions or private estates. Some retail and wholesale nurseries sell by mail.

Nurseries may supply plants for gardens, for agriculture, for forestry and for conservation biology. Some

of them specialize in one phase of the process: propagation, growing out, or retail sale; or in one type of plant: e.g., groundcovers, shade plants, or rock garden plants. Some produce bulk stock, whether seedlings or grafted, of particular varieties for purposes such as fruit trees for orchards, or timber trees for forestry. Some produce stock seasonally, ready in springtime for export to colder regions where propagation could not have been started so early, or to regions where seasonal pests prevent profitable growing early in the season.

nurseries can grow plants in open fields, on container fields , in tunnels or greenhouses. In open fields, nurseries grow ornamental trees, shrubs and herbaceous perennials, especially the plants meant for the wholesale trade or for amenity plantings. On a containerfield nurseries grow small trees, shrubs and herbaceous plants, usually destined for sales in garden centers. Nurseries also grow plants in greenhouses, a building of glass or in plastic tunnels, designed to protect young plants from harsh weather (especially frost.While allowing access to light and ventilation, modern greenhouses allow automated control of temperature, ventilation and light and semi-automated watering and feeding. Some also have fold-back roofs to allow "hardening-off" of plants without the need for manual transfer to outdoor beds.

Plants may be propagated by seeds, but often desirable cultivars are propagated asexually. The most common method is by cuttings. These can be taken from shoot tips or parts of stems with a node (softwood cuttings) or from older stems (hardwood cuttings). Herbaceous perennials are also often propagated by root cuttings or division. For plants on a rootstock grafting or budding is used. Older techniques like layering are sometimes used for crops which are difficult to propagate.

Crop establishment

Sowing Methods The method of sowing a crop depends on a number of factors including the crop to be sown, the condition of the soil and the system of production used. The methods for sowing seed fall into two categories: surface sowing, and drilling the seed into the soil. Surface sowing involves the broadcasting of seed on the surface of the soil by ground machine or from the air. Sowing by this method is generally inferior to placement of the seed in the soil, largely because the conditions are less conducive to good germination and establishment, with seedlings at greater risk of desiccation. Theft of seeds by ants and birds is also a problem. Aerial sowing, however, is a common method of establishing rice (Oryza sativa). The seed is pre-germinated before being dropped into water.

This method has the particular effect of advancing the growth of the crop by up to ten days and therefore is advantageous in situations where sowing is delayed or in areas with a shorter growing season such as the Murray Valley in southern New South Wales. However, crop damage by bloodworms and ducks is increased (Woodlands et al., 1984). The most common method of sowing is by drilling the seed into the soil at a prescribed depth. The winter cereals and many small grain crops are usually sown by a combine, a grain drill with a fertiliser box attached, thereby resulting in the seed being placed in the soil adjacent to a band of fertiliser. From the seedbox the seed passes through a metering device, commonly a fluted wheel or a double run, into droppers which extend to a prescribed depth in the soil behind furrow openers. The fertiliser follows a similar procedure although the metering system is different, usually being a ‗star' feed. The furrow openers vary, there being single disc, double disc and tine types. Traditional tine drills have poor plant residue handling capabilities and blockages occur unless the residues have been fragmented, are dry and are in small amounts (Kamel, 1975; Brown et al., 1986).

This is important for stubble retention farming, necessitating a change in tine geometry to greater trash clearance both within the tine row and between rows of tines. Tines are also less useful under heavy wearing conditions such as sandy soils. Problems arise where disc openers are used under conditions where soil is likely to adhere to the discs (Kamel, 1975).

Many combines have a small seeds box attachment preferably in conjunction with a band seeder through which pasture seed or small seeded crops such as canola are sown by mixing them with the fertiliser, providing consideration is given to likely fertiliser germination damage. Combines sow the crops in rows approximately 18 cm apart although this can be varied in multiples by blocking the appropriate seed openings. The metering systems in conventional combines are not particularly precise and considerable variation in sowing rate and fertiliser rate both within and between rows is frequent. In many crops, however, this is relatively unimportant, but in the case of concentrated fertiliser, small differences represent considerable variation in actual nutrient supply.

Cultural practices

Cultural practices that are carried out during crop production:

- **Thinning.**

Thinning is a term used in agricultural sciences to mean the removal of some plants, or parts of plants, to make room for the growth of others..

In agriculture and gardening, thinning is the selective removal of flowers, fruits, shoots, and seedlings or young plants to allow adequate space for the remaining organs/plants to grow efficiently. In large-scale farming, techniques like precision seeding and transplanting can eliminate the need for thinning by starting plants at their optimum spacing. On a smaller scale, such as a home vegetable garden, thinning can be used as a way to make maximum use of space for certain crops. For example, beets, carrots, green onions and others can be planted densely, and then thinned to make room for continued growth of the plants left in the soil, and also as a harvest of baby vegetables (beet greens, baby carrots, baby onions). Also thinning is used in post harvesting

- **Staking**.

In horticulture, staking refers to inserting a stake beside a plant in order to provide it with support while it grows. Tomato plants are perhaps the most commonly staked plant in household gardens, but there are others that benefit from support.Staking requires very little in the way of materials. A wooden stake and a mallet or hammer is really all that‘s needed. Some growers also use metal stakes or bamboo stakes, and many growers tend to use whatever is lying around the house in a pinch. For example, old broom handles, leftover PVC pipe from another project, and so on.

Throughout your gardening experience, especially when growing tomatoes it is important to stake them as they extend in length. Staking provides each plant the ability to grow without bending to the point where it breaks the plant and stops growth. It can also can also be used prevent the fruit from beginning to rot as it sits on the ground as the stalk grows overtime . Having the plant grow upward after it is staked allows the plant to get the necessary sunlight it needs to continue growth. It can be used as a method to keep the aisles of each row of plants clear and decent. And overall it allows the growth of the fruit to continue successfully.

Training.

Defination:

Training can therefore be defined as ‗an operation done to a plant by which it is made to develop an frame work or structure land this is spreading on pergola with or without pruning of plant pears and training is usually done when the plant / shrubs vines are young.

It is necessary to pay sufficient attention for training of plants during the first few years of planting. During this period, the pre planned frame work as decided by the grower should be allowed to develop. The main points to be kept in view while training the fruit these are:

Objects of Training:

1. To admit adequate sun light and air to the center of the tree and to expose maximum leaf area to the sun.

2. To limit the growth and spread of the tree so that various cultural operation such as spaying and harvesting are performed at minimum cost.

3. To build the frame work and arrangement of scaffold branches.

4. To build the structure of the tree is such heights at which the tres are less exposed for sunscald and wind damage.

Before attachment to train of any tree, one should decide the height of the head or crown. Depending upon the height of the crown from ground level, the plants can be grouped in two:

a) High Head:

In this case, the main branches are encouraged about one meter or higher up from the ground level. In case of these plants, cultural operations with animal or mechanically drawn implements can be carried out easily. In the tropical climate, the high headed trees are unsuitable as they are prone to sunscalted and wind damage.

b) Low Head:

Main branches forming the foundation frame work of the tree are encouraged on the trunk at a height of 1 meter from the ground level. The low headed trees are now becoming common all over the world as they come into bearing comparatively earlier, are able to resist stormy winds more effectively and spraying and harvesting expense are reduced.

How to Train the Plats:

The formation of the main frame work of the tree is most important part of training. Usually two to four main branches are encouraged at almost the same height. These should be allowed be rise from different direction, at some distance from one another as to from a balanced head. These branches are called scaffold branches. The frame work is greatly strengthen if the branches are spaced at 15 cm apart vertically on the main tarn. If two or more branches of equal size are allowed to arise from one place, they from a bad crotch ehicjh is after prone to spilt stem except a few like pomegranate custard apple, fig, etc. which are better trained to two of three stems.

- Pruning.

Selective removal of parts of a plant such as branches, buds, or roots is typically known as pruning.

Pruning is a horticultural and silvicultural practice involving the selective removal of certain parts of a plant, such as branches, buds, or roots. Reasons to prune plants include deadwood removal, shaping (by controlling or redirecting growth), improving or sustaining health, reducing risk from falling branches, preparing nursery specimens for transplanting, and both harvesting and increasing the yield or quality of flowers and fruits.

The practice entails *targeted* removal of diseased, damaged, dead, non-productive, structurally unsound, or otherwise unwanted tissuefrom crop and landscape plants. In general, the smaller the branch that is cut, the easier it is for a woody plant to compartmentalize the wound and thus limit the potential for pathogen intrusion and decay. It is therefore preferable to make any necessary formative structural pruning cuts to young plants, rather than removing large, poorly placed branches from mature plants.

Specialized pruning practices may be applied to certain plants, such as roses, fruit trees, and grapevines. It is important when pruning that the tree‘s limbs are kept intact, as this is what helps the tree stay upright.[1] Different pruning techniques may be deployed on herbaceous plants than those used on perennial woody plants. Hedges, by design, are usually (but not exclusively) maintained by hedge trimming, rather than by pruning

- **Shading.**

This involves the provision of artifical canopy for crops. The main objective of the practice is to reduce the scorching effect of the sun on young tender crop. The practice will also facilitate the comtrol of temperature, excessive evaporation and evaptranspiration and as well regulate the light intensity for croms that a photosensitive. The practice also affortd eed control.

The practice can be achieved by affording a canopy of existing plant with big leaves jast as we have it in cocoa plantation where banana or plantain is been used to ptovide shade for young cocoa plants. It is also possible to errect artifical canopy using thatches from palm trees and bamboo poles. Other options include the use of synthetic material and plastic with fibre or metal poles.

- **Mulching.**

Mulching is the process of covering the topsoil with plant material such as leaves, grass, twigs, crop residues, straw etc. A mulch cover enhances the activity of soil organisms such as earthworms. They help to create a soil structure with plenty of smaller and larger pores through which rainwater can easily infiltrate into the soil, thus reducing surface runoff. As the mulch material decomposes, it increases the content of organic matter in the soil. Soil organic matter helps to create a good soil with stable crumb structure. Thus the soil particles will not be easily carried away by water. Therefore, mulching plays a crucial role in preventing soil erosion.

Description

In some places, materials such as plastic sheets or even stones are used for covering the soil. However, in organic agriculture the term ‗mulching‘ refers only to the use of organic, degradable plant materials.

Why to use mulch?

- Protecting the soil from wind and water erosion: soil particles cannot be washed or blown away.

- Improving the infiltration of rain and irrigation water by maintaining a good soil structure: no crust is formed, the pores are kept open

- Keeping the soil moist by reducing evaporation: plants need less irrigation or can use the available rain more efficiently in dry areas or seasons

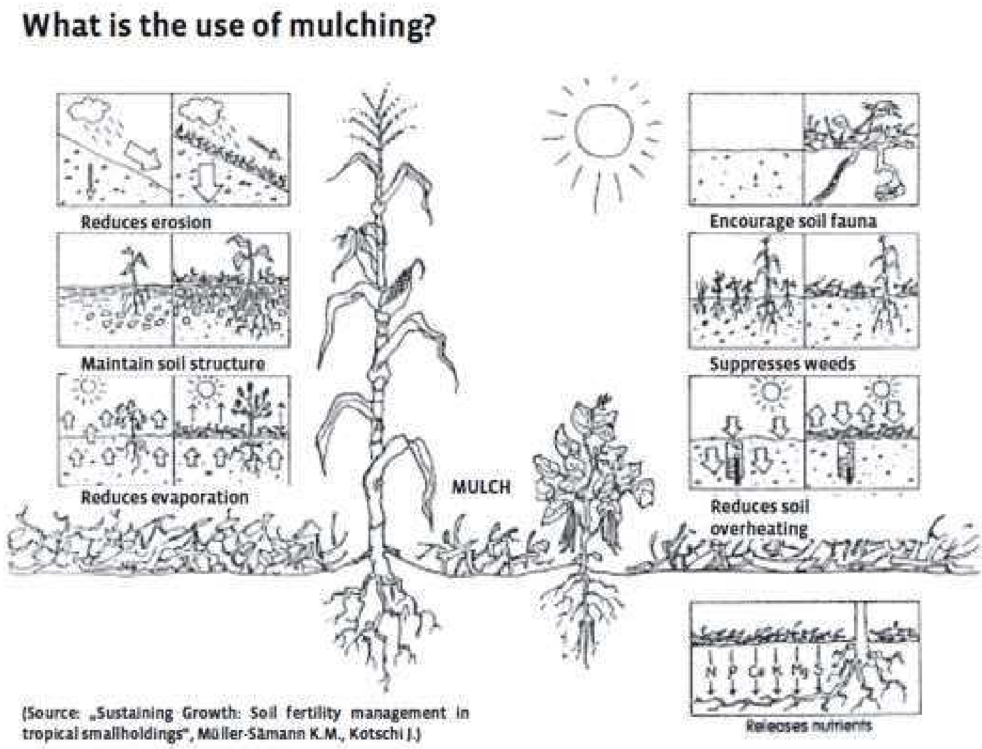
- Feeding and protecting soil organisms: organic mulch material is an excellent food for soil organisms and provides suitable conditions for their growth

- Suppressing weed growth: with a sufficient mulch layer, weeds will find it difficult to grow through it

- Preventing the soil from heating up too much: mulch provides shade to the soil and the retained moisture keeps it cool

- Providing nutrients to the crops: while decomposing, organic mulch material continuously releases its nutrients, thus fertilizing the soil

- Increasing the content of soil organic matter: part of the mulch material will be trans-formed to humus



Sketch on the effects of mulching

Selection of mulch materials

The kind of material used for mulching will greatly influence its effect. Material which easily decomposes will protect the soil only for a rather short time but will provide nutrients to the crops while decomposing. Hardy materials will decompose more slowly and therefore cover the soil for a longer time. If the decomposition of the mulch material should be accelerated, organic manures such as animal dung may be spread on top of the mulch, thus increasing the nitrogen content

Filling- in /supplying

This is the replanting of seeds and seedlings to replace dead crops or gemination failures

Earthing-up

Movement of soil to re-enforse the base of the crops or to cover up the exposed root or tubers. Weeding., pest control, desease control and fertilizer application will be discussed in detail later

Fertiliser applicationa) Broadcasting.

b) Placement.

a) Starter solutions.b) Foliar application.

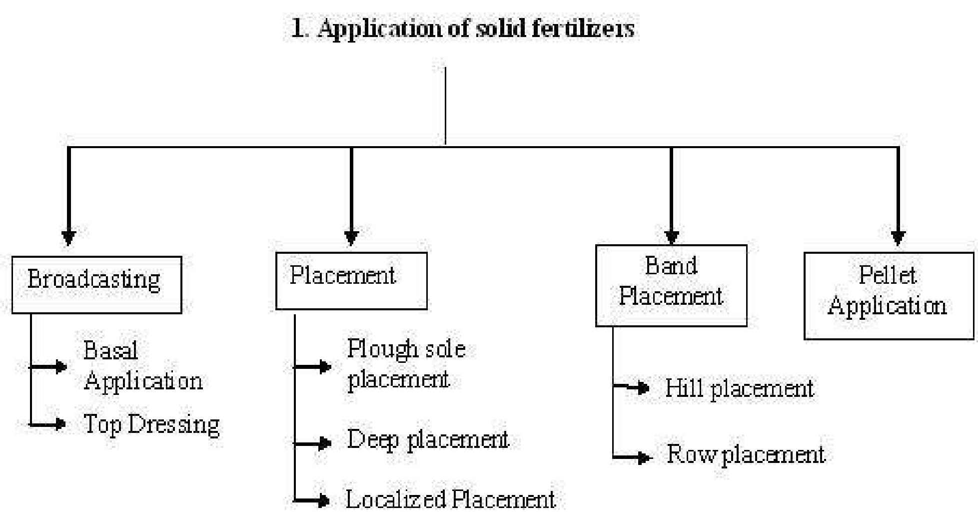
c) Application through irrigation water (Fertigation)

d) Injection into soil.

e) Aerial application

METHODS OF FERTILIZER APPLICATION

The different methods of fertilizer application are as follows:



a) Broadcasting

1. It refers to spreading fertilizers uniformly all over the field.
2. Suitable for crops with dense stand, the plant roots permeate the whole volume of the soil, large doses of fertilizers are applied and insoluble phosphatic fertilizers such as rock phosphate are used.

Broadcasting of fertilizers is of two types.

i) Broadcasting at sowing or planting (Basal application)

The main objectives of broadcasting the fertilizers at sowing time are to uniformly distribute the fertilizer over the entire field and to mix it with soil.

ii) Top dressing

It is the broadcasting of fertilizers particularly nitrogenous fertilizers in closely sown crops like paddy and wheat, with the objective of supplying nitrogen in readily available form to growing plants.

Disadvantages of broadcasting

The main disadvantages of application of fertilizers through broadcasting are:
i) Nutrients cannot be fully utilized by plant roots as they move laterally over long distances.
ii) The weed growth is stimulated all over the field.
iii) Nutrients are fixed in the soil as they come in contact with a large mass of soil.

b) Placement

1. It refers to the placement of fertilizers in soil at a specific place with or without reference to the position of the seed.
2. Placement of fertilizers is normally recommended when the quantity of fertilizers to apply is small, development of the root system is poor, soil have a low level of fertility and to apply phosphatic and potassic fertilizer.

The most common methods of placement are as follows:

i) Plough sole placement

1. In this method, fertilizer is placed at the bottom of the plough furrow in a continuous band during the process of ploughing.
2. Every band is covered as the next furrow is turned.
3. This method is suitable for areas where soil becomes quite dry upto few cm below the soil surface and soils having a heavy clay pan just below the plough sole layer.

ii) Deep placement

It is the placement of ammoniacal nitrogenous fertilizers in the reduction zone of soil particularly in paddy fields, where ammoniacal nitrogen remains available to the crop. This method ensures better distribution of fertilizer in the root zone soil and prevents loss of nutrients by run-off.

iii) Localized placement

It refers to the application of fertilizers into the soil close to the seed or plant in order to supply the nutrients in adequate amounts to the roots of growing plants. The common methods to place fertilizers close to the seed or plant are as follows:

a) Drilling

In this method, the fertilizer is applied at the time of sowing by means of a seed-cum-fertilizer drill. This places fertilizer and the seed in the same row but at different depths. Although this method has been found suitable for the application of phosphatic and potassic fertilizers in cereal crops, but sometimes germination of seeds and young plants may get damaged due to higher concentration of soluble salts.

b) Side dressing

It refers to the spread of fertilizer in between the rows and around the plants. The common methods of side-dressing are

1. Placement of nitrogenous fertilizers by hand in between the rows of crops like maize, sugarcane, cotton etc., to apply additional doses of nitrogen to the growing crops and
2. Placement of fertilizers around the trees like mango, apple, grapes, papaya etc.

c) Band placement

If refers to the placement of fertilizer in bands.

Band placement is of two types.

i) Hill placement

It is practiced for the application of fertilizers in orchards. In this method, fertilizers are placed close to the plant in bands on one or both sides of the plant. The length and depth of the band varies with the nature of the crop.

ii) Row placement

When the crops like sugarcane, potato, maize, cereals etc., are sown close together in rows, the fertilizer is applied in continuous bands on one or both sides of the row, which is known as row placement.

Following are the common methods of applying liquid fertilizers

a) Starter solutions

It refers to the application of solution of N, P_2O_5 *and* K_2O in the ratio of 1:2:1 and 1:1:2 to young plants at the time of transplanting, particularly for vegetables.
Starter solution helps in rapid establishment and quick growth of seedlings.
The disadvantages of starter solutions are
(i) Extra labour is required, and
(ii) the fixation of phosphate is higher.

b) Foliar application

1. It refers to the spraying of fertilizer solutions containing one or more nutrients on the foliage of growing plants.
2. Several nutrient elements are readily absorbed by leaves when they are dissolved in water and sprayed on them.

3. The concentration of the spray solution has to be controlled, otherwise serious damage may result due to scorching of the leaves.
4. Foliar application is effective for the application of minor nutrients like iron, copper, boron, zinc and manganese. Sometimes insecticides are also applied along with fertilizers.

c) Application through irrigation water (Fertigation)

1. It refers to the application of water soluble fertilizers through irrigation water.
2. The nutrients are thus carried into the soil in solution.
3. Generally nitrogenous fertilizers are applied through irrigation water.

d) Injection into soil

1. Liquid fertilizers for injection into the soil may be of either pressure or non-pressure types.
2. Non-pressure solutions may be applied either on the surface or in furrows without appreciable loss of plant nutrients under most conditions.
3. Anhydrous ammonia must be placed in narrow furrows at a depth of 12-15 cm and covered immediately to prevent loss of ammonia.

e) Aerial application.

In areas where ground application is not practicable, the fertilizer solutions are applied by aircraft particularly in hilly areas, in forest lands, in grass lands or in sugarcane fields etc.

Weed and pest management

Although herbicides can provide effective weed management, corn growers should not depend on herbicides alone. Growers should use good cultural practices so the corn is competitive with any weeds and should integrate chemical control programs with cultivation, especially with difficult-to-control weeds or when weather conditions reduce herbicide effectiveness.

The first step in cultural weed control is the selection of a corn hybrid that is adapted to local growing conditions. Timely planting along with proper fitting in tilled situations or proper adjustment of no-tillage planters ensures rapid germination and a competitive advantage for the corn. Another cultural practice that favors rapid establishment of corn is proper band application of fertilizer at planting.

All primary (plowing) and secondary (fitting) tillage operations help provide a weed-free seedbed. Cultivation of row crops is an effective way to control annual weeds between corn rows. Band application of herbicides over the row at planting, combined with one or two cultivations, provides good control of annual weeds such as common lambsquarters and foxtails. Although rotary hoes effectively destroy weed seedlings in small corn, a row cultivator adjusted to minimize pruning of corn roots should be used after corn is 5 or 6 inches tall. Creeping perennials such as common milkweed and quackgrass are not adequately controlled by one or two cultivations. These weeds regrow from rhizomes (underground stems) following cultivation and are controlled with tillage only if the operations are repeated over long periods. Biennial (wild carrot, etc.) and simple perennial (dandelion, etc.) weeds do not persist in fields that are plowed but can be a problem in reduced and zone/no-tillage fields.

A variety of herbicides are available for preplant, preemergence, and/or postemergence weed control in corn. These herbicides vary in their effectiveness in controlling different weeds (Table 3.7.1) and in the length of time they remain active in the soil. Some corn herbicides, such as *atrazine and Princep, can carry over to affect triazine-sensitive rotational crops such as small-seeded forage legumes, small grains, and soybeans. Knowledge of the weeds present, herbicide effectiveness, and rotational plans should be considered when selecting herbicides.

Cost of chemical weed control dictates that herbicides be applied when they will provide maximum return. Label guidelines for the timing of herbicide applications are based on research and are geared for maximum weed control and minimum crop injury. The labeled application timings for corn herbicides are shown as shaded cells in Table 3.7.2.

reventative Weed Control

Preventative weed control refers to any control method that aims to prevent weeds from being established in a cultivated crop, a pasture, or a greenhouse. Examples of preventative weed control would be using certified weed free seed, only transporting hay that is weed free, making sure farm equipment is cleaned before moving from one location to another, and screening irrigation water to prevent weed seeds from traveling along irrigation ditches.

Cultural

Cultural weed control refers to any technique that involves maintaining field conditions such that weeds are less likely to become established and/or increase in number. Examples of cultural weed control would be crop rotation, avoiding overgrazing of pastures or rangeland, using well-adapted competitive forage species, and maintaining good soil fertility.

Mechanical

Mechanical weed control refers to any technique that involves the use of farm equipment to control weeds. The two mechanical control techniques most often used are tillage and mowing.

Biological

Biological weed control refers to any technique that involves the use of natural enemies of weed plants to control the germination of weed seeds or the spread of established plants. This is a rapidly expanding area of weed control with many examples. Examples of biological weed control include sheep to control tansy ragwort or leafy spurge, cinnabar moth and the tansy flea beetle to control tansy ragwort, the chrysolira beetle to control St. John's Wort, and the use of goats to control brush on rangeland.

Chemical

Chemical weed control refers to any technique that involves the application of a chemical (herbicide) to weeds or soil to control the germination or growth of the weed species. In economic terms, chemical control of weeds is a very large industry and there are scores of examples of chemical weed control products. Common examples of chemicals used to control weeds in forages are 2,4-DB; EPTC; bromoxynil; and paraquat.

Irrigation

Irrigation System Types for Every Crop Production

Irrigation systems are widely used in every crop production in order to apply the amount of water needed for the crop. Despite its broad application, irrigation should occur in a uniform and timely manner in order to minimize losses and damage to soil, water, air, plant, and animal resources.

Irrigation is the artificial application of water to the soil at rates, quantities, and times needed to meet farm irrigation requirements. Water can be artificially supplied to plants using five irrigation systems:

Flood irrigation; entire soil surface is covered with water; it moves over the field by gravity flow

Sprinkler irrigation; crops are irrigated with high-pressure sprinklers set in the field; it can be solid or hand-moved

Drip irrigation; water is placed directly into the crop root zone from the low flow emitters

Center Pivot irrigation; single central irrigation pipeline rotates around the pivot point. As it rotates, water sprinklers along the central pipe and irrigates crops

Furrow irrigation; surface irrigation method where water is applied in furrows

Prior to setting up an irrigation system, a farmer must consider the following limiting factors in order to adequately operate an irrigation:

Soil properties; soil type, drainage, water holding capacity

Water availability, quality, quantity, crop water requirements

Crop properties; yield potential, frost resistance, row space, harvest practices, rooting depth

Climate requirements; humidity, temperature, precipitation

Farmer capabilities; farm labor, finance health, management skills, farm practices

Irrigation system properties; operating cost, and the ability to deliver and apply the amount of water needed to meet the crop‘s water requirement.

Some irrigation methods

Irrigation is the the controlled application of water for agricultural purposes through manmade systems to supply water requirements not satisfied by rainfall. Crop irrigation is vital throughout the world in order to provide the world's ever-growing populations with enough food. Many different irrigation methods are used worldwide, including:

Center-Pivot: Automated sprinkler irrigation achieved by automatically rotating the sprinkler pipe or boom, supplying water to the sprinkler heads or nozzles, as a radius from the center of the field to be irrigated. Water is delivered to the center or pivot point of the system. The pipe is supported above the crop by towers at fixed spacings and propelled by pneumatic, mechanical, hydraulic, or electric power on wheels or skids in fixed circular paths at uniform angular speeds. Water is applied at a uniform rate by progressive increase of nozzle size from the pivot to the end of the line. The depth of water applied is determined by the rate of travel of the system. Single units are ordinarily about 1,250 to 1,300 feet long and irrigate about a 130-acre circular area.

Drip: A planned irrigation system in which water is applied directly to the Root Zone of plants by means of applicators (orifices, emitters, porous tubing, perforated pipe, etc.) operated under low pressure with the applicators being placed either on or below the surface of the ground.

Flood: The application of irrigation water where the entire surface of the soil is covered by ponded water.

Furrow: A partial surface flooding method of irrigation normally used with clean-tilled crops where water is applied in furrows or rows of sufficient capacity to contain the designed irrigation system.

Gravity: Irrigation in which the water is not pumped but flows and is distributed by gravity.

Rotation: A system by which irrigators receive an allotted quantity of water, not a continuous rate, but at stated intervals.

Sprinkler: A planned irrigation system in which water is applied by means of perforated pipes or nozzles operated under pressure so as to form a spray pattern.

Subirrigation: Applying irrigation water below the ground surface either by raising the water table within or near the root zone or by using a buried perforated or porous pipe system that discharges directly into the root zone.

Traveling Gun: Sprinkler irrigation system consisting of a single large nozzle that rotates and is self-propelled. The name refers to the fact that the base is on wheels and can be moved by the irrigator or affixed to a guide wire.

Supplemental: Irrigation to ensure increased crop production in areas where rainfall normally supplies most of the moisture needed.

Surface: Irrigation where the soil surface is used as a conduit, as in furrow and border irrigation as opposed to sprinkler irrigation or subirrigation.

Calibration of sprayers

Six Simple Steps for Sprayer Calibration

The following step-by-step method of calibrating a backpack or hand-gun sprayer involves very little math or formulas. It is based on the following principal:

One gallon = 128 fluid ounces and your calibration area to be sprayed is 1/128 of an acre, thus fluid ounces collected = gallons per acre (GPA).

STEP 1. Clean sprayer and nozzle thoroughly. Then, fill the spray tank with clean water. Spray with water only to check to see that the nozzle forms a uniform spray pattern. If the pattern is uneven, check to make sure the nozzle is clean and replace it if needed. Adjustable nozzles should be set and marked to permit repeated use of the selected spray pattern. If necessary, add a marker dye to the water to more easily see your spray pattern.

STEP 2. Measure an area 18.5 feet by 18.5 feet, which is equal to 1/128th of an acre. ***If possible, this should be done in the field on which you will be spraying.***

STEP 3. Time the number of seconds it takes to spray the measured area uniformly with water using gentle side-to-side sweeping motion with the spray wand similar to spray painting a home or automobile. Record the number of seconds required to spray the area. During application be sure to maintain a constant sprayer pressure and cover the entire area uniformly one time. ***You should repeat step 3 at least twice and use the average of the two times.***

STEP 4. Spray into a container for the average time calculated in step 3. Be sure to maintain constant sprayer pressure while you spray into the container.

STEP 5. Measure the number of fluid ounces of water in the bucket. The number of fluid ounces collected from the bucket is equal to the number of gallons of water per acre the sprayer is delivering. ***Volume sprayed in fluid ounces = gallons of water per acre (GPA).***

STEP 6. Add the proper amount of herbicide to the tank.

For backpack or other small volume sprayers:
Use Table 1 to determine how much ***liquid herbicide*** to add to ***1 gallon*** of water. Use Table 2 to determine how much ***dry herbicide***to add to ***2 gallons*** of water.

For larger hand-gun sprayer: Use Table 3 to determine the amount of liquid herbicide to add to your spray tank.

Harvesting

Crop Production – Harvesting & Storage

Ultimate stages of crop production are harvesting and storage. Harvesting requires art and practice because a large proportion of crop can be lost due to an improper method of harvesting. Another responsibility after harvesting is storage. Storage of grains is much more to be taken care. An improper way of storage can lead the whole hard work in vain. This necessitates the knowledge of

Once the crop is mature, it is cut and gathered which is called harvesting. Harvesting depends on many factors like season, crop variety, maturity period etc. Over-irrigation, irregular sunlight can prolong ripening of crop which thus delays the harvesting time. Early harvesting causes loss of unripened grains while delayed harvesting leads to shedding off of grains, sometimes even birds eat the grains. Therefore regular examination of the crop is necessary as the harvesting period approaches. The

Golden yellow color is the indication of ripened crops like rice and wheat. Manually harvesting is done by using sickles but it is a tedious job as well as time-consuming. In recent times, machines called harvesters are used for harvesting especially in large-scale farming.

Followed by harvesting, threshing of the crop has to do. Here grains are separated from the chaff by beating or by the threshing machine. In small-scale farming, chaff and grains are separated from each other by a process called winnowing.

Harvesting is considered as a festival. It is a time of joy where the fruits of the hard work of farmers come into reality. Some of the harvesting festivals are Pongal, Bihu etc.

Storage

In the case of small-scale cultivation, farmers use the harvested crop for themselves while large-scale production is mainly for marketing. Thus the cultivators have to store the grains. For this, a proper storage space has to be arranged. Inadequate storage space and improper storage methods can lead to a huge grain loss.

In addition to pest and rodents, microbes like bacteria, fungus, environmental conditions like moisture, temperature etc. may attack the stored grains. Therefore a proper treatment is required before storing of grains. Rodents and pests can be prevented by pesticides. Moist environment results in fungal growth on grains. This can be avoided by proper drying of grains in sunlight. Another method is fumigation where chemicals are used to prevent bacteria and other microorganisms. After proper treatments, grains have to be stored in gunny bags or granaries and deposited in godowns.

Cleaning

After harvest, excess field dirt and plant debris can often be removed from many types of produce by gentle scrubbing with a dry brush. Be sure to clean the brushes frequently, and use a tarp or container to catch the dirt so it does not contaminate the processing area. It is recommended to use this method of dry brushing when possible, rather than washing, before packing or marketing fresh fruits and vegetables. However, very muddy produce or produce that cannot withstand brushing may require washing with water.

Understanding Contamination from Water

Washing with water must be done carefully, as it has the potential to lower the quality of the produce and cause contamination. Although washing with water is typically a good food safety practice by the consumer just prior to consumption, when preparing produce for sale it can increase the risk of contamination. Water can infiltrate to the inside of the fruit or vegetable through the following process. When produce is placed in a container of water that is at a different temperature than the produce, this situation is called a temperature differential. If the water is colder than the produce, it causes the air in the cells of the fruit to contract. This contraction draws water into the fruit or vegetable through pores, channels, or bruises. The water drawn into the produce may be contaminated, thus causing the produce to become internally contaminated.

In some instances, washing produce may be required. Growers often look to various methods of washing fresh produces before selling it to customers.

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Sorting

Grading

Drying

Methods of primary processing

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Primary processing

Agriculture, horticulture, commercial fishing and aquaculture are all primary industries in Australia. They each produce food for the human population. All of these industries undertake some primary processing activities to make the food available to the consumer. Primary processing is all of the activities involved in the alteration of raw food into food products or to make the food ready to be consumed. Primary processing is carried out after foods are harvested or animals slaughtered, to prepare them for consumption or to turn them into other products. It includes transportation, sorting, cleaning, blending and milling.

Reasons for primary processing

- Prepare raw food so that is ready for human consumption. Raw food is prepared by cleaning and sorting so that the produce is available to the consumer in an appealing and useable form. Removing insects, soil, stones, and other debris from the edible parts of the food extends the shelf life of the food and improves its immediate sensory appeal to the consumer at the marketplace.

- Make raw food available to the consumer despite their geographical location and the season of the year. Cherries grown in New South Wales and Victoria can be transported to various locations in Australia and exported to other countries around the world. Strawberries are made available for sale in the winter months in the southern states of Australia because they can be grown in Queensland at that time.

- Extends the shelf life of the raw food by placing it in suitable conditions so that it is still in peak condition when transported to a food manufacturer or consumer marketplace. Tomatoes are refrigerated in bulk after harvesting so that they will not spoil prior to transportation to a food manufacturer or marketplace.

- 62Test raw food for quality assurance. Manufacturers seek to have a product that has a consistent and reliable quality. Harvested wheat grain is stored in silos and tested for moisture content so that the grain can't spoil during storage. Moisture content is also an important factor when selling the grain to food manufacturers. Hanging meat carcasses is essential to allow maximum tenderness of the meat for the food manufacturer or consumer. The nutrient content of milk is tested for quality assurance and to monitor the yield and health of the herd.

- Protect food from contamination. The temperature in a wheat silo is constant and the air is replaced with a non-toxic gas that kills rodents and insects.

- Prepare raw food for delivery to food manufacturers for conversion into other food products. Wheat is milled and converted into flour. The flour can be transported to a food manufacturer for blending with other ingredients in the manufacture of bread, pasta, noodles, soups and sauces.

Test **your understanding**

1. Identify the origins of the food supply.
2. Outline the advantages of a diverse food supply for the human population.
3. Provide examples of primary processing of raw foods before they are supplied to the consumer.
4. Explain how primary processing improves food quality.
5. Outline the reasons for the primary processing of raw foods.
6. Differentiate between primary and secondary processing of foods.
7. Describe the purpose of the secondary processing of foods.
8. Outline the advantages of secondary processing for food producers and consumers.
9. Differentiate between the physical, chemical, and sensory properties of food. Suggest an example of each property.
10. Explain how an understanding of food properties affects food preparation and processin

Harvesting and threshing

Nearly all small farmers in the developing countries harvest their cereal crops and beans by hand and thresh them later. In the case of peanuts, harvesting involves lifting the plants and attached pods from the ground, then allowing them to cure (dry) in the field for a period of from several days to four to six weeks before threshing.

Threshing consists of separating the seeds from the seedheads, cobs or pods by beating, trampling or other means. With peanuts, threshing separates the pods from the pegs that hold them to the plant and does not include actual shelling. (With maize, the term "shelling" is usually used in place of "threshing".)

With cereal crops and beans, the small farmer has several options as to when to thresh the crop. If the matured crop has stood in the field for some time during dry weather, the seeds may be low enough in moisture content to be threshed without damage right after harvest. However, the farmer may still prefer to delay threshing for two reasons:

• The grain may still be too high in moisture content to escape spoilage if stored as loose seed. Grain stored in unthreshed form on the cob, on the seedhead or in the pod can be safely stored at a much higher moisture content since there is much more air space for ventilation and further drying.

• Maize stored as unhusked ears and pulses stored in their pods are more resistant to storage insects.

Winnowing follows threshing and consists of separating chaff and other light trash from the grain using wind, fan-driven air or screens Winnowing may need to be repeated several times before consumption or marketing and is usually supplemented by manual removal of stones, clods, and other heavy trash.

Guidelines for Harvesting and Shelling Maize

Determining Maturity

In the 0-1000 m zone in the tropics, most maize varieties reach physiologic maturity within 90-130 days after seeding emergence or 50-58 days after 75 percent of the plants have produced silks. As maturity nears, the lower leaves begin to yellow and die off. In healthy, wellnourished plants, this should not occur until the ears are nearly mature. Ideally, most of the leaves should still be green when the husks begin to turn brown. Unfortunately, such high-yielding plants are not often seen in small farmer fields because of stress factors like low fertility, insects, diseases, and inadequate weeding. More typically, most of the leaves are dead by the time the plant matures.

The "black layer" method: When a maize kernel reaches physiologic maturity (maximum dry weight), the outside layer of cells at its base where it connects with the cob will die and turn black, thus preventing any further cob-to-kernel nutrient transfer. This "black layer" provides an indication of maturity. The layer can be seen by detaching kernels from the cob and examining their bases. Newly- matured kernels may have to be slit lengthwise with a pocketknife to expose the black layer. However, with older kernels, the layer can be readily seen by scraping the base with the fingernail.

Keep in mind that physiologic maturity is not reached until all the kernel's milky starch has solidified. This process begins at the tip of the kernel and moves downward toward the base. The kernels at the ear tip are the first to mature, followed by those in the middle and finally the ones at the lower end (the difference is no more than a few days).

With healthy plants, kernel moisture at physiologic maturity will vary from about 28-36 percent. This is usually too high for damagefree threshing or for mold-free storage except in the form of husked ears placed in very narrow cribs. The black layer may form much earlier in the maize plant's growth cycle if growing conditions are adverse. Such kernels will be small and shrunken and have much higher moisture contents when the black layer forms. The drydown rate of maize: When maize plants are left standing in the field after maturity, the kernels lose about 0.25 0.5 percent moisture per day, but this can range from 0.1 - 1.0 percent depending on weather conditions and whether the ears are pointing downwards to prevent water entry.

Methods of Harvesting Maize:

• **By Hand**: The ears are removed by hand from the plants with or without husking. Husked ears require a smaller storage area and are more resistant to insects, but may rot more easily if stored at a high moisture content.

• **Mechanical**: Tractor-drawn pickers and picker-shellers can handle one to two rows at once, but self-propelled combines are available which can harvest up to six to eight rows. By changing the front attachment (the "head"), combines can also harvest other cereal crops (if not overly tall) and bush beans, but cannot be used on peanuts. Well-adjusted pickers and combines should have losses of less than 2 percent and 4 percent respectively unless lodging is severe.

When to Begin Harvesting

Harvest should begin as soon as is practical after maturity, but this depends on the farmer's harvest method and storage and drying facilities.

Hand harvesting: Since husked ears can be safely stored in narrow cribs (see storage section) at up to 30-32 percent kernel moisture, harvest can be started at or soon after maturity if desired. Most small farmers prefer to let the maize dry down further in the field first.

Mechanical harvesting.

• Pickers If narrow cribs (see storage section) are used for storage, mechanical picking can be started once kernel moisture is down to 30-32 percent.

• **Picker-shellers and combines**: In this case, adequate drying facilities and kernel damage from shelling are the main concerns. In the tropics, shelled maize above 14 percent moisture will not store more than a week to a few months without spoilage. Rapid drying is essential and usually requires forced air and heated dryers when large volumes are involved. Kernel damage from mechanical shelling may become serious above 28-30 percent or below 15-18 percent moisture.

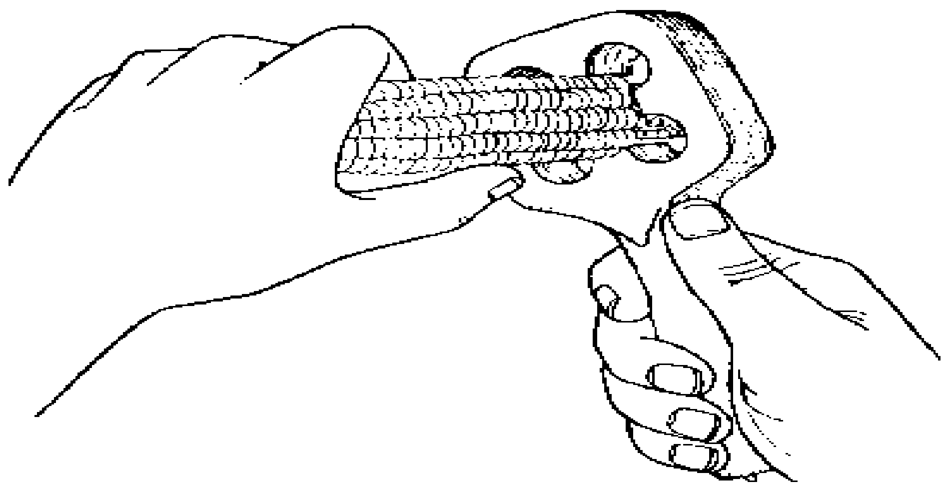
Methods of Shelling Maize

If done too roughly or at too high a moisture content, shelling can cause kernel damage such as tip loss, cracking, stress cracks, and pulverization. Studies have shown that damaged kernels spoil two to five times more rapidly during storage than undamaged ones. Hilysine varieties and other floury types are more susceptible to damage. Shelling methods and guidelines for small farmers include these:

Traditional methods

• **By hand**: This method is very tedious and labor-intensive, but causes little damage to the kernels. It is more thorough than other methods and also allows for separation of damaged and insect-infested grain. This method is best suited to small amounts.

• Beating: Dry ears are placed in bags and beaten with sticks. This is quicker but less thorough than hand shelling and may cause damage.



Wooden, hand-held maize sheller

Improved methods

• **Wooden hand-held maize sheller**: The model shown in the drawing was developed by the Tropical Products Institute and has an output of roughly 80 kg/hour. (Plans are available from ICE.) Other types of hand-held shellers are available commercially. Cobs must be husked first.

• **Hand-cranked or pedaloperated shellers Small**, hand cranked models have outputs of about 50-130 kg/hour. The Ransomes Cobmaster twin-feed pedal-operated sheller has an hourly output of 750-900 kg. For details write Ransomes Ltd., Ipswich 1P3 9QG, England. Maize at too high or too low a moisture content is likely to be damaged, but this can be checked visually. Ears must be husked first.

• Motor-driven shellers have outputs of about 1000-5000 kg/hour. The comments above also apply to this type.

Winnowing Methods

Reliance on wind is the traditional method, but hand-cranked or pedal-driven fans can be constructed easily. The larger models of the hand-cranked or pedaloperated shellers usually are equipped with blowers.

Guidelines for Harvesting and Threshing Sorghum And Millet

spoilage. If large amounts of grain are involved, some form of forced air or heated drying would probably be needed.

Determining Maturity

When grown under favorable conditions and good management, grain sorghum reaches physiologic maturity while the stalks and most of the leaves are still green. Like maize, sorghum kernels also develop a "black layer" at their base when physiologic maturity is reached. The layer can be checked by pinching off some kernels from the bracts that hold them to the head and examining their bases. If present, the black layer can be seen without splitting the kernel. Sorghum flowers and pollinates from the tip of the seedhead downward, a progression which takes from four to seven days. The kernels mature in the same direction, with those at the bottom lagging about a week behind those at the top. Kernel moisture content is about 30 percent at physiologic maturity.

Methods to Harvest Sorghum

• By Hand: The seedheads are cut off using a knife or sickle.

• Mechanical: Tractor driven or self-propelled combine harvesters can harvest and thresh short (dwarf) and medium varieties.

When to Harvest Sorghum

In most sorghum-growing regions in developing countries, maturity often coincides with the start of the dry season, and the crop may be left standing in the field to dry for a number of weeks before harvest. Crop losses during this period can be heavy. If dry conditions prevail, the crop can be harvested at or shortly after maturity and stored on the head with little danger of spoilage. Sorghum can be harvested and threshed with a combine once kernel moisture reaches 25 percent. However, loose grain that is this "wet" must be dried down to around 14 percent within a few days to avoid

Determining Maturity

spoilage. If large amounts of grain are involved, some form of forced air or heated drying would probably be needed.

Methods of Threshing Sorghum

• Traditional methods: These include pounding, beating, and animal trampling and are very tedious except for small quantities. Kernel damage is possible unless care is taken.

• Mechanical methods: Tractoror motor-driven stationary threshers come in many models with outputs of 600-3000 kg/ hour. All but the simplest models will also clean the threshed grain by the use of shaking screens and/or blower fans.

Plans for a four-person pedalpowered grain thresher/mill for sorghum, millet, and wheat designed by VITA can be obtained from ICE. As of 1979, however, this thresher/mill had not been adequately field tested and is not suited to local village construction.

NOTE: Millet is harvested and threshed much like sorghum.

Guidelines for Harvesting and Threshing Peanuts

Peanuts reach maturity when the veins on the inside of the pods turn dark. However, since the plants produce flowers over a period of from 30-45 days, the nuts do not mature simultaneously. Unfortunately, harvesting cannot be delayed until all the nuts have ripened, because heavy losses may occur for two reasons:

• By the time the last pods ripen, many of those which matured earlier will have become detached from the plants due to peg rotting. This pod "shedding" can be especially serious when Cercospora leaf spot causes premature leaf loss or when lifting occurs in dry, hard soils.

• In Spanish-Valencia varieties, the early-maturing kernels may sprout if kept too long in the ground. The Virginia types have a lengthy seed dormancy period which prevents this.

Likewise, if harvesting occurs too early, an undesirably high proportion of the kernels will be immature, shrunken, low in weight, and inferior in flavor. The choice of harvesting date can easily make a 400-500 kg/ha difference on a high yielding crop.

How to determine "peak maturity": The farmer should aim for a harvest date that will recover the largest number of mature kernels before excessive pod shedding or sprouting has occured. This is often referred to as "peak maturity", and there are no easy rules for determining it. The pattern of flowering, pod setting, and kernel maturation varies from year to year due to differences in weather and leaf spot incidence. The first 40-60 flowers to bloom are generally the ones that end up as mature kernels at peak maturity. Flowering starts about 30-45 days after plant emergence in warm areas and begins very slowly. In fact, most of these 40-60 flowers usually bloom near the end of the flowering period, although there maybe several "bursts" of flowering.

Peak maturity cannot be determined by looking at the aboveground portion of the plants. The best method is to carefully dig up a few plants every several days beginning near the end of the growing period and examine the pods. With experience, the farmer can learn to estimate quite accurately how many young pods will ripen before the matured pods begin to shed or sprout.

Minimizing crop losses: Pod shedding can be reduced by keeping the plants green and healthy until maturity. This often requires controlling Cercospora leaf spot with fungicide sprays or dusts. This also increases yields by prolonging the growing season by as much as two to three weeks. Some farmers, however, may object to having leafy green foliage at harvest time, since it may slow down the rate of field curing when the harvested bushes are placed in stacks. In this case, farmers may purposely stop their fungicide applications late in the season to promote defoliations. This also has the effect of making maturity more uniform, although yields are reduced. Such a practice may be justified in some regions, especially where field curing weather is not always dry. On the other hand, farmers can use leafy plants for lifestock feed after harvest.

(NOTE: In the U. S., extension service advise against feeding peanut hay to dairy or beef animals if it has received fungicide applications, except in the case of copper or copper-sulfur products.)

Peanut Harvesting

Whether traditional or modern methods are used, the harvesting process basically consists of four steps:

• The taproots are cut and the plants are pulled (lifted) from the ground with the attached pods.

• Under traditional methods, the plants are cured (dried) in the field for up to 4-6 weeks before threshing. With modern methods, the plants are cured in the field for 214 days, depending on whether artificial drying is available afterwards.

• The pods are threshed from the plants.

• The threshed pods are placed in bags for storage and possible further drying. In dry areas, the pods are often stored in outdoor piles.

Note that shelling the nuts from the pods is not normally a part of the harvesting process, since the kernels dry and store better in the pod. Shelling damage can be high unless kernel moisture is at or below 10 percent.

Methods of "Lifting" the Crop:

• By hand: The plants are pulled from the ground manually after loosening the soil with hand tools. It takes about 30 hours to pull and stack a hectare with this method.

• Animal-drawn methods: Special animal-drawn lifters are available and consist of a sharpened, horizontal blade that is run under the plants right below the nuts to cut the taproots, loosen the soil, and partially lift the plants. One hectare can be lifted and stacked in about 15 hours. A carefully operated weeding sweep (see Chapter 5) about 30-40 cm wide can be used, but the blade should be adjusted to slice rather than push through the soil to minimize pod losses. Some farmers use moldboard or lister plows on ridge-planted peanuts.

• Tractor-drawn methods: Tractors can be equipped with front mounted cutter bars and rear-mounted pullers that lift the plants. Two to four row setups are common, and some of the pullers will combine two or more rows into one windrow for curing. Peanut inverters are available that flip the bushes over to expose the nuts to the sun.

Some General Guidelines for Lifting

• Lifting the crop when the soil is too wet can weaken the pegs. It may cause excessive amounts of soil to adhere to the pods which can also slow down curing.

• Lifting losses can be high in very hard, dry soils.

• If cutter blades are used, they should be kept sharp and be set at a slight forward pitch to aid in lifting the plants and loosening the soil.

Methods for Curing and Threshing Peanuts

The method and length of curing prior to threshing varies considerably with weather conditions and the availability of equipment and artificial methods of drying. The most common methods are:

• The "stackpole" method: This is often used by mechanized and unmechanized farmers alike where curing weather can be wet and no means of artificial drying are available.

Poles are placed firmly in the ground, and two slats are nailed at right angles to each other about 50 cm above ground on each pole. After being allowed to wilt, the plants are stacked around the pole with the pods facing inward. The slats hold the bottom layer off the ground and also improve air curculation. The stack is built in a cone shape and the top covered with a few vines to help shed water.

In some cases, the plants are kept in the stacks until kernel moisture is down to 8-10 percent. This may take up to four to six weeks in cool, wet weather.

If harvest takes place at the start of the dry season, the plants may be stacked right on the ground.

• Row or windrow curing: If artificial methods of drying are available or effective sun drying is possible, the plants may be cured in the field in rows or windrows for two to five days before threshing. Where post-threshing drying is less efficient, the curing period lasts about 7-14 days so the pods will be drier at threshing time.

Windrows can be made by hand or through careful operation of a side-delivery rake (tractordrawn). The main advantage of windrows is that they save time when self-propelled modern threshers are used.

The plants can be placed upside down to expose the nuts to the sun. This will reduce damage in wet weather, hut can lower quality under hot, sunny conditions.

Windrows that are overly compact and dense increase curing time and spoilage under wet conditions. After a heavy rain, it may be necessary to gently turn the windrow to prevent mold. This should be done before it dries out to minimize pod shedding. Avoid placing windrows over depressions in the field.

Methods of Threshing

•Traditional: Peanuts can be manually threshed by stripping the pods by hand or by striking the base of the plants (above the pods) against the edge of a barrel or wooden box.

• Improved: A hand-cranked thresher with an output of 200 kg/hr is being marketed in Senegal.

Stationary motor-driven threshers are available. Tractor-drawn or self-propelLed threshers are used in modern farming and pick up the plants right from the windrows.

Threshing Guidelines

• Peanuts can be threshed any time after the plants are lifted as long as adequate natural or artificial drying methods are available (in the case of high-moisture nuts). Further drying will be needed after threshing for peanuts above 10 percent moisture intended for bulk storage and for peanuts above 16 percent intended for storage in loosely stacked bags under good ventilation. Peanut moisture content at lifting may be over 35 percent.

• Tips on mechanized threshing: llull damage and splitting is lowest for peanuts threshed at 25-35 percent moisture. Letting the lifted plants dry down longer in the field reduces post-threshing drying requirements but increases the weather risk. Unless the vines are dry enough to be easily torn apart, rough threshing action may be needed which will increase kernel damage.

Shelling Peanuts

Peanuts are not usually shelled until shortly before consumption or oil extraction. The shelling percentage is about 68 percent (1000 kg of unshelled peanuts yields about 680 kg of shelled kernels), and the process is most easily accomplished when kernel moisture is below 10 percent. Hand shelling is very tedious and the output is only about 10-20 kg/day Various models of hand-cranked or pedal-operated shellers are commercially available with outputs about 15-90 kg/hour.

Plans developed by VITA for a beltdriven peanut huller made from scrap motor vehicle parts are available from ICE; some simple welding and cement work is needed. Power can be supplied by a water wheel, small motor or animal.

Guidelines for Harvesting and Threshing Beans And Cowpeas

Determining Maturity

The pods begin to turn yellow during the final stages of growth and become brown and rather brittle once maturity is reached. Determinate bush varieties and some indeterminate types have fairly even pod maturity, and the plants have usually lost most of their leave< by the time the pods have ripened. Most indeterminate vining types mature much less uniformly, and a good number of pods may ripen while most of the leaves are still green. Seed moisture content is around 30-40 paecent at physiologic maturity.

When to Harvest

Indeterminate varieties with an uneven maturity are usually harvested in several pickings, while determinate bush types are harvested all at once when most of the pods are dry.

Method of Harvesting

The following methods apply to bush or semi-vine varieties with uniform maturity:

• By hand: The mature plants are pulled from the ground and placed in piles for drying. Pulling is best done in the early morning when the pods are moist to prevent shattering.

• Mechanized: Two basic methods are used. The plants are cut or "glided" out of the ground using a tractor with frontmounted horizontal blades with blunt cutting edges or rotating disks operated slightly below the soil surface. Several rows are combined into one windrow using a side-delivery rake which can be rear-mounted behind the cutters. The windrows are dried for 5-10 days before threshing with tractor-drawn or selfpropelled threshers.

Direct harvesting is popular in the U. S. and Canada using grain combines with modifications.

Threshing Methods for Beans

Beans can be threshed manually by beating the plants or bagged pods with sticks once they are dry enough. Whatever the method used, bean seed can be easily injured if threshed too roughly or when too dry. Injured seed, when planted, will produce weak, stunted plants and other abnormalities (see Chapter 6 on bean diseases).

Winnowing beans: Refer to maize.

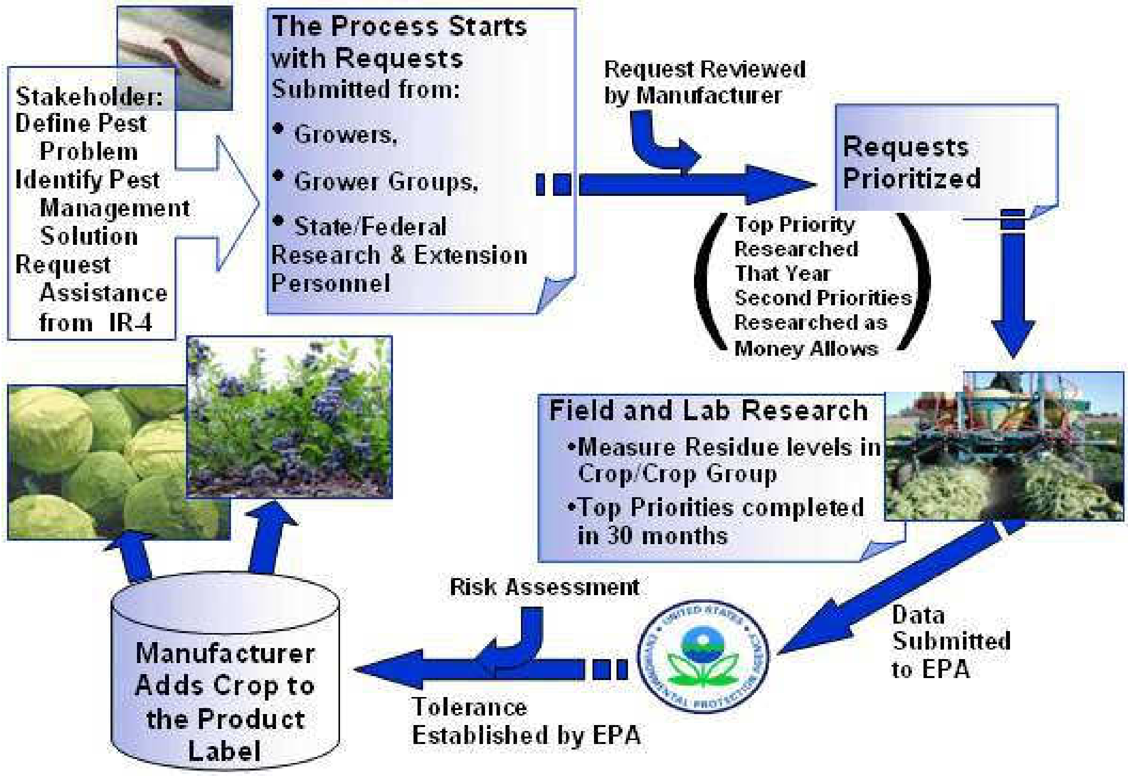
1.0 SUMMARY

2.0 PRACTICAL ASSIGNMENT

3.0 REFERENCES

BIOPESTICIDES

Production of Bacillus thuringiensis (Bt) based biopesticide was studied using hydrolysed or raw wastewater sludge as a raw material. The sludge hydrolysis was carried out at different pH (2, 4 and 6). The sludge after hydrolysis was sterilised at 121 degrees C for 30 minutes. The effect of temperature, pH and agitation speed on growth and toxin production was also investigated. The pH in the shake flask was controlled by adding 0.1 M TRIS buffer. The progress of the biopesticide production process was monitored by measuring viable cell count (VC), spore count (SC) and entomotoxicity (Tx). The entomotoxicity was measured against spruce budworm. Control of pH substantially increased the entomotoxicity of the final product. Increased agitation speed resulted in higher VC, SC and Tx values.



STEP I; Production of Mass/Stock Culture of Bioagents

Various agricultural and waste materials viz., seed husk-soil-molasses, saw dust-soil-molasses, baggasse-soil-molasses, leaflitter-molasses, sorghum meal-molasses and sorghum seeds were tested for mass production of biocontrol fungi and bacteria. Based on relative performance of the material tested, sawdust-soil-molases (5%) mixture in the ratio of 15:5:1 was selected to grow mass (stock) culture of bioagents viz., Trichoderma harzianum, Pochonia chlamydosporia and Pseudomonas fluorescens. One kg of the mixture was filled in heat resistant polybags. The bags were sealed and steam sterilized at 15 kg/cm2 pressure at 121° C. for 15 minutes. For trichoderma harzianum and pochonia chlamydosporia, chloramphenicol 10 mg/kg material and for P. fluorescens 45 mg novoboicin, 44.9 mg penicillin and 75 mg cycloheximide was added to the 1 kg material. There after the bags containing 1 kg autoclaved sawdust-soil-molasses mixture were inoculated with homogenized pure culture of the bioagent (5 ml/bag) by sterilized needle and syringe. A puncture made in the polybag to insert the needle was released by cellotape. Pure culture of Trichoderma harzianum and Pochonia chlamydosporia were prepared in potato dextrose broth supplemented with chloramphenicol 10 mg/litre and pseudomonas fluorescens in Kings B broth supplemented with 45 mg novobiocin, 44.9 mg penicillin and 75 mg cycloheximide per litre. The bag was resealed and incubated at room temperature (30-35° C.) or at 25±2° C. in an incubator for 10-15 days (fungi) and 35±2° C. for 5 days (bacteria) in an incubator. During incubation the bag were shaken daily for a few minutes to achieve uniform colonization by the bioagents on the material. Luxurient and uniform colonization by the bioagents occurred with in the incubation duration of 5-15 days.

STEP II: Immobilization of Bioagents

After preliminary screening of molasses-lignite-stillage granules, alginate-bran-fermenter biomass pellets, alginate-clay pellets, diatomacious molasses-soil pellets, sawdust-soil-molasses fermenter biomass, seek husk-sand-molasses fermenter biomass.

charcoal powder/pyrex (talc) fermentor biomass powder, fly ash fermenter biomass powder, sodium alignate pellets of liquid fermenter biomass etc., to support survival and multiplication of biocontrol fungi and bacteria four carriers viz., talc, charcoal, fine clay and flyash were selected for further study (FIG. 1 of the accompanying drawings). The stock culture of biocontrol fungi viz., Trichoderma harzianum and Pochonia chlamydosporia was mixed in the above mentioned four carriers and 5% molasses in the ratio of 1:0:1, 1:5:1, 1:10:1, 1:15:1 and 1:20:1 and supplemented with 10 mg chloramphenicol/kg formulation and was incubated at 25±2° C. in an incubator for 10 days. For pseudomonas fluorescens the carrier was supplemented with novobicoin (45 mg), penicillin (44.9 mg) and cycloheximide (75 mg/kg carrier) and then mixed with the stock culture and incubated at 35±2° C. for 15 days. After incubation CFU load/g formulation was determined using the dilution plate method which has been presented in FIG. 1. The fly ash based formulation revealed highest CFU count in comparison to the other materials used. The CFU load of T. harzianum, P. chlamydosporia and P. fluorescens on fly ash was increased by 31-117%, 19-40% and 23-71% in fly ash compared to the stock culture or other carriers, respectively (FIG. 1).

Final Composition of the Biopesticides

A mixture of flyash, soil (loam) and 5% molasses in the ratio of 15:3:1 plus chloramphenicol formulation for biocontrol fungi or 45 mg novobiocin, 44.9 mg penicillin and 75 mg cycloheximide formulation for biocontrol bacteria was used as a carrier to immobilize Trichoderma harzianum, Pochonia chlamydosporia and Pseudomonas fluorescens. The fly ash was collected from a coal fired thermal power station, Kasimpur, Aligarh, where bituminous coal is burnt. Some of the important physico-chemical characteristics of the ash were: pH 8.9, conductivity 7.6 m mhos/cm, cation exchange capacity 9.3 m mhos/cm, sulphate 9.72%, carbonate 1.07%, bicarbonate 2.60%, chloride 1.85%, nitrogen 0.00%, phosphorus 0.093%, potassium 0.82%, calcium 1.06%, magnesium 0.90%, manganese 64.5 mg/g, copper 117.8 mg/g, zinc 85.1 mg/g and boron 198.5 mg/g. The ash soil mixture was solarized under thin and transparent polythene sheet for five days (+38° C. ambient temperature) or filled in heat resistant polybags and autoclaved at 15 kg/m2 pressure at 121° C. for 15 minutes. Thereafter, 1 part stock culture was added to the bags containing 20 parts carriers (ash-soil mixture) and shaken for uniform distribution. The bags were sealed and incubated for 10-15 days at room temperature (25-35° C.) or inside an incubator at 25±2° C. for T. harzianum and P. chlamydosporia and 35±2° C. for P. fluorescens. After incubation number of colony forming units (CFUs)/g formulation was determined using dilution plate method. The ratio of 20 parts carrier and one part stock culture was found to be the best in comparison to 5:1, 10:1 and 15:1. The formulations were packed in airtight polypacks of 200, 500 and 1000 g.

FUMIGATION

Fumigation is the treatment of a structure to kill pests such as wood-boring beetles by sealing it or surrounding it with an airtight cover such as a tent, and fogging with liquid insecticide for an extended period, typically of 24–72 hours. This is costly and inconvenient as the structure cannot be used during the treatment, but it targets all life stages of pests.[32]

An alternative, space treatment, is fogging or misting to disperse a liquid insecticide in the atmosphere within a building without evacuation or airtight sealing, allowing most work within the building to continue, at the cost of reduced penetration. Contact insecticides are generally used to minimise long lasting residual effects

umigation is a method of pest control that completely fills an area with gaseous pesticides—or fumigants—to suffocate or poison the pests within. It is used to control pests in buildings (structural fumigation), soil, grain, and produce, and is also used during processing of goods to be imported or exported to prevent transfer of exotic organisms. This method also affects the structure itself, affecting pests that inhabit the physical structure, such as woodborers and drywood termites.[1]

Process[edit]

Fumigation generally involves the following phases: First the Homeowner will have to put all their food in fume bags to prevent the loss of good food. Second the area intended to be fumigated is usually covered to create a sealed environment; next the fumigant is released into the space to be fumigated; then, the space is held for a set period while the fumigant gas percolates through the space and acts on and kills any infestation in the product, next the space is ventilated so that the poisonous gases are allowed to escape from the space, and render it safe for humans to enter. If successful, the fumigated area is now safe and pest free.

Baur, Fred. Insect Management for Food Storage and Processing. American Ass. of Cereal Chemists. pp. 162–165. ISBN 0-913250-38-4.

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Jump up^ Decanio, Stephen J.; Norman, Catherine S. (2008). "Economics of the "Critical Use" of Methyl bromide under the Montreal Protocol". Contemporary Economic Policy. 23 (3): 376–393. doi:10.1093/cep/byi028.

SEED DRESSING TECHNIQUE

Seed treatment describes both products and processes. Using specific products and specific techniques can improve the growth environment for the seed, seedling, and young plant. Seed dressing is the most common method of seed treatment. The seed is dressed with either a dry formulation or wet treated with a slurry or liquid formulation of the seed treatment chemicals. Dressings are applied both industrially and on-farm. Seed treatment comprises priming, coating, pelleting, phytosanitary treatment, and microbial inoculation. The seed treatment techniques continue to evolve.

PESICIDE DOSAGE CALCULATION

Calculation based on pesticides

Being highly toxic, pesticides are not sold in its pure form. They are subjected to dilute with any carrier to avoid the hazards of poisoning to applicator or human being. The pure forms or technical grades are only used in analytical and toxicological studies. Pesticides are commercially manufactured in various formulations (by adding various additives) like emulsifiable concentrates, water-dispersible powders, dusts, granules, solutions etc. The strength or active ingredient is mentioned on the label.

What is active ingredient?

It is the chemical in commercial products which is directly responsible for its toxic effect.

What is acid equivalent?

It refers to the formulation that theoretically can be converted to the parent acid. Some herbicides are active organic acids like phenoxy acetic acid, picloram & chloramben and some are generally supplied in the form of their salts and esters as in 2, 4-D.

Let us see some commercially available pesticides

Insecticides: Endosulfan 35EC, Malathion 50EC, Metasystox 25EC, Dimethoate 30EC, Phorate 10G, Carbafuron 3G,

Herbicides: Atrazine 50 WP, Simazine 60 WP, Paraquat 24WSC, Fluchloralin 45EC, Alachlor 50EC or 100G, Butachlor 50EC or 5G, Glyphosate 41WSC, Propanil 35EC, 2, 4-D Ethyle ester 18 & 35%, 2, 4-D Amine salt 58 & 72%, 2, 4-D Sodium salt 80 & 85P etc.

Fungicides: Carbendazim 50 SC, Carbendazim 50 WP, Copper Oxychloride 50WP, Difenconazole 24.9EC, Dithianon 5, 10EC, Dithianon 5SC, Hexaconazole 5, 10EC, Hexaconazole 5 SC, Mancozeb 80, 75 WP, Miclobutanil 10 WP, Propiconazole 10, 25 EC, Tebuconazole 24.9 EW, Tricyclozole 75 WP etc.

Pesticides are recommended in three ways for its field application such as amount of pesticides per hectare (kg/ha), amount of active ingredient or acid equivalent per hectare (kg a.i./ha) and concentration of solution to be applied (eq 0.07 % of endosulfan).

Before application or purchase of pesticides it is always strike in the mind of farmers that how much amount of insecticides or herbicides or fungicides etc would be required for application on their farm of definite size so that he could parches only the required amount . Let us see the methods for calculating the pesticide dose with some example.

If recommended as kg a.i./ha:

Rate of herbicides is given mainly in terms of a.i. or a.e. /ha

Rate of application

Quantity of material required per hectare = ------------------------------------ X 100

Active ingredient in %

Example: Find out the quantity of simazine 80WP to be sprayed in one hectare area if rate of application is 3 kg a.i. /ha

Quantity of simazin/ha =3/80 x 100 = 3.75 kg WP/ha

For the calculation of this type we must know the a. i. present in the commercial product.

If recommended as kg/ha:

Experience has shown that to spray one hectare with a hydraulic nozzle sprayer in good working condition and a 15 liter sprayer, one will need 300 liters of solution, i.e. 20 sprayer loads.

Example: To control grasses, 5 liter of propanil should be applied per hectare. Its mean

1 liter = 1000 ml

20 sprayers (15 L each) per ha

5000 ml/ 20 = 250

i.e. 250 ml per 1 small Kap-sac sprayer and 20 loads will be required.

If recommended as per cent concentration:
By Formulae

$$\text{Amount of pesticide} = \frac{\text{Volume of spray solution (liter)} \times \text{Per cent strength of pesticide solution to be sprayed}}{\text{per cent strength of pesticide given (a.i./l or kg)}}$$

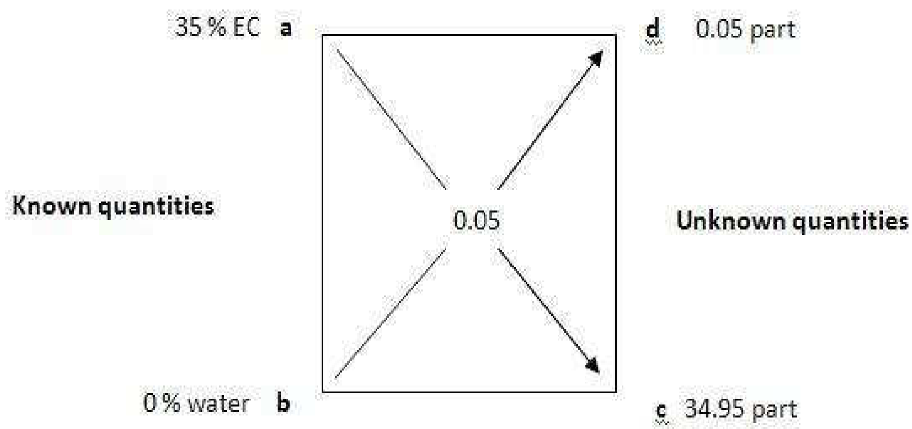
Example: Amount of malathian 25 EC when applied as 0.025 per cent solution

$$= \frac{300 \times 0.025}{25}$$

$$= 0.3 \text{ liter or } 300 \text{ ml/ ha}$$

By Pearson's square method:

Example: To prepare 0.05 per cent mixture from endosulfan 35EC.



To get the required amount of insecticide and water, substract the smaller figure from the higher ones (i.e., 0.05-0=0.05 and 35-0.05=34.95), diagonally.

Put 0.05 opposite EC at **d** and 34.95 opposite water at **c** point.

This mean that to make 0.05 % solution out of the endosulfan 35 EC, we have to require 0.05 part of endosulfan + 34.95 part of water.

SAFETY IN THE USE OF PESTUCIDES

- Make sure kids, pets, and anyone non-essential to the application is out of the area before mixing and applying pesticides.
- Be sure to wear clothing that will protect you when using pesticides. Consider wearing a long sleeve shirt, long pants, and closed-toe shoes in addition to any other protective clothing or equipment required by the label.
- Mix pesticides outdoors or in well-ventilated areas.
- Mix only what you need to use in the short term to avoid **storing or disposing** of excess pesticide.
- Be prepared for a **pesticide spill**. Have paper towels, sawdust or kitty litter, garbage bags, and non-absorbent gloves on hand to contain the spill. Avoid using excessive amounts of water, as this may only spread the pesticide and could be harmful to the environment.

- Read the first aid instructions on the label before using the product. Have the telephone number for the Poison Control Center (1-800-222-1222) available in case you have additional questions.
- Remove personal items, such as toys, clothing, or tools from the spray area to avoid contamination.
- When spraying pesticides indoors, make sure the area is well ventilated.
- When applying pesticides as a spray or dust outside, avoid windy conditions and close the doors and windows to your home.
- After using pesticides, wash your hands before smoking or eating.
- Evaluation of disease severity and/or disease incidence is crucial to many phytopathological studies. Disease severity is defined as the 'area of a sampling unit affected by disease, expressed as a percentage or proportion of the total area', while disease incidence is defined as the 'number of plant units sampled that are diseased expressed as a percentage or proportion of the total number of units assessed' (10). The amount of disease, either expressed as severity or incidence, is referred to as disease intensity (10) . Incidence is used in pathosystems in which a single lesion per plant is critical, as well as for many wilt and systemic virus diseases (4). On the other hand, severity is more difficult to estimate, but it is used in many pathosystems, such as potato late blight (LB), to conduct research related to disease management (4).
-
- Severity can be estimated with special equipment or with the naked eye. The use of equipment (e.g. 11) is normally too expensive or too labor-intensive for large-scale disease evaluations (5). For this reason, severity of foliar diseases is generally estimated visually.
-
- Scales have been developed to improve visual estimation of severity for many diseases (see Campbell and Madden 4). Different scales can be compared based on the accuracy and precision of their estimates. Accuracy is defined as the 'measure of the closeness of an estimate (disease assessment) to the true value', and precision is defined as a 'measure of reliability and/or repeatability of disease assessments' (10). Hau (cited in Campbell and Madden 4) proposed the following method to determine the accuracy and precision of disease severity estimates: plant units with known severity are assessed by an evaluator with no previous knowledge of the actual severity. The estimates are then regressed on the actual values with a no-intercept model (regression through origin). The slope of the regression represents the accuracy: the closer to 1.0, the more accurate the estimation made by the evaluator. Precision is directly related to the coefficient of determination (r2).
-
- Severity of LB is routinely evaluated using two types of scales: Horsfall-Barratt scales (Table 1) and direct percentage. Horsfall and Barratt (7), through application of the Weber-Fechner

law to visual assessment of disease severity, proposed that the human eye would estimate high and low disease severities with greater precision than mid range severities (5). To correct this problem, they suggested that scale increments should be logarithmic rather than linear (5). On the other hand, the percentage scale estimates disease severity directly. Forbes and Korva(5) compared a Horsfall-Barratt scale formerly used in the International Potato Center (CIP) and direct percentage on LB under field conditions. They found that evaluators tended to linearize the Horsfall-Barratt scale and, therefore, direct percentage estimation was more accurate. The Horsfall-Barratt scale used at CIP has intervals that double in size until 50% infection and then reduce in size symmetrically (Figure 1) (5). Intervals on the scale are roughly similar to unit intervals of the linearizing transformation for the logistic model (or logit = ln [x /(100 ? x)], where x = percentage severity 5).

- Table 1. Horsfall-Barratt scale formerly used at the International Potato Center to estimate severity of potato late blight (5).

Class	Disease severity (%)	Value to convert back to % (midpoint)
1	0	0
2	> 0 to 2.5	1.25
3	> 2.5 to 10	6.25
4	> 10 to 25	17.5
5	> 25 to 50	37.5
6	> 50 to 75	62.5
7	> 75 to 90	82.5
8	> 90 to 97.5	93.75
9	> 97.5 to 100	98.75

- An example of a percentage scale used to evaluate LB severity is the 'modified blight rating system' developed by W. E. Fry and co-workers (unpublished data) (Table 2).

This scale was based on data reported by Fry (6), James (8), and the British Mycological Society (3). The methodology to estimate LB severity consists in dividing the plot (experimental unit) in small quadrants, each containing 20 to 25 plants. The percentage of infected tissue is then estimated in each quadrant according to Table 2, and averaged to obtain the estimated severity in the plot. The number of quadrants to be evaluated varies according to plot size: in 4.5 x 4.5 m plots containing
100 plants, the number of quadrants is 4 (6), i.e., 80 to 100 plants are evaluated. In bigger plots, the number of quadrants to be evaluated depends on the variability in disease distribution: more variability, more quadrants. This scale was developed for epidemics in which the first symptoms appeared when plants had about 200 leaves (6) (approximately two-month old plants), but it has been used successfully with younger plants (1,2). The modified blight rating system may be used just as a reference, because there is evidence suggesting that it is better to simply estimate the percentage of foliage (everything green: stems, leaves, etc.) which is affected by disease rather than using some kind of scale (5).

- Table 2. Modified blight rating system used to estimate severity of potato late blight (W. E. Fry and co-workers, unpublished data). See text for references.

Severity (%)	Description
0.01	Two to five leaflets per 10 plants affected. About five large lesions per quadrant (20 to 25 plants).
0.1	About five to 10 infected leaflets per plant, or about two affected leaves per plant.
1.0	General light infection. About 20 lesions per plant, or 10 leaves affected per plant, or 1 in 20 leaves affected severely.
5	About 100 lesions per plant. One in 10 leaflets affected, up to 50 leaves affected.
25	Nearly every leaflet infected but plants retain normal form. Plants may smell of blight. Field looks green although every plant is affected.
50	Every plant is affected and about 50% of the leaf area is destroyed. Field appears green

	flecked with brown.
75	About 75% of the leaf area destroyed. Field appears neither predominantly green nor brown.
95	Only a few leaves on plants, but stems are green.
100	All leaves dead, stems dead or dying.

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-
-
-
- Visual estimation of disease severity is subject to an important source of error. The portion of the disease that is really evaluated is the one that has produced visible symptoms and that is still on the plant. Symptomless tissue and infected leaves that had fallen off are not evaluated. This is an important consideration when severity is used as a criterion to decide an intervention (e.g., fungicide application), because the estimated severity may be much lower than the actual severity.

Cractical Considerations for Estimating LB Severity

Practical considerations for estimating foliage late blight severity in the field

Estimation of severity is crucial to study epidemics of potato late blight (LB) (see Estimation of Disease Severity). Severity is used to graph disease progress curves and to calculate epidemic descriptors, such as the area under the disease progress curve (AUDPC) and the apparent infection rate (*r*) (see Summarizing the Epidemic). Several questions may be raised when estimating foliage LB severity in the field.

What method to use? The International Potato Center (CIP) recommends simply estimating the percentage of foliage affected by LB. Illustrated keys for whole plants (Figure 1, 4) or leaves (Figure 2, 8) can be used as reference. The modified blight rating system (see Estimation of Disease Severity can be used if greater precision is required. Readings across the season in a certain experiment should be done by the same person to avoid inter-assessor variability.

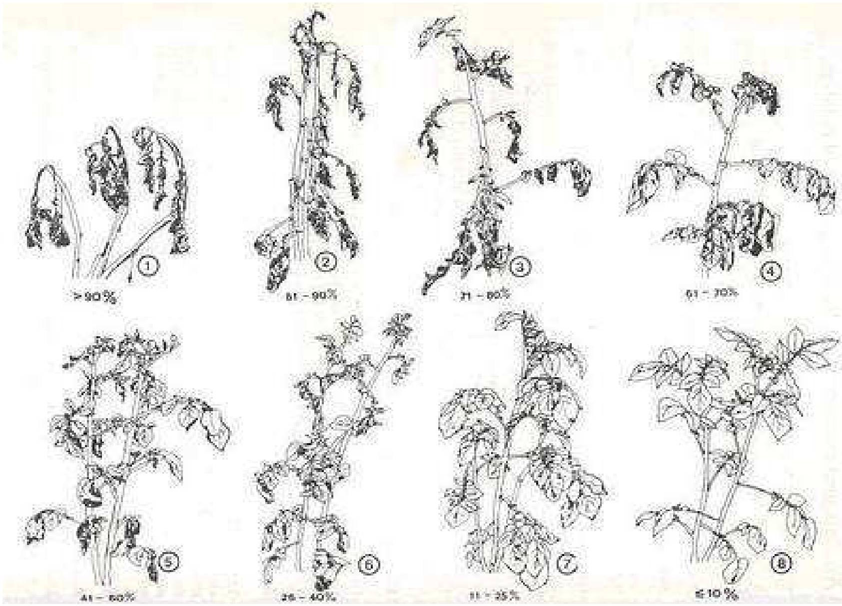

Figure 1. Key to evaluate percent infection of late blight in potato plants. Reproduced from Cruickshank et al. (4).

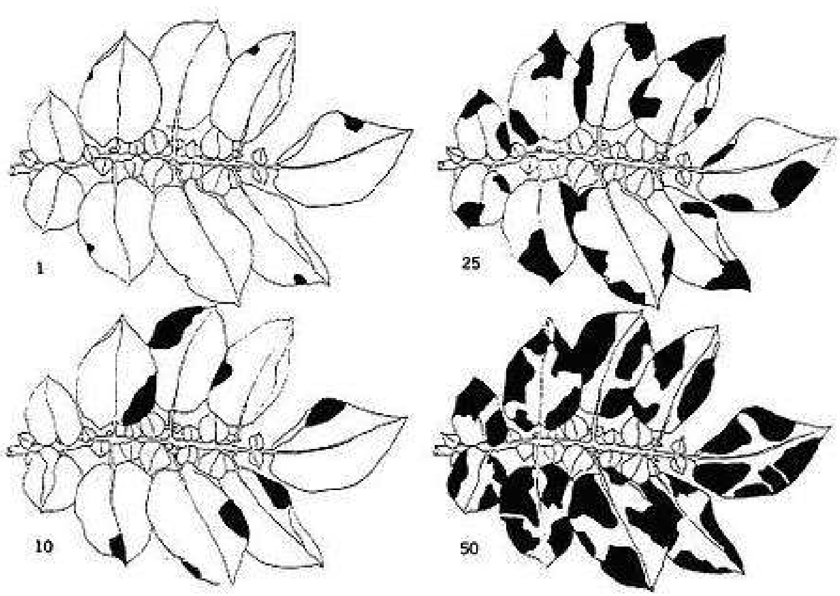

Figure 2. Key to evaluate percent infection of late blight in potato leaves. Reproduced from James (8).

Severity is estimated in each experimental unit several times across the growing season. The results are written in a datasheet (Table 1) preferably printed in dark tone paper to avoid reflection of sunlight. If possible, the evaluations should be made early in the morning or in overcast days, because excessive sunlight may difficult the readings (7). Depending on the size of the experimental unit and the variability within it, it may be possible to take more than one reading per unit and use the average for the calculation of descriptors. In that case, the experimental unit could be divided into quadrants

(Table 2) as described by Fry (5) (see Estimation of Disease Severity). Also, it is best to record readings independently (i.e., without knowing the value given at the previous reading) at each date, such as having someone else write in the field book or by using a cassette recorder (7).

Table 1. Data sheet for evaluation of potato late blight severity (%) in an experiment with 2 treatments, 3 repetitions, and 3 evaluation dates.

Treatment	Repetition	15-aug	30-aug	15-jul
A	1	0	1	5
A	2	0	3	5
A	3	0	1	5
B	1	0	0	1
B	2	0	0	3
B	3	0	0	1

Table 2. Datasheet for evaluation of potato late blight severity (%) in an experiment with 2 treatments, 3 repetitions, 4 quadrants per repetition, and 3 evaluation dates.

Treatment	Repetition	Quadrant	15-aug	30-aug	15-jul
A	1	1	0	3	10
A	1	2	0	1	5
A	1	3	0	0	5
A	1	4	0	0	0
A	2	1	0	5	10
A	2	2	0	1	3
A	2	3	0	1	3
A	2	4	0	5	5
...	...	...	...	...	...

B	3	1	0	1	1
B	3	2	0	0	1
B	3	3	0	0	1
B	3	4	0	0	1

It is recommended to confirm that what it is being evaluated is indeed LB. Other diseases (e.g., early blight), frost, and herbicides cause necrosis that may be misinterpreted as LB (7). Inexperienced evaluators may use field microscopes to verify the presence of sporangia and sporangiophores. In closed canopies, it is advisable to take a closer look within them, because there is usually more disease in the lower than in the upper leaves.

When to start? The time to start the severity readings depends on the objective of the experiment and on weather conduciveness for LB. Depending on the objective of the experiment, severity readings should start before the initiation of disease or as soon as the symptoms appear. In experiments for validation of LATEBLIGHT, a LB simulator (1), it is critical to have an accurate estimation of the time when disease starts and initial severity (2). Therefore, severity readings should start before the initiation of disease. In experiments for evaluation of treatments to control LB (e.g., potato genotypes, fungicides, etc.), severity readings should start as soon as the symptoms appear. Otherwise, part of the disease progress curve of the less effective treatments would not be considered and epidemic descriptors, such as AUDPC, would be biased.

Weather conduciveness for LB also determines the time to start the severity readings. In locations/seasons with very conducive weather (and inoculum available), LB can appear a few days after plant emergence (2). Thus, it is advisable to start the readings as soon as the plants emerge. In locations/seasons with less favorable weather, there is no a defined moment to start the severity readings and frequent scouting is required.

How many readings? The number of severity readings depends on the objective of the experiment and on the expected speed of the epidemic. If the objective of the experiment is to evaluate resistance of many potato genotypes against *P. infestans* and AUDPC is used as epidemic descriptor, then the number of readings could be as low as 2 (6,9). The first severity reading must be made shortly after the epidemic has started, and the second when the epidemic has reached its peak (100% severity) in the most susceptible genotypes (6). Using 2 severity readings is recommended when time and economic resources are tight, but there are two conditions that must be met: (i) the period of time that disease is present must be the same for all the genotypes, and (ii) the disease must progress as a sigmoid curve (6).

In experiments in which non-sigmoid progress curves are expected (e.g., in experiments to test fungicides), or in those in which an accurate estimation of disease progress curves is needed (e.g., in the validation of a disease model), the number of severity readings depends on the expected speed of the epidemic. In locations/seasons with very conducive weather for LB and susceptible potato genotypes, a high level of disease (e.g. 50% blight severity) may be reached in a few days (3) and, therefore, severity should be evaluated frequently (5 to 7 days). In locations/seasons with less favorable weather and/or resistant genotypes, 50% blight severity may be reached in a longer period (3), and the interval between evaluations can be longer (10 to 14 days).

The intervals between evaluations are flexible, especially if AUDPC is being used as epidemic descriptor. If an accurate estimation of disease progress curves is needed, then the intervals are still flexible, though it is advisable to try to keep them constant.

When to finish? It depends on the objective of the experiment and the variables to evaluate the treatments. In experiments to evaluate the resistance of potato genotypes against *P. infestans* by using AUDPC and/or r, the severity readings should be finished when the most susceptible genotypes reach 100% severity. If readings are taken too long after susceptible genotypes reach 100%, the differences in AUDPC between resistant and susceptible genotypes may be underestimated. In the case of r, the logistic transformation is undefined at severity values of 100%.

In experiments in which the efficacy of a certain treatment (e.g., potato genotype, fungicide, etc.) is evaluated by measuring yield, or in those to validate a disease model, it is advisable to continue the severity readings until plants in LB-free treatments start to senesce. These treatments are obtained usually with continuous applications of fungicides against *P. infestans*.

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Sample SOP: Cleaning and Sanitizing Surfaces, Tools, and Equipment

1—Purpose

Describes how food contact surfaces, tools, and equipment are to be cleaned and sanitized.

2—Scope

Applies to farm and packinghouse personnel including farm owners and workers.

3—Responsibility

Workers are responsible for following the SOPs to properly clean and sanitize food contact surfaces. Farm owners and food safety managers are responsible for training the workers on proper technique, providing necessary resources such as tools, detergents and sanitizers, and making sure the cleaning and sanitizing steps are followed correctly.

4—Materials

- Detergent name, brand, and concentration (labeled for use on food contact surfaces) ***[Provide name here]***
- Sanitizer name, brand, and concentration ***[Provide name here]***
- Container(s) as needed for mixing and using detergent(s) and sanitizer(s) or for washing tools
- Brushes, sponges, or towels for scrubbing tools and equipment
- Clean water (microbial equivalent to drinking water)

5— Procedure

1. The surface should be brushed or rinsed to remove visible dirt and debris.
2. Prepare the detergent ***[Add detergent mixing or preparation instructions here]***.
3. Apply the prepared detergent solution and scrub the surfaces moving in the direction top to bottom for large pieces of equipment. Detergent should be mixed according to the product instructions.
4. Rinse the surface with clean water until all soap suds are rinsed away moving in the direction top to bottom for large pieces of equipment.
5. Prepare the sanitizer. ***[Add sanitizer mixing or preparation instructions here]***.
6. Apply the prepared sanitizer solution. Allow it to sit for ***[Enter number of minutes according to product instructions]*** minutes.
7. Rinse with clean water.
8. Let the surface air dry.

ASSIGMENT

Disease symptoms album preparation

SECTION 2
(300LEVEL)

NATIONAL OPEN UNIVERSITY OF NIGERIA

FACULTY OF AGRICULTURAL SCIENCES

DEPARTMENT OF
ANIMAL SCIENCE AND FISHERIES

FPY/SIWES PRACTICAL GUIDE MANUAL

ANP 403:
ANIMAL HUSBANDRY TECHNIQUES
NON-RUMINANT

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Animal Husbandry Techniques Non-Ruminant

CONTENT **PAGE**

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PRODUCTION OF EGGS AND BROILER CHICKENS/TABLE AND HATCHABLE EGGS

1.0 Introduction

Farmers are careful to house and feed the chickens to maximize laying and ensure the hen has a relatively long and healthy life. Egg producers also have flocks of hens at different ages, ensuring they have a steady supply of eggs ready for market to provide year-round income. The females (mature hens and younger pullets) are raised for meat and egg production and breeds have been developed to fulfill commercial needs. Fresh egg production is primary to the egg industry, however, a significant amount of egg production includes eggs purposely broken and used for powdered eggs, frozen eggs, or purchased by food producers for inclusion in food products.

The broiler growing phase is only one part of the integrated total meat production process. The objective of the broiler manager is to achieve the required flock performance in terms of bird welfare, live weight, feed conversion, uniformity, and meat yield within economic constraints. Broiler production is a sequential process, with ultimate performance being dependent on each step being completed successfully. For maximum performance to be attained each stage must be assessed critically and improvements made wherever required.

2.0 Objectives

At the end of this session, you should be able to

- identify methods of rearing chicken, acquire knowledge and skill of complete package of practice for quality production of broilers.
- explain how to produce table and hatchable eggs
- discuss the skill involved in caring and management of chicks.

3.0 Procedure

Egg production cycle: Birds usually start to lay at around five months (20-21 weeks) of age and continue to lay for 12 months (52 weeks) on average, laying fewer eggs as they near the moulting period. The typical production cycle lasts about 17 months (72 weeks) and involves three distinct phases, as follows.

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i. Phase 1: Small chicks or brooders. This phase lasts from 0 to 2 months (0-8 weeks) during which time small chicks are kept in facilities (brooder houses) separate from laying birds.

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ii. Phase 2: Growers. This phase lasts about 3 months, from the ninth to the twentieth week of age. Growers may be either housed separately from small chicks or continue to be reared in brooder-cum-grower houses. It is important to provide appropriate care to the growers particularly between their seventeenth and twentieth week of age as their reproductive organs develop during this period.

iii. Phase 3: Layers. Growers are transferred from the grower house to the layer house when they are 18 weeks old to prepare for the laying cycle. Birds typically lay for a twelve-month period starting when they are about 21 weeks old and lasting until they are about 72 weeks old.

Management of chicks: Before chicks arrive at home; make sure that;

i. A brooder is in place
ii. Paraffin lamps/electric bulbs/charcoal stove is available o Litter for the floor is available 1m2 will accommodate 20 chicks upto 4 weeks old.
iii. Temperature control: 350C for day-old chicks, 24-270C for 1 week. Reduce heat as they grow especially at night.

Feeding Exotic chicken

i. Broilers – 1 to 3 weeks feed with chick mash, 3 to 6 weeks feed with broiler starter, thereafter with broiler finisher.
ii. Layers – 1 to 8 weeks feed on chick mash, after 8 weeks introduce growers mash gradually, then with layers mash after drop of first egg.

Management of Layers

a) Allow for good air circulation in laying house
b) Layer needs on average 120 gm of food per day
c) Distribute food troughs and water troughs evenly (one basin/50 birds)
d) Provide grit at 20 weeks
e) Laying nests must be kept in dark places, collect eggs 3 times a day, allow a nest/5 hens
f) Provide soft clean litter
g) Store eggs with small end down
h) Clean dirty eggs with steel wool/coarse leaves (**never** wash them)
i) Add greens to the diet and whenever possible vitamins to water
j) Debeaking at onset of lay
k) Culling when egg production drops below 40% .

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Before Your Chicks Arrive: Setting the Stage

i. Brooder: a safe place to keep chicks warm, watered, and fed. You can buy or build elaborate brooders, but many chick growers go with a large plastic tote or large cardboard box. Be certain to have the right size (with high walls) for the number of chicks. You can also start small and move to a larger brooder as the chicks get older. Finally, you'll want a (ventilated) lid to keep brave chicks from escaping once they get bigger.

ii. Brooder location: You want to keep the brooder in a warm, dry place; many people set it up in a garage, others do it in their house, while yet others do it in the chicken coop (if there are no adult chickens in the coop).

iii. Heat lamp: Fairly essential to keeping the chicks warm and their temperature regulated, as they can't do so initially. You can use a regular lamp and light bulb, but products made for this purpose (with a guard) are a bit safer and more consistent. Attaching heat lamp to a 2x4 across top of brooder works well as does attaching it to a floor lamp's pole.

iv. Thermometer: While not absolutely crucial, a thermometer will help you more easily monitor the temperature in the brooder. -- Bedding: Pine shavings in general are the best materials, but in the first week or so, we like newspapers with a layer of paper towels on top (because the chicks will try eating the pine shavings).

v. Waterer: Absolutely essential to have one or more waterers designed specifically for chicks; other systems will lead to sad results and death.

vi. Feeder: You don't necessarily have to get chick feeders (though it's recommended); some folks use the base of an egg carton. If you don't use a chick feeder, be more vigilant about keeping the feed clean (from poop) and dry. Some experts recommend simply placing the feed on a paper plate for the first few days.

vii. Chick starter feed: It's essential to use a feed specifically designed as starter for chicks; your main choice will be deciding between regular and medicated. Feed this feed for the first 8 weeks or so.

viii. Electrolyte powder: If your chicks are arriving by mail, purchase the electrolyte powder (think Gatorade for chicks) to supplement their water starting the third day or so and give the chicks extra strength in those key early days. (Old timers used to put sugar in the chick water.)

ix. Coop: Unless you're keeping the brooder in the coop, you don't technically need to have it ready now, but it is best -- as time will pass quickly. Every imaginable type of chicken coop exists -- and

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your goal should be to find/build the one that best fits your needs/code/number of chickens.

x. Pen: The healthiest chickens are the ones who forage the yard for their food, thus you should have a plan for where you'll let your chickens roam, from one nicely fenced pen to a series of pens, to a moving pen, to your entire backyard. The pen should be fenced/enclosed to protect chickens from predators.

Day 1: Acclimating Chicks

i. Temperature: Brooder temp should be 90 degrees.
ii. Water: First thing to do when baby chicks arrive is to take one at a time and dip their beaks in the water and be certain they drink; this step is absolutely essential to survival. Refill waterer often.
iii. Feed: Once the chicks have had a drink, repeat the process with their feed.
iv. Location: Keep feed and water on outskirts of heat lamp, ideally on opposite sides (with heat lamp in the middle) to keep water from feed.
v. Sleep: Expect the chicks to sleep quite a lot during this first week.

Week 2: Baby (Chick) Steps

i. Temperature: Bring down brooder temperature 5 degrees to 85 degrees.
ii. Water: Check and refill waterer(s) at least twice a day. Clean regularly with diluted vinegar.
iii. Feed: Keep with the starter feed. Be vigilant about keeping feed free of moisture and chick poop. Using a piece of plywood or extra floor tile, raise waterer and feeder for less waste and mess.
iv. Feathers: You'll begin to see small feathers replacing the fluff on your chicks' wings and tail.
v. Bedding: Switch to pine shavings -- about 1-2 inches deep; clean brooder before doing so.
vi. Grit: Introduce a small amount of fine "chick" grit to chicks' diet -- needed to assist in digestion (which they would normally get if raised naturally outside).
vii. Perch: Consider adding a small, chick-sized perch in brooder for "roosting 101" -- made easily with three small branches in an H-shape.
viii. Socializing: If your chicks are going to be more than simply production birds, now is the time to acclimate the chicks to you.

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Week 3: Keeping a Lid On

i. Temperature: Bring down brooder temperature 5 degrees to 80 degrees by raising heat lamp about 3 inches.
ii. Lid: Now's the time when you should start putting a lid on your brooder.
iii. Waterer and Feeder: Consider raising the height again, placing them on a 2x6 -- and possibly switching to adult units to make it easier on your maintenance.
iv. Brooder: If you started with a small brooder, it may be time to upgrade to a larger one to accommodate your chicks' growth.
v. Feathers: Lots more feathers are appearing and replacing the fluff

Week 4: Life Beyond the Brooder

i. Temperature: Bring down brooder temperature 5 degrees to 75 degrees by raising heat lamp another 3 inches.
ii. Field trip: Depending on the season (assuming late spring/early summer), now is the time to introduce the pen to the chicks in small doses -- say 1-3 hours daily with supervision.

Week 5: Tweens

i. Temperature: Depending on the season, the heat lamp is done, as long as the temperature does not dip below 60s at night.
ii. Feathers: The chicks should be looking less like babies and more like miniature chickens, as adult feathers grow out.
iii. Separating the sexes: It's hard to tell the genders of most breeds of chicks, but by now you should be able to by examining their feather development -- and it's a good time to separate the sexes -- the cockerels (young roosters) and the pullets (young hens) -- especially if your focus is on keeping only hens for laying. -- Pen: The chicks can take longer day trips to the pen.
iv. Feed: It's now time to start mixing in adult chicken feed as you finish up your chick starter feed.
v. Feeders and Waterers: If you have not already, time to switch to larger (adult size) feeder and waterers.

Week 6: From Brooder to Coop

i. Acclimating: Time for the chicks to flee the brooder for the coop! If they have not been raised in the coop, take time to help the chicks get used to their new digs.
ii. Feed: Provide your chicks with chicken feed, table scraps, and other tasty treats.

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iii. Feeder: Consider hanging the feeder (at the proper height at top of chicks' backs) to make it easier on the chickens -- and less waste overall.

iv. Pen: Being outside (depending on the season/weather) should now be part of daily routine for the chicks, bringing them home to the coop to roost for the evening.

Week 8: Expanding the Menu

i. Treats: Chickens are omnivores, so a good mixed diet is essential. Be creative and help the chicks from being bored by hanging some of the treats (such as a head of lettuce) so the chicks can peck at them.

Week 12: Readying the Hens I

Nesting Boxes: Assuming you are raising hens for egg-laying, now is the time to install/prepare the nesting boxes. These should be raised above the ground and away from roosting area (to avoid poop contamination), ideally offering some privacy. Lots of methods for constructing the boxes, from old drawers and crates to water buckets.

Week 16: Readying the Hens II

i. Fake eggs: A great tip a veteran told us was putting a plastic egg (partially filled with sand to give it a bit of weight) in the nesting boxes to help your young hens learn.

ii. Feed (layers): Time to switch to a layer feed for your young hens.

Week 20: Laying Begins

i. Harvesting eggs: Once your hens start laying eggs (there may be a few misfires first), you'll want to check the nesting boxes for eggs twice a day (while you also refresh water/feed). Discard any broken or pooped-on eggs.

ii. Nesting Boxes: Keep clean and fresh.

iii. Extending the season: As fall arrives and daylight gets shorter, hens will slow down egg production for the winter. You can extend the season by placing a light in the coop that comes on in the late afternoon and stays on for about 5 hours -- giving the hens about 15 hours of "daylight."

4.0 Conclusion

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Broiler poultry farming is a lucrative business. Basically, broilers are only for meat production. Generally highly meat productive birds or

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poultry breeds are called broiler poultry. Broilers are like other common poultry birds. But this broiler is made in a scientific way for producing more meat in a short time. Following the procedure above will ensure sustainable, profitable production of broilers.

5.0 Practical Assignment

1. Do you understand the different procedure of managing day old chicks in the poultry farm? If yes, write down what you understand about them

2. How is layers managed in the farm you visited?

6.0 References

http://www.naads.or.ug/files/downloads/POULTRY%20REARING.pdf

https://www.sapoultry.co.za/pdf-training/Trainees-manual-poultry-course.pdf

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PRODUCTION/MULTIPLICATION OF PIGS

1.0 Introduction

The major production systems of the swine industry are farrow-to-finish production, feeder pig production, and feeder pig finishing. Farrow-to-finish swine production is the most common type of production. It covers the entire production process, from breeding to sales of market hogs. Gilts and sows are mated to boars or artificially inseminated. Females farrow a litter of pigs. The piglets are weaned, and the sows are bred again. The baby pigs are moved into a nursery until they weigh approximately 50 pounds and then to a finishing barn where they grow until they reach 240 to 270 pounds. The pigs are then sold as market hogs to provide pork for human consumption. Farrow- to-finish production is the most intensive production system and generally has the greatest requirements as to management skills, labor, and facilities.

2.0 Objective

At the end of this unit, you should be able to:

- explain production and multiplication strategies of pigs.

3.0 Procedures

General Procedures

i. Several breeds can be used in the production of swine. Producers should select breeds that work well in their production system. When breeding animals, swine producers use purebred and hybrid genetics to produce profitable offspring. Most commercial swine producers use some form of crossbreeding program.

ii. The three production systems used in producing swine vary as to the facilities needed, costs, and returns on the pigs marketed. Swine producers require different types of facilities, depending on the production system.

iii. Pigs can contract many different diseases. Producers use a variety of methods to help reduce the spread of disease, including biosecurity measures, proper sanitation, and the purchase of disease-free breeding animals. They need to identify specific health problems and work to reduce their effects. Swine diseases can generally be prevented through the use of disease-free breeding stock, biosecurity, and vaccinations. Producers should use subcutaneous injections whenever possible.

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iv. Swine producers must make sure to meet nutrient requirements for proper herd health and production. Diets vary depending on the stage of growth or production.

Multiplication/Breeding Procedures of Pigs

Breeding is a complex science that requires skill and knowledge. It also requires thorough record keeping. To achieve genetic improvement the following methods can be used:

Selection: select the best individuals in the herd for breeding, looking at their performance in various characteristics e.g. litter size, growth rate, feed conversion ratio, disease resistance etc.

Culling: remove the individuals that do not perform well.

Artificial Insemination (A.I.)

Artificial insemination is becoming popular in Pig breeding. It is not a difficult procedure provided the basic guidelines are followed it can be highly successful.

The principles of oestrus detection, timing and frequency of insemination do not differ from those employed when using natural mating. However it is important in ensuring that;

i. Suitable equipment is used
ii. Suitable insemination environment
iii. Proper insemination techniques.
iv. Well stored and viable semen.

Management of Breeding Stock

a) Boars

i. Start serving > 8 months of age.
ii. First two months of service, serve only twice per week.
iii. After can service six times per week.
iv. Should be kept in its own pen to avoid fighting.
v. When mating transfer the sow to the boar
vi. One boar can serve up to 15 sows
vii. Considerable exercise is necessary to prevent the development of leg weaknesses.
viii. The boar's feet should be trimmed regularly as deemed necessary.

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ix. Boar should be washed with soap and water every 4 months and sprayed for the lice and mange.

x. The pen walls should be white washed with a wash containing a powerful disinfectant at the same time.

b) Gilts/sows

i. Provide enough exercise as some sows will tend to fatten if not exercised.
ii. A fat sow takes longer to come on heat.
iii. It is also more likely to crush her young piglets.
iv. First service for gilts should not be until the age of 7 - 8 months.
v. Sexual maturity occurs as early as 4 - 5 months.
vi. Reproductive life of a sow is 4 - 5 years.
vii. Keep about 3-4 gilts/sows per pen of 9-10 m^2
viii. Pen should be kept clean (change bending regularly).
ix. Sows/gilts pens should be next to the boars to stimulate them to come on heat.
x. But not too close so that they would not get use to him.

Flushing

i. It is important that the gilt has at least two true heat periods before mating, to gain the increase in ovulation rate.
ii. For gilts, the ovulation rate can be further increased by a high energy intake for 10–14 days prior to service.
iii. But should be reduced for the first 3 days after mating.
iv. Increased feeding levels afterward to ensure adequate energy intakes,
v. but prevent high energy intakes between days 70 and 105 of gestation.

Breeding Cycle

The normal heat period lasts for 3 - 5 days

Heat signs
1st Stage: Early Heat Signs

i. General restlessness
ii. Vulva turns red and is swollen
iii. White mucus discharge.

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2nd Stage: Service Period Signs

i. Real Oestrus lasts for 40 - 60 hours
ii. Vulva becomes less red and swollen
iii. Slimy mucus discharge
iv. Tendency to mount and be mounted by others.
v. The sow or gilt will stand still when pressure is applied to her back. (Thus the right stage to send her to the boar or inseminate).

3rd Stage: *Post Oestrus*-Period Signs

i. The sow/gilt will not stand still when pressure is applied to her back.
ii. The swelling of the vulva disappears.

Recommended practices

i. Put the sow with the boar for a short period every day when the heat is expected.
ii. Always take the sow to the boar. This is less upsetting for him.
iii. Put the sow and boar together just before feeding.
iv. Allow the boar to serve twice, with an interval of about 12 hours between services. If the sow doesn't conceive, she will return on heat in about 3-week's time.
v. 10 days before service, give the sow/gilt 1 - 2 kg of feed extra per day. Continue this for one week after service.
vi. give 0.5 kg extra feed per day at last month of pregnancy, but decrease gradually one week before farrowing. Provide plenty of water to help prevent congested gut during farrowing.
vii. Each boar should be kept in its own pen to avoid fighting. For mating, the sow is taken to the boar.

Farrowing and Birth Management

Expected date of birth: On average pregnancy lasts 115 days after conception (3 months, 3 weeks and 3 days).

Farrowing Preparation measures and birth of piglets

About a week before the expected delivery date, the sow should be:

i. Washed with soap and water and then rinsed with a mild disinfectant. The pen should be disinfected before the pregnant sow is put in. Immediately after washing she should be put in a pen of her own.

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ii. Dewormed and treated for lice and mange. Any good acaricide (cattle dip) can be sprayed on the sow or gilt to kill the lice and ticks.
iii. Putting in the farrowing pen a week before the birth will also help her get used to the new surroundings. This increases chance of a quiet and smooth farrowing. It makes individual feeding of the sow possible.
iv. 2 days before farrowing, the sow and the pen should be washed and disinfected again.
v. high pressure sprayer in shower area for pigs should be provided, in case of large farms

Piglet Management
Care of the Newborn Piglets

i. A few minutes after the birth the umbilical cord may be pulled gently away or cut if necessary (to about 5 cm length).
ii. After birth, the navel of each piglet should be soaked in a cup of iodine solution to prevent inflammation and tetanus.
iii. Each piglet should be rubbed carefully, dry with a cloth.
iv. Make sure the piglets are able to suck from the udder as soon as possible after birth.
v. Weak piglets may need to be assisted.
vi. The piglets can be given additional feed of goat or cow's milk, or a mashed bean porridge to which a little sugar has been added.
vii. If the milk produced by the sow is too little to meet the needs of the piglets or the sow completely neglects the piglets, they should be put on another sow or reared on cow or goat's milk.

Feeding Piglets Who's Mother Produce Less Milk

i. If the sow does not produce enough milk the piglets should be given to another sow which farrowed or gave birth up to three days before.
ii. This sow should have fewer piglets than the number of teats on her udder.
iii. Transfer extra piglets to the sow with less piglets after disguising them with a spray which has a strong smell e.g. engine oil/kerol diluted with water to last at least 1 or 2 days.
iv. All piglets should be sprayed as soon as introduction is done so that the foster mother doesn't recognize the foreigners.
v. If there is no sow to take over feeding the piglets, they will have to be given extra food by hand.
vi. Goat or cow's milk can be given to the motherless or orphaned piglets.

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Teeth Trimming

i. The piglets are born with needle sharp teeth
ii. It is usually necessary to trim the piglets' teeth to prevent them biting the udder.
iii. Only the points of the teeth should be removed.
iv. If any more is removed there is a risk of damaging the mouth.
v. When trimming the teeth the tongue of the piglets should be rolled back to avoid injuring it.

Anaemia or Iron Deficiency

i. Anaemia is caused by iron deficiency.
ii. This iron is needed for the formation of haemoglobin.
iii. This is an important problem, especially for young piglets kept indoors.
iv. They receive additional 1-2 mg/day from milk while they need 7mg during the first week.
v. The piglets become very pale a few weeks after birth and their growth slows down.

Tail Cutting

i. Cut the tip of the tail within 4-7 days.
ii. This prevents tail chewing, which can lead to infections.
iii. A piece of chain can be hung down from the ceiling for the piglets to chew.

Heating for Piglets

i. In cold weather, a small area can be heated with an infrared lamp.
ii. This keeps the young pigs warm.
iii. It helps prevent pneumonia and crushing as the piglets tend to stay under the lamp when not feeding.

Creep Feeding

i. Young piglets from 7 days onwards should have high protein feed available to them.
ii. This has to be fed in a small area where the mother cannot eat the feed.
iii. The feed conversion rate of young piglets is very high and thus creep feeding is particularly economic.
iv. Creep feeding helps the piglets to get used to feeding at an early age.

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Weaning Piglets

i. The piglets should already have started getting used to eating from a trough alongside their mother.
ii. They will need protein-rich feed as they will be growing fast.
iii. There should also be plenty of clean water for the piglets to drink.
iv. It is important for the piglets to learn to drink water early in preparation for weaning.

Types of Weaning

i. Weaning is usually undertaken in one of the three following categories:
ii. Conventional weaning: 3–5 weeks of age.
iii. Early weaning: 10 days of age to 3 weeks.
iv. Specialised weaning: segregated early weaning (SEW) and medicated early weaning (MEW).

Steps Taken at Weaning Sow

Determine whether the sow is to be culled or served again.

i. On the day of weaning don't feed the sow, in the days following farrowing flush the sow until serving (flush for max of 10 days)
ii. Move the sow to another pen (near a boar)
iii. Sometimes vitamin/mineral is given just after weaning

Steps Taking at Weaning Piglets

i. Give piglets identification (tagging, notching, tattooing)
ii. Weigh the piglets to judge their average weight gain and uniformity
iii. Feed piglets with care to prevent digestive problems after weaning. The type of feed should not be changed during and just after weaning
iv. Weaning (3-5 wks) do not feed more than 100-200g/piglet/day during 1st 4 days
v. Weaning (6-7 wks) start by feeding about 50% of the ration piglets receiving during the last few days of suckling, then increase gradually
vi. Check health of the piglets carefully (especially first 4-12 days after weaning)
vii. Prevent stress, pay attention to hygiene and climate of the pen.

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4.0 Conclusion

One of the big advantages of farming pigs is their ability to reproduce. Sows can produce over two litters per year with in excess of 20 piglets weaned. This is a very high reproductive rate compared to cattle and sheep for example. This article covers the basic information you need to adequately manage breeding pigs.

5.0 Practical Assignment

1. What are the production and multiplication procedures of pigs in the piggery farm you visited?

2. Enumerate the recommended practices of pigs management as practiced in the farms you visited

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FATTENING OF PIGS

1.0 Introduction

Pigs are considered intelligent, normally gentle animals that appeal to many people as pets, whilst being a highly productive meat producer and one of the most popular farmed species throughout the world. The three prerequisites for successful pig ownership are: Keeping pigs well fed on a balanced diet, providing shelter from the weather and paying attention to their health and welfare.

Good nutrition is fundamental to a pig's growth rate, reproductive success, health and longevity. Pigs are opportunistic omnivores that have evolved to eat a wide range of feeds. They are classed as monogastric animals, which mean that they have one stomach compartment – this is compared to ruminant animals that have four stomach compartments. Pigs digest feed very similarly to humans, with limited ability to extract nutrients from high fibre feeds such as pasture.

2.0 Objectives

At the end of this unit, you should be able to:

- understand the nature of pigs and their nutrition

3.0 Procedure

i. The feed mixture should be high in protein. Examples of feed high in protein: Oilcake, Fish meal, Purchased concentrates (buy 18% protein formulation). Mix these protein-rich feeds with rice bran, vegetables and kitchen scraps for a rich, balanced feed.
ii. Keep the feed trough clean. Remove dirt and old feed before giving new feed.
iii. Pigs must be provided at all times with an adequate daily supply of drinking water that is palatable, not harmful to their health and at a temperature that does not inhibit drinking, about 8 to15 litres.
iv. Feed the pigs twice a day with fresh, clean feed. Make sure it is not mouldy
v. Corn is their most common food, but they could benefit from having a diet with protein from soybeans or cooked meat.
vi. They grow faster with vitamins and other supplements.

4.0 Conclusion

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Pigs can be competitive for food when group housed and because concentrated feed can be eaten quickly, it is important that they are all

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given equal opportunity to eat their fair share. Compound feeds should be formulated by nutritionist that understands the specific nutritional requirements of pigs to ensure a balanced diet that supports health and productivity.

5.0 Practical Assignment

1. List local ingredients available for feeding pigs in your area:
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____
____
____
____

2. Formulate feeding regime for pigs grown for slaughter and market?
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____
____
____
____

3. Write out the standard feed stuff formulation to make complete pig diets in the farm you visited?
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____
____
____
____

6.0 References

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PRODUCTION OF MICRO-LIVESTOCK (RABBITS, GRASS CUTTERS AND SNAILS)

1.0 Introduction

Micro-livestock' has also been referred to as mini-livestock' 'or 'unconventional livestock'. Any species living permanently or temporarily on the ground can be considered as mini- livestock provided that has potential benefits for humans, nutritional and/or economic, well known in its area of natural dispersion and not usually obtained by controlled breeding.

2.0 Objective

At the end of this unit, you should be able to:

- discuss the basic principle or act of raising grass-cutter and snails.

3.0 Procedure

Grass-cutters

Rearing pen: The grass-cutters are kept in pens inside the rearing shed. The number of pens depends on the production objectives. It is recommended to have one breeding female per pen. The recommended surface area per adult animal in the pen is 0.2 m2. The layout of the pens depends on the type of material used in their construction. Metal pens can be moved around, whereas brick pens will be fixed.

It is not recommended to use materials such as straw, bamboo, wood or matting because they can be eaten away by the grass-cutters. The pens can be open or closed, whichever the producer prefers. There should be room to move around between the pens. Feeding and drinking troughs can be made of cement or clay, and should be heavy enough so that the grass-cutters cannot knock them over. The producer can make the troughs himself. All that is needed is to make a mould out of wood or other scrap material. Calculate one trough per three grass-cutters.

The squeeze cage is used to handle the animals more easily. The dimensions of the cage should be almost the same as the animal to be handled. The producer can make it himself, by building a rectangular cage with fine meshed screening. The producer should base the size of the cage on the average weight of the animals in his production, and will also depend on the animal stock chosen (heavy or light variety). The squeeze

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cage should be built in such a way that the animal cannot turn around inside the cage.

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Selecting a group of animals for breeding should not be done at ran dom. The farmer can get the best animals from the nearest breeding and multiplication centre, or from another breeder. The selection should be made on the basis of weight. The females should all have around the same weight (avoid weight differences of greater than 500 g); in contrast, the male should be 0.5 to 1 kg heavier than the females. Closely related mating pairs, where the male is related to the females, are also not recommended. The females can, however, be related.

The male grass-cutter can mate with several females in a single period. The male, who can be identified by his wrinkled, brown genitals, is placed first in the pen so that he can mark his territory and thereby reduce the risk of fights. The female, identified by the closeness of the anus to the genital area, is put in the pen with the male for 24 hours. During the mating session, make sure the male is heavier than the female.

Handling grass-cutters is not easy: The technique used depends on the size of the animal. Young, light animal is lifted by the tail by holding at the base of the tail. Then grab its back with the other hand (just behind the front legs and without squeezing too hard). The animal is thereby turned on its back, while holding the tail stretched out at the same time.

A medium-sized animal can also be lifted by the tail, but it is recommended to grab it on the back with the other hand so that there is not too much weight on the tail, especially if the animal is agitated. The animal is then turned on its back in order to calm it down. A heavy animal should be handled by means of the squeeze cage.

The animals should get a balanced diet each day. A diet based solely on green forage will lead to slow growth and reduced milk production in feeding mothers, thereby increasing the risk of various infections. At the same time, insufficient forage can lead to digestive problems. It has been calculated that a complete and balanced diet will produce an average weight of 3.5 kg in males and 2.8 kg in females.

Snail

Snail meat has been consumed by humans worldwide since prehistoric times. It is high in protein (12-16%) and iron (45-50 mg/kg), low in fat, and contains almost all the amino acids needed by humans.

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Snail farmers follow this sequence for maximum production, namely;

i. Select the most favourable site for the snail farm
ii. Providing good housing for the snails
iii. Providing good feed and ensuring good snail farm management.

Obviously, it is possible to farm snails in a completely controlled environment, but this would require considerable investment costs. Without artificial climate control, successful commercial snail farming is more or less restricted to areas with the following characteristics:

i. Temperature: a steady year-round temperature of 25-30 °C, and a low fluctuation between daytime and nighttime temperatures.
ii. Day-length: a fairly constant 12/12-hour photoperiod throughout the year.
iii. Air humidity: a year-round relative air humidity of 75-95%.
iv. These conditions correspond to the tropical rainforest climate zones – and they work best when there is no pronounced dry season or strong fluctuations.

4.0 Conclusion

A well-managed integrated production system comprising several diverse enterprises including small animal production adds considerable value to a farm household. Small animals add to food security, improve human health through a more varied diet, generate a steady cash flow that increases household income, have an important role in poverty alleviation, contribute to the empowerment of women and children as well as the sick and the disabled and other marginalized groups, make productive use of labour and valorise local feedstuffs and feedstuffs not normally suitable for direct consumption by people.

5.0 Practical Assignment

Enumerate the principles required for raising mini-livestock in your area?

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What are the basic equipment and conditions necessary for successful rearing of snails and grass-cutters?

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IDENTIFICATION OF BREEDS OF POULTRY, PIGS AND RABBITS

1.0 Introduction

There are several recognized breeds of poultry, pigs and rabbits in the world. Choosing the best breed can be challenging, and this practical session will make aware of the various breeds and varieties, and will provide necessary information so that poultry farmers can select the right type for given situation.

2.0 Objective

At the end of this practical session, you should be able:

- to identify different breeds of poultry, pigs and rabbits.

3.0 Procedure

1. **Poultry**: To identify different breeds of poultry, follow the following procedures and criteria. Parameters for Identification includes: Color, Comb, Feathers, Weight, Egg color, Egg Size, Disease resistance, Taste / Palatability, Adaptability, Pigs.

Breeds of Poultry

Jersey Giant 	The Jersey Giant is the largest of the American breeds, weighing 10 to 13 pounds. There are two varieties of Jersey Giants: Jersey Black Giants and Jersey White Giants. Both varieties exhibit similar characteristics of yellow skin and single comb. However, they differ in plumage color and pigmentation in the beak and shanks. Jersey Black Giants have black beaks and nearly black shanks. Jersey White Giants have yellow streaked beaks and dark willow-colored shanks.

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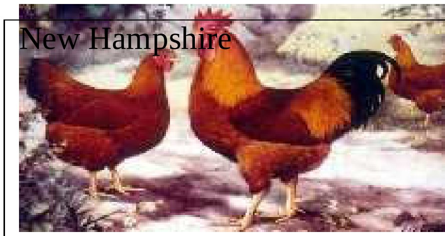
New Hampshire 	Originally developed from the Rhode Island Red, the New Hampshire is used for bothmeat and egg production. With almost identical characteristics as its ancestor, the New Hampshire breed is slightly meatier, weighing 6 1/2 to 8 1/2 pounds. Also, its plumage is lighter red in color and is generally less uniform. New Hampshires have red ear lobes and a single comb.
 Plymouth Rock	Considered the oldest and most popular of the American breeds, the Plymouth Rock exhibits excellent meat propertiesand layingcapabilities. Plymouth Rocks have long bodies of good depth; they are fairly broad-breasted. Body weight varies from $7\frac{1}{2}$ to $9\frac{1}{2}$ pounds. Several varieties of Plymouth Rocks, each distinguished by plumage color, are available. White and barred varieties are most popular; both have single combs.
Rhode Island Red 	First developed for utility purposes and later becoming a fancier's breed, the Rhode Island Red is rangier looking than the Plymouth Rock. With a wide and deep rectangular body, the breed is considered a meat-type, but it is also noted as the best egg layer of the heavier breeds. A Rhode Island Red is slightly smaller than a Plymouth Rock, weighing between 6 1/2 to 8 1/2 pounds.
Wyandotte	The Wyandotte is a general-purpose breed, well adapted for meat production and egg production. The Wyandotte's body shape and feathering give it a short-backed and low-set appearance.

	A mature bird weighs 6 1⁄2 to 8 1⁄2 pounds. Eight varieties of Wyandottes are available; each differs mainly in color. Only the White Wyandotte is raised commercially for producing broiler crosses. A Wyandotte has yellow skin and shanks, a rose comb, and red ear lobes. It lays brown-shelled eggs.
Brahma (Light Brahma variety). 	The Brahma breed originated in India and was brought to the American continent more than a century ago. Three varieties of Brahmas were developed. A mature bird weighs 9 1⁄2 to 12 lbs. The Brahma is characterized by a pea-comb. The Light Brahma variety is most popular because of its plumage color; its body is white, the hackle feathers are black with white edging, and the tail feathers are black.
Cochin 	The Cochin breed was imported into the United States about 1847. The Cochin was bred for loose feathering with little attention given to egg production. Its feathering is extremely long and abundant. A Cochin appears massive in size because of loose feathering and feathered shanks. A mature Cochin weighs 8 1⁄2 to 11 pounds. Cochins have a low-carried breast and a single comb. Four varieties within the breed are Black, Buff (pictured), Partridge, and White.

Langshan 	This single-combed breed originated in China, but was imported to the U. S. from England. The Langshan is smaller in body size than other Asiatic breeds and has longer legs with moderately feathered shanks. Body feathering is moderately tight. Tail feathers are long and are carried high. A mature Langshan bird weighs 8 to 10 pounds. The three breeds lay brown-shelled eggs.
Cornish 	Several varieties of the Cornish breed have been produced with the Dark and White varieties being most popular. Cornish crosses are quite popular for broiler production. The breed is noted for its broad, deep breast and its compact, heavily-meated body. A Cornish is heavy for its body size, weighing from 8 to 10 1⁄2 pounds. All varieties of Cornish have small pea-combs. As a purebred, a Cornish is a poor egg producer. Cornishes have yellow-colored skin, beak, and shanks. The White Cornish has pure white plumage; the Dark Cornish's plumage color varies from greenish-black to a reddish-mahogany.
Orpington 	The Orpington breed's popularity has decreased because of the broiler industry's development of crossbreeds with yellow skin. The Orpington is slightly larger than the Plymouth Rock. The Orpington breed is low-set and heavy-boned. A mature bird weighs from 8 to 10 pounds. Loose feathering and white skin has hindered the Orpington's prominence. Differing only in color, the four varieties of Orpingtons include Buff, Black, White, and Blue. Buff is the most popular

	variety.
Ancona 	The Ancona resembles the Leghorn in body conformation. A mature Ancona weighs from 4 1⁄2 to 6 pounds. appearance. The skin and shanks of the Ancona are yellow. The beak is yellow with shades of black.
Leghorn 	Hybrid Leghorns make up most of the egg production market. The Leghorn’s reputation for being the number one egg layer makes it one of the most popular of all breeds in America. Known for its stylish carriage, the Leghorn varies in weight from 4 1⁄2 to 6 pounds. The varieties of Leghorns differ in plumage color – White, Buff, and Brown. Leghorns have yellow or horn- colored beaks and yellow skin and shanks. Leghorns are either single comb or rose comb.
Minorca 	The Minorca is the largest of the Mediterranean breeds. A mature Minorca weighs from 7 to 9 pounds. In conformation, the Minorca is a long-bodied bird with its back sloped downward from the shoulders to the base of the tail. In comparison, the Minorca’s tail is carried lower than the Leghorn’s tail. Mainly plumage color and type of comb distinguish five varieties of Minorcas. The Single-Comb White is raised in the largest numbers. Skin color is white on all varieties of Minorcas.

Animal Husbandry Techniques Non-Ruminant

There are 3 basic types of chickens – broilers, cockerels and layers

Broilers 	A **broiler** (*Gallus gallusdomesticus*) is any chicken that is bred and raised specifically for meat production. Many typical broilers have white feathers and yellowish skin. Most commercial broilers reach slaughter-weight between four and seven weeks of age, although slower growing breeds reach slaughter-weight at approximately 14 weeks of age. Because the meat broilers are this young at slaughter (roughly 500g), their behaviour and physiology are that of an immature bird.
Layers (Rhode Island Red) 	The bird's feathers are rust-colored, however darker shades are known, including maroon bordering on black. Rhode Island Reds have red-orange eyes, reddish-brown beaks, and yellow feet and legs, often with a bit of reddish hue on the toes and sides of the shanks. Chicks are a light red to tan color. The roosters usually weigh in at about 8.7 pounds (3.9 kg), the hens average slightly less at 6.5 pounds (2.9 kg
Cockerel 	A rooster, also known as a **cockerel** or cock, is a male gallinaceous bird, usually a male chicken (Gallus gallus). Mature male chickens less than one year old are called **cockerels**.

2. **Pigs:** Breeds of swine can be grouped into two different catagories, “Maternal” or “Terminal” breeds. The maternal breeds are known for their large litters and are selected for replacement females. Terminal sire breeds are recognized for their growth and carcass quality and are usually used for terminal crosses.

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Breeds of Pigs

Berkshire 	The third-most recorded breed of swine in the United States, Berkshires are known for fast and efficient growth, reproductive efficiency, cleanness and meat flavor and value. The first U.S. meeting of Berkshire breeders and importers was held in 1875, with the American Berkshire Association formed shortly after – making it the oldest swine registry in the world.
Chester White 	Chester Whites originated in Chester County, Pa., from which their name was formed. These white hogs with droopy, medium-sized ears are known for their mothering ability, durability and soundness. Packers also tout their muscle quality.
Duroc 	The second-most recorded breed of swine in the United States, the red pigs with the drooping ears are valued for their product quality, carcass yield, fast growth and lean-gain efficiency. They also add value through their prolificacy and longevity in the female line. Much of the U.S. breed improvement has occurred in Ohio, Kentucky, Illinois, Indiana, Iowa and Nebraska.
Hampshire 	The hogs with “the belt,” Hampshires are the fourth-most recorded breed in the United States. Most popular in the Corn Belt, Hampshires are known for producing lean muscle, high carcass quality, minimal back fat and large loin eyes. Females also are known for their mothering ability, with longevity in the sow herd.
	White hogs with droopy ears,

Animal Husbandry Techniques Non-Ruminant

Landrace	Landrace are the fifth-most recorded breed of swine in the United States. Known as "America's Sowherd,"

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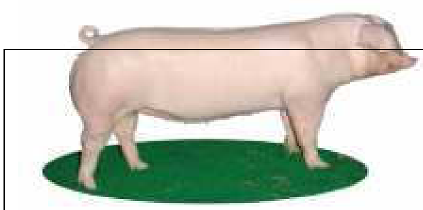	Landrace females are heavy milkers and often farrow large pigs. Crossing well with other breeds, Landrace often possess length of body, a high percentage of carcass weight in the ham and loin and the ideal amount of finish.
Poland China 	In the early 1800s, Poland China hogs originated in Ohio. Today, Poland China hogs are known for their large frame, length of body, leanness and muscle. They also are excellent feeders, gaining well under good care and management. They also are quiet in their disposition.
Spotted 	The Spotted swine breed is characterized by large, black-and-white spots. Many breeders in central Indiana specialized in breeding Spotted hogs through the years. Today, Spots are known for their feed efficiency, rate of gain and carcass quality. In addition, commercial producers appreciate Spotted females for their productivity, docility and durability.
Yorkshire 	The most-recorded breed of swine in North America, Yorkshires are white with erect ears. They are found in almost every state, with the highest populations being in Illinois, Indiana, Iowa, Nebraska and Ohio. Yorkshires are known for their muscle, with a high proportion of lean meat and low backfat. Soundness and durability are additional strengths.

3. Rabbits: Rabbits are easily identified due to their long ears, large eyes, and short, fluffy tails. These pests typically look reddish brown or gray in color and a little more than a foot in length. As the weather gets

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colder, their fur tends to darken and get longer. Rabbits are prolific breeders and can produce as many as seven litters a year. Each baby

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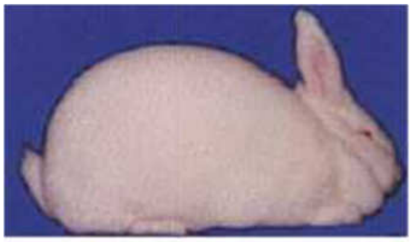
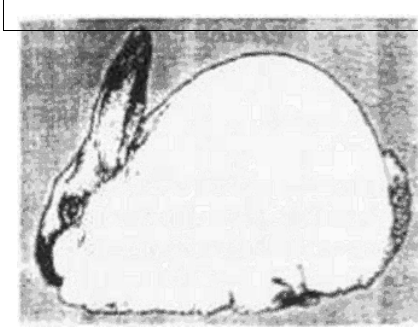
rabbit is born blind and without fur, but becomes independent within four weeks and is able to breed at two to three months old.

Breeds of Rabbits

1. Utility Breeds

New Zealand 	The crossing originally of the Belgium Hare and the Golden Fawn produced the New Zealand Red and later the New Zealand White and New Zealand Black. It's the preferred breed of the commercial producers and has acquired an excellent reputation as a show rabbit. Its body should be of medium length, not long like the Flemish or short and cobby as in the Dutch. Its hindquarters should be well rounded and meaty with a deep well filled loin and shoulders in proportion. Weights - Senior Bucks 4.5 kg (10 lbs), Senior Does 4.9 kg (11 lbs).
Californian 	The Californian has been around since about 1930. Its lustrous coat and black point markings make it a most attractive show animal with its broad shoulders, deep well filled loin, and well rounded hindquarters. Weights - Sr. Buck 4 kg (9 lbs), Sr. Doe 4.3 kg (9.5 lbs).



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Champagne D'argente	Its fur colour is Silver, and Silver in French is Argente, hence the name Champagne D'Argente or the Silver's of Champagne. The breed is judged primarily for meat purposes. It is fined boned with good meat qualities. On the show table, in prime coat, it is very hard to beat. The young of this breed are born jet black and begin silvering out at around 6 weeks of age. Weights - Sr. Buck 4.5 kg (10 lbs), Sr. Doe 4.8 kg(10.5 kg).

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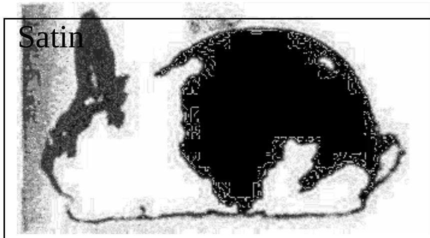
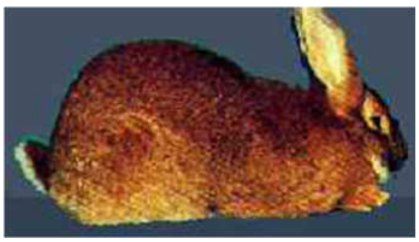
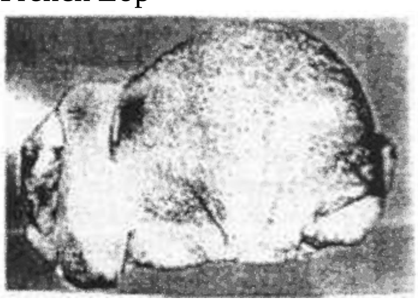
Satin 	The Satin Fur is soft and silky and has a very noticeable brilliance or sheen, meaning, it does not shine like some normal furred rabbits, it glows. The Satin is an ideal exhibition and commercial rabbit. Its excellent meat producing qualities and the lustrous sheen of its fur when on the show table, will rival any breed of rabbit for Best in Show. Weights - Sr. Buck 4.3 kg (9.5 lbs), Sr. Doe 4.5 kg (10 lbs).
Flemish Giant 	The Flemish Giant is the largest of all breeds. Although it is considered a commercial breed, its slow growth and large bone make it very uneconomical to raise in a commercial situation for food. However, once it is placed on the show table it's a different matter. People just stare in silence at this gentle "Giant". Weights - Sr. Buck 6.3 kg (14 lbs), Sr. Doe 7 kg (15 lbs

2. Fancy Breeds

French Lop 	Flemish Giant is rather docile and good mannered, making it a real favourite among the public at fairs and exhibitions. With its massive size, bold head, and its ears framing the head, giving with the crown, the appearance of an inverted horseshoe, it's a hard breed to resist. Weight - Sr. Buck 5 kg (11 lbs), Sr. Doe 5.5 kg (12 lbs)
Dutch 	The person who raises Dutch must be dedicated to the breed. The cheeks, neck, blaze, undercut, feet and more must all be marked their certain ways and breeders must constantly pay attention to these markings while at the same time,

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	placing them on the proper, compact and cobby, Dutch body. They are high spirited and inquisitive and on the show table a perfect Dutch is

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	unbeatable. Weight - Sr. Buck 2 kg (4.5 lbs) , Sr. Doe 2 kg (4.5 lbs)
Rex 	The Rex breed is another breed that, like the Satin. The fur should be short and plush-like and approximately 5/8" long, extremely dense, straight and upright, and should be the same length all over its body. As a show animal they are extremely beautiful and add a lot of class to the rabbitry that raises them. Weight - Sr. Buck 3.6 kg (8 lbs), Sr. Doe 4 kg (9 lbs)
Havana 	The Havana first appeared in Holland in 1898. 4-H Members have benefited greatly from this breed. A good beginner's rabbit, the Havana normally has a mild, easy-going disposition, making it easy to handle and care for. On the show table, the lustre of their fur and their gentle manner make them one of the top contenders for the Best in Shows. Weight - Sr. Buck & Sr. Doe 2.5 kg (5.5 lbs)
Holland Lops 	This is the smallest of the lop breeds. They should resemble the French Lop in giving the appearance of a massive little lop. They are not a miniature duplicate of a French Lop though, because they do have their own individuality. The motto of its speciality club is "The Hallmark Breed" and that says it all. Weights - Sr. Buck & Sr. Doe 1.4 kg (3.0 lbs)
American Fuzzy Lop 	The American Fuzzy Lop is one of our more recent breeds, and more or less just a woolly version of the Holland Lop. With its short cobby body, covered by 2" of wool, its ears framing an endearing face, it becomes a very hard breed to resist. The body should be well rounded and well filled, with no rise to the back from the shoulders to the hindquarters. The

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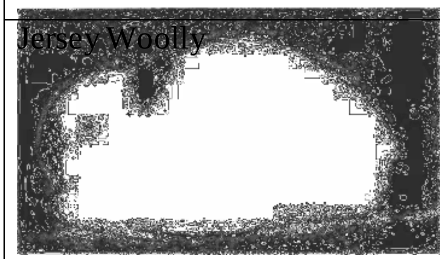
	Fuzzy Lop comes in numerous recognized colours, in solid and broken. Weight - Sr. Buck & Sr. Doe 1.8 kg (3.5 lbs)
Jersey Woolly 	The Jersey Woolly is another of the recent breeds. The Jersey Woolly has a gentle disposition. They arenot given to aggressiveness nor are they over excitable. The wool on a Jersey is somewhat different than other angoras; 2-3" in length and when prime, the wool is fullof life. The body should be cobby, shoulders nearly equal in width with the hindquarters and well rounded.
Mini Rex 	This is another of the newer breeds. In the simplest of terms, as its name suggests, it is a miniature of the standard Rex. It should show balance and uniformity throughout. To the touch its body should be covered with firm flesh and no protruding bones should be felt. On the show table the Mini Rex has been holding its own and is showing up in the winners section more and more. They are available in solid and broken colours. Weight - Sr. buck 1.8 kg (4.0 lbs) & Sr. Doe 2 kg (4.25 lbs)
Netherland Dwarf 	This is the smallest of all breeds of rabbits. It is a truly miniature breed with a short, compact, well-rounded cobby body with wide shoulders, well- developed loin and hindquarters. When everything is put together right you could compare its body to a short piece of 2x3 with straight lines from the shoulders to the hindquarters on the top, sides, and bottom. It is very alert and inquisitive and with its bold and bright eyes, it doesn't miss a thing. They are available in 30 plus colours that are classed in 5 groups; Solids, Shaded, Agouti, Tans, and A.O.V.'s

<table>
<tr><td></td><td>(any other variety). Weights -Sr. Buck & Sr. Doe 1.1 kg (2 lbs</td></tr>
<tr><td>Angora
</td><td>The Angora rabbit, which originated in Ankara, Turkey, has been around for hundreds of years.
Angoras are a bit smaller than the medium weight breeds. Angora rabbit wool has some unique characteristics unlike regular Angora wool that makes it ideal for spinning. Angoras require more upkeep than normal furred rabbits but if the upkeep is regular, then it is not too time consuming.</td></tr>
</table>

4.0 Conclusion

Animal identification is a process done to identify and track specific animals. It is done for a variety of reasons including verification of ownership, biosecurity control, and tracking for research or agricultural purposes.

5.0 Practical Assignment

i. Visit a rabbit farm or show and learn about a variety of kinds of breeds.

ii. Name breeds of Poultry you can find in your area

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iii. Visit a poultry farm and learn about a variety of kinds of breeds.

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iv. List the names of the purebred breeds of hogs that are found in your locality.

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v. Write the name of the breed of swine in the space that is provided for each description.

6.0 References

https://www.pork.org/facts/pig-farming/major-swine-breeds/

https://extension.umd.edu/sites/extension.umd.edu/files/_images/programs/poultry/Breed%20choices

https://mpra.ub.uni-muenchen.de/48476/1/MPRA_paper_48476.pdf

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HANDLING AND RESTRAINING POULTRY AND HOW TO CARRY RABBITS

1.0 Introduction

Handling poultry shows chickens being captured and moved to another area for weighing. Birds should be captured and handled only when necessary. The non-holding arm can be used to assist with restraining the bird and prevent the wings from flapping.

2.0 Objective

At the end of this unit, you will be able to:

- explain handling and restraining poultry for physical examination, vaccination, blood collection or weight taking.

3.0 Procedure

Chicken are fragile but can exercise fear when they are not approached gently.

a) Remove the chicken from the cage or catch it in the pen. When removing the chicken from a cage, come from behind and wrap your hands around its body. When catching a chicken in a pen, move it calmly into a corner or lure it with a treat and then quickly grab it by wrapping your arms around the body. Don't chase it as this can cause a lot of stress.

b) Hold the wings against the body to prevent the chicken from flapping its wings but don't squeeze too tightly - allow the chicken to breathe.

c) Lift the chicken out of the cage or up from the ground and tuck it under your arm.

d) Put one of your hands between the legs and squeeze them together gently, supporting it at the same time with the palm of your hand. Your arm can be used to gently press the wings against the body and stop it from flapping. This method leaves one hand free for examination, such as checking the feet, taking temperature, measuring respiration rate etc.

e) To turn the chicken around, wrap your hands around the body again and while turning it, tuck it under your other arm. Use your hand again for support of the body and to hold the legs together. This position allows you to take the temperature and examine the vent.

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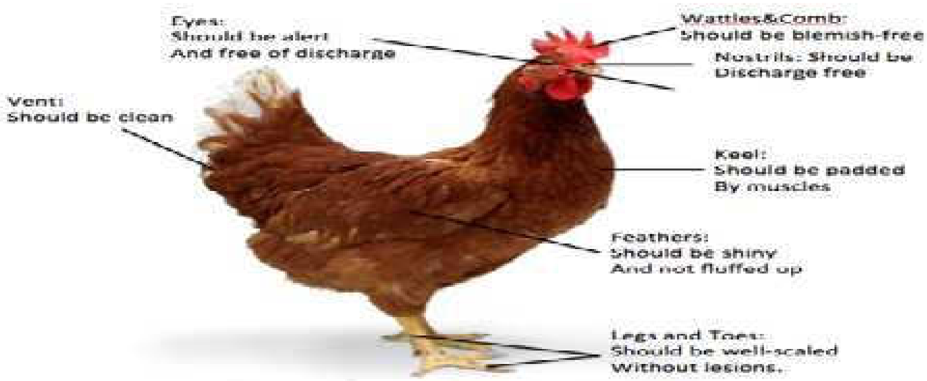
f) To put the chicken back down, hold the wings against the body and with your hands wrapped around it gently lift it down. Make sure the feet touch the ground, before you let go.

Therefore to have a good technique of handling and restraining, you have to examine the chicken first by identifying all physical body parts.



S/N	Parts of Chicken	Expected Observation
1	**Check the eyes**	They should be bright, clear and alert and show no signs of discharge. The pupils on each side should be the same size & shape.
2	**Check the nostrils**	The nostrils should be free of discharge. You should not be able to hear sounds of respiration. If you can hear the chicken breathe without strenuous exercise, this always means that it is sick.
3	**Check the wattles & the comb**	They should be blemish free. Also check for signs of parasites around the base of the wattles.
4	**Check the beak and the trachea**	This is a little bit more difficult, and you might need two people. One person holds the beak open while the other checks the inside. Chickens can have many parasites that hide around their trachea and esophagus such as gapeworm and throat worm. There should be no white lesions in the mouth and no obstructions anywhere.
5	**Check the feathers**	There should be no bald spots, the plumage should be well maintained and sleek due to regular preening. Check for parasites moving in between the feathers. Dull feathers may indicate a bad diet. Consider changing the diet.

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6	**Check the keel bone**	The keel is the breastbone and birds should be well muscled around their keel. If the keel is

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		pointy and sticks out, this may be a sign of undernourishment.
7	**Check the vent**	There should be no sign of faeces around the feathers of the vent. The vent should be clean.
8	**Check the legs & the toes**	They should be well-scaled and smooth. If there are lesions on the legs or bumps, this could indicate bumble foot or pox and needs to be treated.

How to carry Rabbits

i. The first and most important rule of handling your rabbit correctly is to never pick him/her up by the ears, the scruff, legs or tail. It is painful and can cause serious damage. You wouldn't want to be lifted by your ears, would you?
ii. The second rule to remember is that rabbits are fragile. They are quick indeed, but have weak skeletal systems.
iii. Thirdly, rabbits do not always enjoy being picked up. Some of them will tolerate it, but many will struggle when you try to lift them. Therefore, picking them up can be a delicate business. Sometimes it is necessary to pick up your rabbit, however, such as for nail clipping or vet checks. So here are some useful tips.
iv. Approach your rabbit slowly and get down to his/her level. It will help put your bun at ease. Petting the rabbit will also have a calming effect.
v. When you feel confident your rabbit is ready to be picked up, scoop him/her up by placing a hand under the torso and pull your bunny close to your body.
vi. Support the rabbit's hindquarters. Your bunny needs to feel secure in your arms.
vii. If your rabbit struggles when being picked up, hold him/her firmly, but be ready to put him/her down. Your rabbit may think the better alternative to being held is to leap from your arms, but this can cause serious injury.
viii. When putting your rabbit down, slowly squat down while holding your bunny close, and let him/her down gently.
ix. Your rabbit may respond with a thump or may kick up his/her hind legs at you while scampering away. It's nothing personal, he/she just disapproves of being picked up.

4.0 Conclusion

Restraining a chicken humanly is an act of holding the chicken in a way that is the least stressful from the chicken.

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5.0 Practical Assignment

Write out Practical Observation in the farms you visited

6.0 References

Back-Yard Rabbit Keeping in the Tropics (Agrodok Series #20), by J.B. Schiere & C.J. Corstiaensen, AGROMISA and CTA, the Netherlands, 2008, 74 pp.

Raising Healthy Rabbits under Primitive Conditions, by Dr. W.S. Bivin & Dr. W.W. King, Christian Veterinary Missions, Division of World Concern, 108 pp.

The Homesteader's Guide to Raising Small Livestock, by J.D. Belanger, Rodale Press Inc. Book Division, 1974, pp. 10-62.

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PIG HANDLING TIPS- USE OF VOICE, TOUCH AND FOOD/HANDLING AND RESTRAINING PIGS FOR INSPECTION AND ORAL TREATMENTS

1.0 Introduction

All stockmen that handle and restrain pigs should be shown the correct techniques relevant for the size/age of the pig. Correct handling and restraining a pig will reduce the risk of injury and stress to both the pig and stockman.

2.0 Objectives

At the end of this unit, you should be able to:

- safely handle young pigs.
- handle older pigs.
- restrain the pig.

3.0 Procedure

Before restraining a pig for treatment ensure:

i. All the required equipment is ready to use
ii. The equipment is easily accessible once the pig is restrained.

Young Pigs (up to 10 kg)
Outline of Work – Moving Piglets (By Lifting Them)

i. Lift the pig by a back leg, taking care not to 'snatch' or 'swing' the piglet as you lift it
ii. Support the chest with your other hand, when moving with the piglet over any distance to avoid undue pressure on the leg joints
iii. Lower the piglet back to the ground, ensuring both front legs have contact with the surface
iv. Then gently lower the back legs to the floor and release your grip Only lift one piglet at a time in each hand.
v. Never pick a piglet up by their ear - this can cause ear haematomas - or by a front leg or tail.

Outline of Work-Restraining/Handling for Inspection

i. Lift the piglet by the back leg

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ii. Place your other hand under the chest of the piglet to provide support (Figure 1)

iii. Lift the piglet and hold so that it is horizontal (Figure 2)

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iv. Hold the piglet firmly to minimise the piglet's ability to move

v. Alternatively after lifting, place the piglet over your forearm with the chest in the palm of your hand and the legs hanging either side of your arm.


Figure 1


Figure 2

Older Pigs (over 10 kg)
Outline of Work

i. When moving pigs, ensure the way forward is clear, secure and obvious to the pigs

ii. When moving pigs, ensure that the pigs are moved from dark to lighter areas with no shadows

iii. When restraining pigs, ensure the area will not pose a risk of injury to pig or stockman ie nonslip floor, flat sides, clear of distractions.

iv. When restraining pigs ensure the required equipment for task is ready and immediately available to you in the handling area.

Outline of Work-Moving Growing Pigs, Sows and Boars

i. Move the pig in a calm, unhurried manner

ii. Allow the pig to walk to its destination at its own pace at all times

iii. The pig can be encouraged forward by use of a pig board and voice

iv. Do not kick the pigs or use sticks/prods to directly hit the pigs

v. Pigs should only be encourage forward, when the way ahead of them is clear.

vi. Certain pieces of equipment, e.g. electric goads, are banned by Assurance schemes.

Outline of Work–Restraint

i. Ensure the area is large enough to perform the task safely, but small enough to restrict movement, e.g. at the end of a passage way or specific handling crate

ii. Ensure the pig cannot move forward

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iii. Apply gentle pressure with the pig board/your leg to the hind-quarters and flank of the pig to keep them still

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iv. Treat the pig as quickly as possible, and return to its pen promptly.

Restraining Using a Snare

i. If the task will take a long time, e.g. to lance an abscess, the use of a restraining snare or snatch may be necessary to provide adequate restraint.
ii. They should only be used when absolutely necessary, and the person snaring should be trained and competent at this activity.
iii. The snare/snatch should be designed specifically for the purpose of restraining pigs and kept clean and hygienic.

Outline of Work

i. Set up the area of restraint as above Control the pig's movement with a pig board
ii. The size of the snare loop should be relevant to the size of the pig being restraint
iii. Place the snare loop in the mouth and over the top jaw and snout of the pig, with the snare handle held vertically in the other hand
iv. Move the loop as far back in the mouth as possible before tightening it Hold the snare securely
v. A second person can then perform the required task
vi. Release the pig as soon as possible by smoothly loosening and releasing the snare and then return the pig to its pen
vii. Pigs should not be restrained by snatching for prolonged periods. Do not attempt to move the pig by pulling the pig by the snare Pigs should not be tied up by the snare.

Recommended Practices

i. Aim for 0% of pigs being injured from handling, restraining, or moving pigs
ii. Respect the pigs' flight zone: never approach an unsuspecting animal through its blind spot. Refer to Appendix K – Pig Vision and Flight Zone
iii. Move pigs in manageable groups that are small enough for the handler to be able to affect the lead pigs and that are appropriate for the facilities and the size of pigs. Always move pigs at a pace comfortable to the animal
iv. Have non-essential people move out of the line of pigs' sight when moving pigs
v. Walk through finishing pens periodically in a calm manner so that pigs become accustomed to people.

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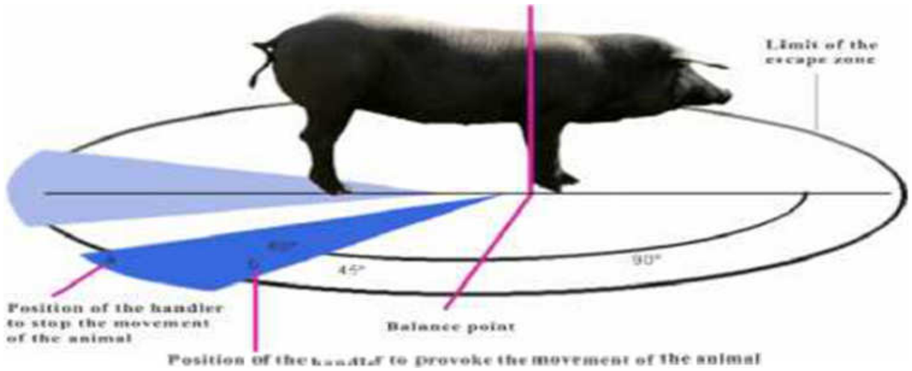

Balance point of the pig. If the intention is to move the pig in a forward direction, the animal handler should be situated at point b.

4.0 Conclusion

Pigs will naturally head for a gap (or opening) when you approach them or try to catch them. You can use this habit to make the pig go where you want it to If two pig boards (wooden boards 0.8m square) are placed either side of the pig's head it will move forward in the direction the

handlers want it to go. As the animal gets older it can be trained to move under the control of one handler who uses a board and a wooden bat

about 1 m long. The handler always keeps the pig board between himself and the pig. If several people try to drive a pig it can turn and charge between them.

5.0 Practical Assignment

1. Outline of work for moving growing pigs, sows and boars in the farms you visited

2. Outline of work for restraining/handling pigs for general inspection in the piggery.

6.0 References

Kittawornrat A, Zimmerman J. J. Toward a better understanding of pig behavior and pig welfare. Animal Health Research Reviews 2010 www.fao.org/fileadmin/user_upload/animalwelfare/1_download.pdf

http://www.thepigsite.com/articles/2392/handling-and-restraining-pigs/

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MANAGING STRESS DURING HANDLING OF PIGS

1.0 Introduction

Pigs can easily be handled in the farm with a minimum of stress, if their behavior is understood Improper handling of pigs, however, causes considerable stress in the animals and can have a detrimental effect on many of their physiological functions. For example, stress can reduce weight gains, lower immune responses, alter physiological factors such as blood chemistry and interfere with reproductive processes.

2.0 Objectives

After studying this unit, you should be able to:

- minimize stress during pigs handling

3.0 Procedure

i. Use Lighting to your Advantage: Pigs are very sensitive to sharp contrasts of light and dark; Lighting should be bright, but evenly diffused; Pigs reared in enclosed buildings may balk at full daylight; Use lamps to illuminate areas into which you want the pigs to move; Lamps must not shine directly into eyes of approaching animals

ii. Be Aware of Changes in flooding or Wall: Changes in flooding types or texture or wall color can cause pigs to refuse to move. When transferring from metal/plastic floors to concrete, allow 30 minutes to become accustomed to new flooring; Ensure non-slip floor surface

iii. Reduce Excitability in Pigs: Reduce excitability in pigs by: Providing toys; Providing extra contact with people; Prefer daily contact; Playing a radio in the building; Effectiveness dependent on type of housing, genetics, husbandry, procedures, and other factors

iv. Use Appropriate Sorting and Handling Equipment: Lightweight sorting boards or panels, Nylon flags; Witch's/Matador's Cape and Shaker paddles

Procedure to Reduce Fighting in Mixed Pigs

i. Minimize other stressors
ii. Avoid overcrowding
iii. Ensure adequate ventilation

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iv. Do not mix when disease is obvious
v. Mix all pigs at same time in a strange new pen

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vi. Avoid mixing pigs when temperature > 90°F
vii. Provide areas for pigs to escape during fighting

4.0 Conclusion

Observations of pigs indicate that providing them with toys and positive human contact reduces their excitability. A calm animal can be trained to cooperate during restraint and handling. This makes handling less stressful for both the pigs and their handlers.

5.0 Practical Assignment

- What are the procedures for minimize stress during pigs handling

6.0 References

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MANAGEMENT OF ECTO-PARASITES IN POULTRY AND PIGS

1.0 Introduction

External parasites, including lice and mites, attack poultry by either sucking blood or feeding on the skin or feathers. Flocks infested with lice or mites can show similar symptoms: decreased egg production, reduced appetite and weight loss. Because early detection can prevent a flock outbreak, regularly check your flock for external parasites. Pigs can suffer from infection with dark coloured lice which can be seen on the animal's body. The lice feed on the skin and irritate the pig which will scratch and can cause wounds which become infected. Treatment involves spraying with coumaphos and cleaning the areas where the animals are kept. Indigenous chickens can be found in almost all households in rural areas. They are considered as an important source of income, besides providing a cheap source of protein in the form of meat and eggs to rural people (1, 2). Several species of ecto-parasites (e.g., flies, lice, mites, and ticks) can infest poultry.

Ectoparasites can be found practically in all birds, where they feed on their blood, feathers, skin, and scales. They may cause a range of symptoms, including discomfort, irritation, loss of plumage, stunted growth, reduced egg production and hatchability, anemia, increased feed costs, elevated mortality, and susceptibility to other infections. In addition, ectopara-sites transmit several infectious diseases and serve as transport or intermediate hosts for different helminthic parasites. While lice generally feed on feathers, M. stramineus is known to feed on blood and to carry the equine encephalomyelitis virus. In contrast, Chlamydia psittaci, an intracellular bacterium causing psittacosis in birds, has been isolated from Menopongalli-nae. Furthermore, a number of other poultry diseases, such as pasteurellosis, fowl pox, Newcastle disease, and in some cases, Chlamydia, can be spread by some species of ectopara-sites, especially ticks and mites. Dermanyssusgallinae has been widely reported to transmit human and animal pathogens (e.g., viruses and bacteria) and parasites (e.g., Hepatozoon) to farmers and veterinarians. Therefore, poor management of these parasites and limited accessibility to relevant resources prevent efficient poultry production through output reduction and the increasing risk of disease outbreaks.

2.0 Objective

At the end of this section, you should be able to:

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- identify ecto-parasites and treatment available for each of them.

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3.0 Procedure

Generally an aerosol (ACI) should be gently sprayed over the feathers and the ectoparasites should be collected after 5 min by shaking the indigenous chickens. The vent, cloacae, breast, comb, wattles, and ear areas of the animals should be inspected for fleas using a magnifying glass and/or flashlights. To collect lice, the head, neck, wings, body surface, and cloacae should thoroughly be examined using a magnifying glass.

To detect infestation with poultry red mite (PRM), the animals should be examined during the night hours. Finally, the ectoparasites should be preserved in 70% alcohol, cleared in lactophenol, and mounted in Canada balsam on a slide. They should be identified according to their morphological characteristics using key identification as described by Soulsby.

The table below shows brief information of ecto-parasites and treatment of infections.

Ectoparasites	Descriptions	Treatment
Poultry and Pig lice	Poultry lice are tiny, wingless parasites with broad heads. Lice spend their entire life cycle on the chicken, but do not suck blood. Instead, they eat feathers and dry skin usually found below the vent.	Lice can be controlled with: nicotine sulphate, malathion 4-7% dusts, or stirfos.
Mites	Mites are spider-like creatures that are so small they are hard to detect. They typically survive on a chicken's blood, tissue cells, or feathers. Mites do not need to live on chickens to survive; some types live in the chicken coop and only crawl on the bird to feed. Common poultry mites include: Northern Fowl Mites, Red Mites, and Scaly Leg Mites.	They can be controlled with: nicotine sulphate, malathion 4-7% dusts, or stirfos.
The Northern Fowl Mite	The Northern Fowl Mite is the most common external poultry parasite and can be very hard	Treatment includes: nicotine sulphate,

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	to eliminate. It lives on the bird at all times and sucks blood	malathion, stirfos and carbaryl.

	from the chicken to survive. These mites can live up to three weeks and are commonly spread through bird-to-bird contact.	
Red Mites	Red Mites live on birds during night and feed on their blood. Found throughout the chicken coop in tiny crevices or in nesting boxes, these mites can live up to one year without feeding on hens. These parasites can carry fowl cholera, fowl pox or New Castle disease.	Treatment includes: painting walls, roosts and other cracks with carbolineum, other anthracene oil or malathion.
Scaly Leg Mites	As the name indicates, Scaly Leg Mites live under the scales of chickens' legs. These mites will leave white encrustations between the scales, but, if left undetected, thick scales will build up on the legs. This parasite spreads slowly throughout the flock.	Treatment includes dipping the infected birds' legs in hot water and then in petroleum based oil.
Internal Parasites		
Internal parasites	Internal parasites can be common in backyard flocks. Common internal parasites include roundworms and tapeworms.	
Roundworm	Roundworm is picked up from the ground as chickens scratch around eating bugs - beetles, snails, slugs, grasshoppers, ants, and earthworms - that are contaminated. The adult worm lives in the intestine where it lays eggs which are excreted in the birds' droppings and transmitted throughout the flock as the chickens scratch for food. Birds suffering from roundworm infections are usually thin with poor feather quality and often suffer from diarrhea.	

4.0 Conclusion

Ectoparasites can be found practically in all birds, where they feed on their blood, feathers, skin, and scales. They may cause a range of symptoms, including discomfort, irritation, loss of plumage, stunted

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growth, reduced egg production and hatchability, anemia, increased feed costs, elevated mortality, and susceptibility to other infections.

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Therefore, poor management of these parasites and limited accessibility to relevant resources prevent efficient poultry production through output reduction and the increasing risk of disease outbreaks. Outbreaks of ectoparasites can be controlled using good management, control, and the treatment of poultry ectoparasites infestations.

5.0 Practical Assignment

Which of the internal and external ecto-parasites did you observed in the farms you visited

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Enumerate the treatment of the infections by the farmers

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6.0 References

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CONTROL OF VICE-HABITS: DE-BEAKING, DE-SPURING AND DE-CLAWING

1.0 Introduction

De-beaking (also called beak trimming) is the act of cutting the lower and upper points of the beaks. The trimmed upper beak is usually shorter than the lower beak. Debeaking birds will help prevent feed wastage, cannibalism, feather pecking, and egg eating. Mortalities due to cannibalism can reach up to 15% in un-debeaked laying hens that are housed in aviaries, straw yards and free range systems. However when they are kept in smaller groups in cages, cannibalism is reduced. Birds that are normally debeaked are laying hens, turkeys, quail and ducks. Broilers meant for meat are not debeaked because they reach slaughter weight before injurious pecking start. However broiler breeders are debeaked because they are kept for a long time.

2.0 Objectives

At the end of this section, you should be able to carry out De-beaking, de-spuring and de-clawing of your birds in the farm.

3.0 Procedure

Procedure for De-beaking

i. Cut the beaks of older birds separately; always cut the upper beak first.
ii. The upper beak must be cut to two-thirds and the lower beak to one-third.
iii. Prevent stress as much as possible.

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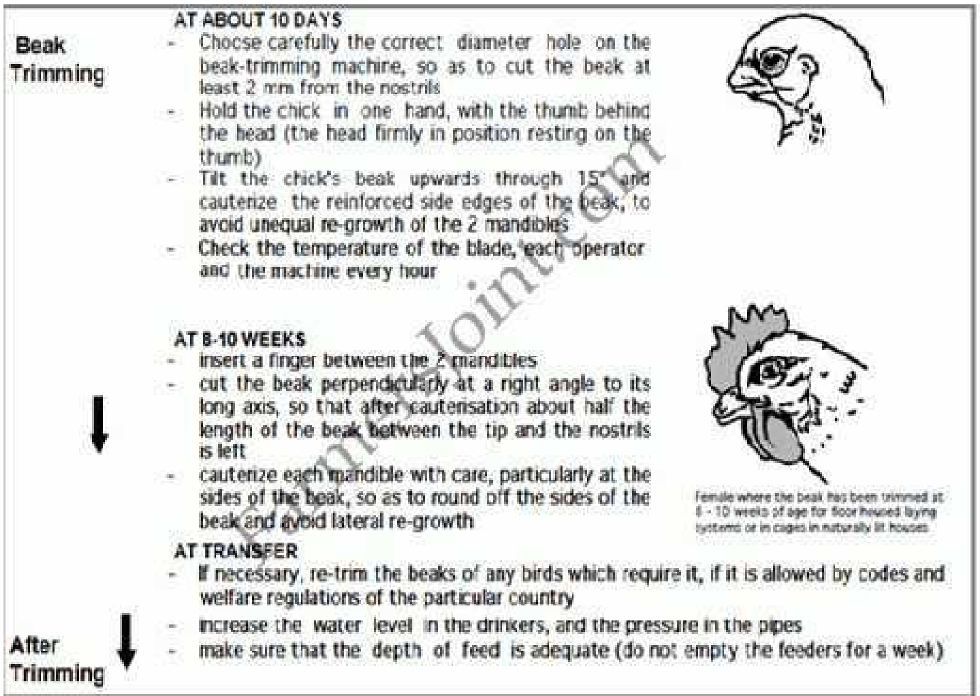

Procedure to get rid of rooster spurs and claws are:

i. File down the tip of the spur with a dremmel or other grinding instrument. Since the spur continuously grows, like the toe nails, this procedure will have to be repeated as the spur tip grows out.

ii. The spur can be removed when the rooster is still a chick. A veterinary uses electrocautery to hinder the growing cells of the spur.

iii. Instead of cutting them, which is dangerous, you can take a pair of pliers, place them at the base of the spur near the leg, and twist until they come off. It removes the outer sheath of the spur leaving a much smaller spur underneath. I do this to my show roosters as it makes them look more "classy" to the judges' eye.

iv. The plier method will make them bleed, but I have never had one scream in pain yet and I've done thousands of roosters like this. Just put some water on the spur and dab some fresh household WHITE SUGAR on it. This will keep the spur clean while helping to clot the blood. The spur shell makes for unique jewelry/pendants too.

v. Wire cutters may also be used by snipping off the tip of the spur. Be careful not to snip off too much as this can cause profuse bleeding and a very unhappy rooster. Cutting too deep means that you've cut too far into the new soft spur that is found underneath the old cap. After snipping a metal file may be used to file the edges smooth.

vi. This method is said to remove a spur permanently. This is done when the cockerel is 10-16 weeks old and the spur is 1/4 inch long. The spur is cut off close to the cockeral's leg. After cutting the spur then rub potassium hydroxide into the wound to prevent profuse bleeding and also preventing the spur from regrowing again.

vii. Another known method is using an electric calf dehorner and burning them off. This has been said that it is a permanent form of removal. With this method you must be extremely careful not to burn too much or too little. It's said it doesn't bother the rooster and he's back to normal in a couple of days.

viii. According to Stromberg's Book of Poultry is the following: Place a hot baked potato on the spur and hold it there for a few minutes. Remove the baked potato, twist the spur and you will find it comes right off. There is no blood or mess. This technique really works well.

ix. A Dremel Motor tool with a cut off wheel attachment may also be used. With this method one person holds the rooster's leg and the other cutting the spur off just before the quik. There is the risk of cutting too close and profuse bleeding may result.

4.0 Conclusion

In some countries, beak trimming is banned and producers are forced to go for alternative measures to prevent cannibalism and other antagonistic behaviors. These alternatives include reducing light intensity so that birds can hardly see each other. This is only possible in houses where light can easily be controlled. The birds are introduced to enrichment devices at an early age. Enrichment devices are anything the birds can play with. You can use grasses, branches etc suspended from the ceiling. You can also use perches. Dividing large number of birds into smaller groups can also reduce aggressive behaviors.

5.0 Practical Assignment

1. How do the farms you visited control cannibalism?

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2. What are the errors in debeaking you observed in the farms you visited?

3. Enumerate the precautions that is required before, during and after be-beaking a bird

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REARING AND MANAGEMENT SKILLS OF DAY-OLD CHICKS, BROILERS, LAYERS AND COCKERELS

1.0 Introduction

In order to run any enterprise (poultry farming included) profitably, the operator requires good knowledge and skills in the activities involved in management of the enterprise. Management is a dynamic process and involves various factors. Upgrading small scale poultry producers' management skills will enable them to cope with the rapid changes in agribusiness environment and run their businesses more efficiently and profitably.

2.0 Objectives

At the end of this unit, you should be able to manage day-old chicks, raise layers, broilers and cockerels.

3.0 Procedure

Before Your Chicks Arrive: Setting the Stage

i. Brooder: a safe place to keep chicks warm, watered, and fed. You can buy or build elaborate brooders, but many chick growers go with a large plastic tote or large cardboard box. Be certain to have the right size (with high walls) for the number of chicks. You can also start small and move to a larger brooder as the chicks get older. Finally, you'll want a (ventilated) lid to keep brave chicks from escaping once they get bigger.
ii. Brooder location: You want to keep the brooder in a warm, dry place; many people set it up in a garage, others do it in their house, while yet others do it in the chicken coop (if there are no adult chickens in the coop).
iii. Heat lamp: Fairly essential to keeping the chicks warm and their temperature regulated, as they can't do so initially. You can use a regular lamp and light bulb, but products made for this purpose (with a guard) are a bit safer and more consistent. Attaching heat lamp to a 2x4 across top of brooder works well as does attaching it to a floor lamp's pole.
iv. Thermometer: While not absolutely crucial, a thermometer will help you more easily monitor the temperature in the brooder. -- Bedding: Pine shavings in general are the best materials, but in the first week or so, we like newspapers with a layer of paper towels on top (because the chicks will try eating the pine shavings).

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v. Waterer: Absolutely essential to have one or more waterers designed specifically for chicks; other systems will lead to sad results and death.

vi. Feeder: You don't necessarily have to get chick feeders (though it's recommended); some folks use the base of an egg carton. If you don't use a chick feeder, be more vigilant about keeping the feed clean (from poop) and dry. Some experts recommend simply placing the feed on a paper plate for the first few days.

vii. Chick starter feed: It's essential to use a feed specifically designed as starter for chicks; your main choice will be deciding between regular and medicated. Feed this feed for the first 8 weeks or so.

viii. Electrolyte powder: If your chicks are arriving by mail, purchase the electrolyte powder (think Gatorade for chicks) to supplement their water starting the third day or so and give the chicks extra strength in those key early days. (Old timers used to put sugar in the chick water.)

ix. Coop: Unless you're keeping the brooder in the coop, you don't technically need to have it ready now, but it's best -- as time will pass quickly. Every imaginable type of chicken coop exists -- and your goal should be to find/build the one that best fits your needs/code/number of chickens.

x. Pen: The healthiest chickens are the ones who forage the yard for their food, thus you should have a plan for where you'll let your chickens roam, from one nicely fenced pen to a series of pens, to a moving pen, to your entire backyard. The pen should be fenced/enclosed to protect chickens from predators.

Day 1: Acclimating Chicks

i. Temperature: Brooder temp should be 90 degrees.

ii. Water: First thing to do when baby chicks arrive is to take one at a time and dip their beaks in the water and be certain they drink; this step is absolutely essential to survival. Refill waterer often.

iii. Feed: Once the chicks have had a drink, repeat the process with their feed.

iv. Location: Keep feed and water on outskirts of heat lamp, ideally on opposite sides (with heat lamp in the middle) to keep water from feed.

v. Sleep: Expect the chicks to sleep quite a lot during this first week.

Week 2: Baby (Chick) Steps

i. Temperature: Bring down brooder temperature 5 degrees to 85 degrees.

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ii. Water: Check and refill waterer(s) at least twice a day. Clean regularly with diluted vinegar.
iii. Feed: Keep with the starter feed. Be vigilant about keeping feed free of moisture and chick poop. Using a piece of plywood or extra floor tile, raise waterer and feeder for less waste and mess.
iv. Feathers: You'll begin to see small feathers replacing the fluff on your chicks' wings and tail.
v. Bedding: Switch to pine shavings -- about 1-2 inches deep; clean brooder before doing so.
vi. Grit: Introduce a small amount of fine "chick" grit to chicks' diet -- needed to assist in digestion (which they would normally get if raised naturally outside).
vii. Perch: Consider adding a small, chick-sized perch in brooder for "roosting 101" -- made easily with three small branches in an H-shape.
viii. Socializing: If your chicks are going to be more than simply production birds, now is the time to acclimate the chicks to you.

Week 3: Keeping a Lid On

i. Temperature: Bring down brooder temperature 5 degrees to 80 degrees by raising heat lamp about 3 inches.
ii. Lid: Now's the time when you should start putting a lid on your brooder
iii. Waterer and Feeder: Consider raising the height again, placing them on a 2x6 -- and possibly switching to adult units to make it easier on your maintenance.
iv. Brooder: If you started with a small brooder, it may be time to upgrade to a larger one to accommodate your chicks' growth.
v. Feathers: Lots more feathers are appearing and replacing the fluff.

Week 4: Life beyond the Brooder

i. Temperature: Bring down brooder temperature 5 degrees to 75 degrees by raising heat lamp another 3 inches.
ii. Field trip: Depending on the season (assuming late spring/early summer), now is the time to introduce the pen to the chicks in small doses -- say 1-3 hours daily with supervision.

Week 5: Tweens

i. Temperature: Depending on the season, the heat lamp is done, as long as the temperature does not dip below 60s at night.

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ii. Feathers: The chicks should be looking less like babies and more like miniature chickens, as adult feathers grow out.

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iii. Separating the sexes: It's hard to tell the genders of most breeds of chicks, but by now you should be able to by examining their feather development -- and it's a good time to separate the sexes -- the cockerels (young roosters) and the pullets (young hens) -- especially if your focus is on keeping only hens for laying. -- Pen: The chicks can take longer day trips to the pen.

iv. Feed: It's now time to start mixing in adult chicken feed as you finish up your chick starter feed.

v. Feeders and Waterers: If you have not already, time to switch to larger (adult size) feeder and waterers.

Week 6: From Brooder to Coop

i. Acclimating: Time for the chicks to flee the brooder for the coop! If they have not been raised in the coop, take time to help the chicks get used to their new digs

ii. Feed: Provide your chicks with chicken feed, table scraps, and other tasty treats.

iii. Feeder: Consider hanging the feeder (at the proper height at top of chicks' backs) to make it easier on the chickens -- and less waste overall.

iv. Pen: Being outside (depending on the season/weather) should now be part of daily routine for the chicks, bringing them home to the coop to roost for the evening.

Week 8: Expanding the Menu

i. Treats: Chickens are omnivores, so a good mixed diet is essential. Be creative and help the chicks from being bored by hanging some of the treats (such as a head of lettuce) so the chicks can peck at them.

Week 12: Readying the Hens I

Nesting Boxes: Assuming you are raising hens for egg-laying, now is the time to install/prepare the nesting boxes. These should be raised above the ground and away from roosting area (to avoid poop contamination), ideally offering some privacy. Lots of methods for constructing the boxes, from old drawers and crates to water buckets.

Week 16: Readying the Hens II

i. Fake eggs: A great tip a veteran told us was putting a plastic egg (partially filled with sand to give it a bit of weight) in the nesting boxes to help your young hens learn.

ii. Feed (layers): Time to switch to a layer feed for your young hens.

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Week 20: Laying Begins

i. Harvesting eggs: Once your hens start laying eggs (there may be a few misfires first), you'll want to check the nesting boxes for eggs twice a day (while you also refresh water/feed). Discard any broken or pooped-on eggs.
ii. Nesting Boxes: Keep clean and fresh.
iii. Extending the season: As fall arrives and daylight gets shorter, hens will slow down egg production for the winter. You can extend the season by placing a light in the coop that comes on in the late afternoon and stays on for about 5 hours -- giving the hens about 15 hours of "daylight."

4.0 Conclusion

Management skills among broiler producers are important to enable them to face challenges in high competitive business environment of poultry production. Following the recommended procedures will ensure sustainable and profitable venture in the long run.

5.0 Practical Assignment

Enumerate the traditional and modern management practices among the farms you visited.

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What are the challenges faced by poultry farms in your area?

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6.0 Reference

http://www.hansenwoodlandfarm.com/raising-chickens-checklist.html

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TECHNIQUES FOR ENHANCING ANIMAL PERFORMANCE

1.0 Introduction

There exist obvious challenges to rapidly increase agricultural productivity to help feed their growing populations without depleting the natural resource base. Biotechnology is regarded as a means to meet both objectives through addressing the production constraints of small-scale or resource-poor farmers who contribute more than 70% of the food produced in developing countries. Techniques of modern biology such as molecular cloning of genes, gene transfer, genetic manipulation of animal and plant embryo transfer, genetic manipulation of rumen microbes, chemical and biological treatment of low quality animal feeds for improved nutritive value, genetically engineered immunodiagnostic and immunoprophylactic agents as well as veterinary vaccines, inter alia, are a reality today and are finding their ways into research and development programmes of developing countries. Biotechnology is offering unprecedented opportunities for increasing agricultural productivity and for protecting the environment through reduced use of agro-chemicals.

2.0 Objective

At the end this section, you should be able to:

- explain the various techniques for enhancing animal performance.

3.0 Procedure

The available biotechnologies for enhancing animal performance are as follows:

1. Reproductive physiology: One of the challenges for genetic improvement is to increase reproduction rates. Several reproduction techniques are available. The commonest of these are artificial insemination (AI), embryo transfer and associated technologies. Measurement of progesterone in milk or blood, which is a widely used technique for monitoring ovarian function and for pregnancy tests is also an important technology for managing the reproductive function of the animal.
2. Embryo transfer (ET): Although not economically feasible for commercial use on small farms at present, embryo technology

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can greatly contribute to research and genetic improvement in local breeds. The principal benefit of embryo transfer is the

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possibility to produce several progeny from a female, just as AI can produce many offspring from one male.

3. Embryo sexing and cloning: Although embryo sexing may not have dramatic effects on rates of genetic gain it can considerably increase efficiency. If multiple sexed-embryo transfer became as routine an operation as AI is, beef operations based on this system could become competitive with pig and poultry production in terms of efficiency of food utilization.
4. Hormone use: Use of hormonal assays to monitor reproductive function can be rewarding for both research purposes and commercial livestock operations. Reproduction can also be manipulated using hormonal treatments.
5. Animal genetics and breeding: Genetic improvement of livestock depends on access to genetic variation and effective methods for exploiting this variation. Genetic diversity constitutes a buffer against changes in the environment and is a key in selection and breeding for adaptability and production on a range of environments.
6. Multiple ovulation embryo transfer and open nucleus breeding system: Multiple ovulation embryo transfer (MOET) is a composite technology which includes superovulation, fertilisation, embryo recovery, short-term in vitro culture of embryos, embryo freezing and embryo transfer. Benefits from MOET include increasing the number of offspring produced by valuable females, increasing the population base of rare or endangered breeds or species, ex situ preservation of endangered populations, progeny testing of females and increasing rates of genetic improvement in breeding programmes.
7. Genetic markers and marker-assisted selection: A genetic marker for a trait is a DNA segment which is associated with, and hence segregates in a predictable pattern as, the trait. Genetic markers facilitate the "tagging" of individual genes or small chromosome segments containing genes which influence the trait of interest. Availability of large numbers of such markers has enhanced the likelihood of detection of major genes influencing quantitative traits. Marker identification and use should enhance future prospects for breeding for such traits as tolerance or resistance to environmental stresses, including diseases. Already, identification of carriers of genes for resistance and introduction of such genes into a population seems feasible for resistance against Trichostrongyluscolubriformis and Haemonchuscontortus (Gogolin-Ewens *et al.* 1990).
8. Nutrition and feed utilization: Gene-based technologies are being increasingly used to improve animal nutrition, either through

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modifying the feeds to make them more digestible or through modifying the digestive and metabolic systems of the animals to

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enable them to make better use of the available feeds (Bedford M.R. (2000).

4.0 Conclusion

Increasing production and the safe processing and marketing of meat and milk, and their products are big challenges for livestock producers. Biotechnology is being harnessed in various aspects of the livestock industry to hasten breed development for improved animal health and welfare, enhanced reproduction.

5.0 Practical Assignment

1. Which of these biotechnologies is in use in the farms you visited?

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2. W at are the major constraints on applying biotechnologies?

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RODENT CONTROL

1.0 Introduction

Rodents, such as rats and mice, can be a major cost factor on the poultry farm because of the food that they eat and spoil with faeces and urine, the damage they do to the housing and equipment. Further, the diseases they may carry can result in flock health problems, staff health problems and/or food safety concerns regarding the products produced on the farm. The effectiveness of rodent control programmes depends upon the people responsible for their implementation being aware of the problems involved, their motivation and their interest in achieving success.

2.0 Objectives

At the end of this practical session, you should be able to:

- learn how to prevent rodents from destroying chicks, piglets, rabbits and their feeds for maximum growth and profitability.

3.0 Procedure

For us to effectively control rodents' activities, the following steps are to be carried out:

i. Regular monitoring
ii. Well trained operators
iii. Access to labour and materials when they are needed.

A continuous integrated programme to control rodents includes:

i. Minimising points of access into buildings.
ii. Preventing access to feed, water, and shelter.
iii. Elimination of nesting places.
iv. Make sure any material that would be attractive to rodents for nesting is placed in rodent proof storage areas.
v. If the storage area cannot be rodent proofed, move the material at least every week to prevent rodents from establishing themselves in it.
vi. Appropriate sanitation conditions
vii. Baiting and/or trapping programmes
viii. Monitoring of rodent populations and control measures.
ix. Closure of Cracks and openings

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4.0 Conclusion

From the above steps, the students have been exposed to the control techniques in handling the activities of rodents in livestock farms.

5.0 Practical Assignment

1. Identify and state explicitly how rodent control methods are carried out in the farms you visit.

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POULTRY AND PIG HOUSE HYGIENE

1.0 Introduction

The starting point of "field biosecurity" is the reception of a healthy flock from the hatchery. This also implies healthy breeders and a good biosecurity program both at the hatchery and during the transport of the chicks to the house. But, as today's genetics became so performant, they became less and less resistant and therefore require optimum biosecurity conditions. There are different vectors for possible disease transmission, apart from unhealthy chicks. We can subdivide them as follows:

i. **Mobile: Biological:** people , rodents(able to transmit Pasteurelosis , Salmonelosis , …) ; insects (that can carry Avian Viruela , Marek, IBD, Salm. , E.Coli, Campilobacter, …) , wild birds (often carrying Avian Influenza, Pasteurella, Salmonellae, ….) **and Mechanical:** vehicles (vectors for IBD and Salmonellae)
ii. **Nutritional:** feed (possibly containing Salmonellae, paramixovirus, IBD, …) and water (*often containing enterobacteria like Salmonellae and E. coli*)
iii. **Static:** litter, fluff, surfaces (floors, walls, roofs ,able to transmit IBD and Salmonella spp.)
iv. On the macro-biological side, rodent control and excluding wild bird entrance are the main challenges. Meso-biologically, good working insecticides will be useful.

2.0 Objective

At the end of this subject matter, you should be able to:

- explain the techniques needed in keeping the poultry and pig houses hygienic.

3.0 Procedures

Hygiene consists of cleaning and disinfection. Disinfection without cleaning is a waste of money.

Cleaning

Cleaning is the management of dirt that can be seen partially: to separate and remove this dirt from a surface, through water and a detergent. In

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other words, to make the surface as free as possible from organic soil, that would impede the disinfectant to reach the surface.

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Therefore, the characteristics of a detergent are explained below, four factors will determine the functioning of a detergent:

i. Chemical energy: pH and concentration. (Alkaline detergents remove proteins and fat; acid detergents remove mineral deposits like scale)
ii. Thermal energy (Fat starts to dissolve as from 95°F)
iii. Physical energy (e.g. a high pressure washer)
iv. Contact time: this will enable the chemical energy to do its job.

Moreover, it's the only factor that does not cost any energy, its Free of Charge.

Disinfection

The goal of disinfection is to reduce the number of pathogens , ideally with log 4 (99.99 %). Therefore, the disinfectant should comply with a number of characteristics. First of all, it should be compatible with the detergent, foam or gel cleaner. This means that if your cleaning agent contains cationic surfactants, your disinfectant should not contain anionics. (Phenols and especially their derivates like cresolics are known not to be compatible with non-ionic surfactants and cationics like quaternary ammonia).

Well formulated disinfectants should comply with a number of characteristics, such as:

1. **Composition**
   i. How many different active ingredients compose the product , so that it assures a maximum SINERGY? (eg. VIROCID® contains 1 aldehyde (glutaraldehyde), 2 different quaternary ammonia (1 single chain and one twin chain) and alcohol (isopropanol); KICK START® contains stabilised hydrogene peroxide and organic acids).
   ii. Does the products contain buffering agents (surfactants, wetting agents, sequestering agents, …) so it does work in contact with organic matter, in hard water and assures minimum a two years shelf life?
   iii. The one million dollar question: how many oz/gal active ingredients does the product have? (VIROCID®: 70 oz/gal or 522 gr/ L); or in other words: how much water is there in the drum? This concentration will determine the dilution.

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2. Safety

i. For the people (e.g. not containing carcinogenic substances like formaldehyde)
ii. For the animals
iii. For the equipment (not being corrosive on galvanised feeder lines and fans, or aluminium drinker supports)
iv. For the environment (being biodegradable and therefore not containing heavy metals such as tin, silver)

3. **Efficacy**

Does the product have the FULL SPECTRUM: bactericide, fungicide, virucide and sporicide? (Beware of statics, like bacteristatics: they stop their development, but don't reduce their number).

4. Versatility

Can the product be sprayed, foamed and fogged as it is?

5. Cost/Benefit

What is the price, not per gallon, but DILUTED?

Water Treatment

Not only the cleaning and disinfection of surfaces are important, but also your waterlines should be cleaned and disinfected!

Cleaning means removing the scale and the biofilm. The biofilm is a polysaccharide layer, caused by adding vitamins, medication etc. through the water. It harbours mainly enterobacteria (Salmonella, E. coli) and impedes the good functioning of medicine, vaccines, etc. It will, as scale, block the nipples and reduce the water flow. Chlorine (that gets neutralised by organic matter) will not remove the scale and not even penetrate the biofilm. Removing the biofilm is only possible by OXIDATION. Stabilised hydrogen peroxide will do the job! In combination with organic acids, it will also remove scale. And, if the products do not contain heavy metals (like silver nitrate), it can also be given during production , avoiding a new build up and sanitising the drinking water. All this without leaving residues in the neither meat nor eggs. CID 2000® is such a product.

Procedures

The Dutch ICC (Integrated Chain Control) system describes the procedures for poultry houses as follows:

a) remove litter, empty drinkers and clean dry all visible dirt
b) wash down with a cleaning agent and allow for enough contact time (20 min) and clean drinker lines (and flush them afterwards)

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c) rinse and let dry

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d) disinfect (by spray or foam; foaming will visualise better where the product has been applied and stays longer on vertical surfaces and ceilings)
e) install new litter, re-install and fill the feeders and drinkers
f) do a terminal disinfection by fogging
g) do a continuous disinfection of trucks (wheel dips) , people (hand hygiene, foot dips) and drinking water.

For Best Practice in the Broiler House, It is recommended that you:

1. Establish a plan: Any good poultry house cleaning and disinfection program will start with a plan, detailing dates and times, along with the labor and equipment needed, and this should be established prior to depleting the farm.
2. Control insects: Wearing appropriate protective equipment, spray the poultry house interior with a locally recommended insecticide as soon as the flock is removed and while the house is still warm. A second treatment with insecticide should be completed before fumigation.
3. Remove dust: Remove all dust and cobwebs from interior surfaces and equipment.
4. Pre-spray: Again, wearing appropriate protective equipment, spray detergent solution throughout the broiler house interior to dampen any remaining dust. Close the curtains in open-sided poultry houses first.
5. Remove equipment: Remove all equipment from the house and raise automatic feeders and drinkers.
6. Remove and dispose of litter: Litter must be removed to a distance of at least 3.2 km (2 miles) and disposed of in accordance with government regulations.
7. Wash: Use a pressure washer with a foam detergent. Ensure the detergent is compatible with the disinfectant to be used. Rinse with hot water.

Broiler houses should be washed using a pressure washer and foam detergent, compatible with the disinfectant to be used, and then rinsed with hot water.

8. **Clean water and feeding systems:**
   a) Drain, clean and disinfect the water system.
   b) Water pipes should be cleaned at least once per flock to remove any biofilm that may have built up. If physical cleaning is not possible, use high levels (140 ppm) of chlorine.
   c) Flush water lines with clean, fresh water prior to flock placement.
   d) Empty, wash and disinfect all feeding equipment.
   e) Empty bulk bins and connecting pipes and brush out. Clean out and seal all openings.
   f) Wherever possible, fumigate.

9. **Disinfect**: Use an approved disinfectant that is effective against specific poultry bacteria and viruses. Follow manufacturer's instructions at all times. Most disinfectants are not effective against sporulated coccidial oocysts, and selective coccidial treatments should be used by trained staff only. It is always worth remembering that disinfectants are ineffective in the presence of dirt and organic matter and should not be applied to wet surfaces, as this will result in dilution.

10. Fumigate: Where permitted, formalin fumigation should be completed by trained personnel, following safety legislation and guidelines. Fumigate as soon as possible after disinfection; surfaces should be damp and the house warmed to a minimum of 21C (70F) and a relative humidity of greater than 65 percent. Seal the house for 24 hours. Prior to permitting any re-entry, ventilate the house to reduce formalin levels to 2 ppm. Repeat fumigation after the litter has been spread. Fumigation should be carried out as soon as possible after disinfection. Surfaces should be damp, and the house warmed to a minimum of 21C (70F) and a relative humidity of greater than 65 percent. Do not forget external areas External areas around the poultry house should also be cleaned and disinfected thoroughly. Particular attention should be paid to the areas under the ventilator and extractor fans, under feed bins, access routes, door surrounds and gutters.

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Ideally, the poultry house should be surrounded by an area of concrete or gravel (1-3 meters/3-10 feet in width). If this is not possible, the area around the house must be free from vegetation and machinery and equipment and have a level, well-drained surface.

Evaluating farm cleaning, disinfection efficacy

- The efficacy of clean and disinfection should be monitored regularly.
- Bacterial and salmonella counts should be completed at least once per flock.
- Monitoring trends in Salmonella counts will permit continuous improvements in farm hygiene to be made.
- It should be remembered that if cleaning and disinfection have been effective, no Salmonella species should be isolated during sampling.

4.0 Conclusion

At the end of the practical session, students were practically thought the techniques of how to keep and manage the hygiene of poultry houses.

Biosecurity is about an integrated program that should be implemented and checked. Ideally, one supplier should provide you with all necessary products and advice. For integrated companies, the supplier should have both field sanitation and a hatchery sanitation program.

5.0 Practical Assignment

Highlight the techniques of hygiene adopted in the poultry houses you visited?

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6.0 Reference

http://www.thepoultrysite.com/BusinessDirectory/Focus.asp?Display=57

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VACCINATIONS AND MEDICATIONS IN POULTRY AND PIG REARING

1.0 Introduction

Vaccination is an effective means to prevent and/or reduce the adverse effects of specific diseases in poultry. Poultry refers to birds that people keep for their use, and generally includes chicken, turkey, duck, goose, quail, pheasant, pigeon, guinea fowl, pea fowl, ostrich, emu, and rhea.

Disease-causing organisms can be classified, smallest to largest, as viruses, mycoplasma, bacteria, fungi, protozoa, and parasites. All these organisms are susceptible to chemotherapy, except viruses. Control of viral diseases is dependent upon prevention through sanitation and biosecurity, and by vaccination.

2.0 Objectives

At the end of this course you should be able to:

- identify various types of vaccines available for poultry
- administer different types of vaccination to poultry and pigs.

3.0 Procedure

i. Day-old vaccination is generally accomplished by giving 0.2 to 0.5 ml of vaccine subcutaneously under the skin at the back of the neck or intramuscularly in the leg.
ii. The automatic vaccination machines used in many parts of the world generally are designed for the neck injection.
iii. A skilled operator can vaccinate about 1600-2000 chicks/hour.
iv. A dye is frequently mixed with the vaccine to allow visualization of the vaccine after the injection.
v. Needles should be changed several times during the course of the day. Burred or bent needles must be replaced immediately.

Before Vaccination

i. Calibrate all vaccinators pre-vaccination for accuracy
ii. Verify the position of the needles
iii. Provide plenty of new sterile needles
iv. Check all vaccinators for dose accuracy
v. Check the pneumatic pressure
vi. Verify that the vaccine vials to be used have not been thawed.

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Many hatcheries invert the vaccine vials to leave the frozen product on top. If the vaccine is thawed inadvertently, the vaccine will flow to the bottom (the cap of the vial), and be visualized.

i. Verify that the vaccine diluent has the correct color (not yellow; not purple) and that it is not cloudy or has any kind of sediment or foreign particles.
ii. Put on safety goggles and insulating gloves.

Vaccine Administration

i. Begin the vaccination process with properly sanitized equipment.
ii. Hook up the diluted vaccine to the vaccination equipment and test the system before chicks are vaccinated.
iii. The amount of vaccine delivered is usually 0.2 to 0.5 ml.
iv. Needles must be replaced with new needles at least every 1000 chicks.
v. Once reconstituted, the vaccine should be used completely within 30-45 minutes. Should the vaccination personnel need to stop or interrupt the procedure at any time, keep track of the interruption and do not allow the use of vaccine that has been sitting for more than 45 minutes.
vi. A chick sample may be taken per vaccinator to insure the quality of vaccination. Because dye has been added to the vaccine, one can look for evidence of dye in the SC tissue. Count the numbers of chicks with SC dye for every 100 chicks sampled and determine the percent chicks missed. Correct any problems immediately. The inspection must be done within 15 minutes post-vaccination or else the dye will no longer be visible under the skin.
vii. Determine the percentage of chicks with visible blood, which would be an indication of the needles being mal-positioned, burred or blunt, or of too much pressure being applied.
viii. Verify that the machine is properly calibrated to deliver the prescribed volume of vaccine.
ix. Verify that the prescribed air pressure is correct (most machines operate with 75 psi).
x. Excess pressure will hurt the chicks and may promote leakage of vaccine or break down the cells in the vaccine. Insufficient air pressure may result in reduced doses of vaccine.
xi. Post Vaccination
xii. Insure proper cleaning, sanitation, sterilization and maintenance of the vaccination equipment at the end of the day
xiii. Discard all unused vaccine, including vaccine left over during personnel “breaks”.

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Spray Vaccination with Backpack Spray System Procedure

i. Walking SLOWLY, start at one end of the house and make two complete passes through the house.
ii. One person should walk ahead of the vaccinators to part the birds and to keep the birds from piling against the back wall.
iii. Each vaccinator sprays one side of the house.
iv. Direct the nozzle three feet (1m) above the birds heads.
v. Keepaconstantpressureof4.5-5.0 Bars(65-75PSI).

Water Vaccination Procedure

i. Pour the reconstituted vaccine into the drinkers, or open the valve of the water tank or the proportioner.
ii. Walk the birds to check if they are all drinking water. If using hand drinkers, redistribute drinkers if necessary.
iii. Note that the birds must drink all the vaccine solution in no more than two hours, and never in less than 1 hour.

Using Water Tanks

i. Open the water tank valve in order for the birds to consume the vaccine.
ii. After the vaccine is consumed, open the water flow normally.

Using a Water Pump Procedure

i. Once the vaccine, vaccine stabilizer and vaccine dye (usually blue in color) are mixed in the large container, the vaccine is pumped into the drinker lines with the assistance of a water pump.
ii. The end of the drinker lines is open to improve flow.
iii. Onevaccinatormustobservethewatercomingoutoftheendofthedrink erlinesuntil the blue solution (the vaccine) is visible. When the dye is seen, close the end of the drinker lines.
iv. Lower the drinker lines to allow the chickens to consume the vaccine.
v. Alternate the drums of mixed vaccine until all of the vaccine doses are consumed.
vi. Walk through the birds at least 2-3 times while the vaccine is being consumed in order to stimulate consumption by all birds in the house.

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Intraocular (Eye Drop) or Nasal Drop Vaccine Procedure

i. The vaccination will only be considered successful if the drop (0.03ml) is placed into the eye or nasal cavity and absorbed. For this to occur, it is important to wait a few seconds after administering the drop, before releasing the bird.

ii. If the drop is not totally absorbed, a new drop should be administered.

iii. To prevent the contents of the vaccine vial from getting warm against the hands of the vaccinator, divide the contents of the reconstituted vaccine into two or three empty vials, and alternate their use while keeping the others in a cooler with ice.

Wing Web Vaccination Procedure

i. Administer the vaccine in the center of the wing web, using a two-pronged needle applicator or other wing web applicator (Grant innoculator or others).

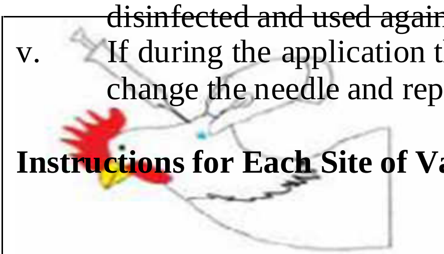
ii. Remove the feathers located on the wing web before exposing it for vaccination.

iii. Dip the two-pronged applicator into the diluted vaccine and pierce the web on the underside of the wing, avoiding feathers, blood vessels and bones.

iv. Change the needle every 500 birds. The used needles can be disinfected and used again as long as they remain sharpened.

v. If during the application the wing vein is punctured, immediately change the needle and repeat vaccination.

Instructions for Each Site of Vaccine Administration

	
Neck	**Inguinal Fold**
The skin on the back of the neck should be lifted up to create a	Vaccine is injected into the pocket created by skin connecting the

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pocket between the skin and neck muscles. Insert the needle through the skin into this pocket with the needle pointing toward the bird's body. The site of injection should be the middle to lower neck region on the dorsal mid line of the neck.

abdomen and the thigh. This SC space is large and creates less of an issue with spent hen processing as compared to IM injections.

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<table>
<tr>
<td>

Breast

Vaccine is injected into the superficial pectoral muscle about 1 to 1.5 inches (3 to 5 cm) lateral to the keel bone, depending on the age of the bird. The needle should be directed caudally at a 45o angle to the body. This will help avoid injecting the vaccine through the muscle and into the body cavity.</td>
<td>

Tail Head

This injection is made into the underside of the tail head. The needle is directed to the side of the tail bone and pointed cranially. Care should be taken to not withdraw the needle too quickly, which can lead to leakage of vaccine out of the injection site.</td>
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Further Instruction

For all vaccines:

i. Vaccine should arrive with cool packs in a well-insulated box
ii. If vaccine arrives hot, call manufacturer or distributor
iii. Storage temperature=35-45oF(2-8oC).
iv. Avoid freezing, extreme heating and intense light.

For Live Vaccines:

i. Transport to farm in cooler with ice packs to keep temperature constant.
ii. Mix with diluent (reconstitute) just before application.

For Inactivated Vaccines:

i. Remove24hourspriortovaccinatingsothattheproductcanwarmtoroomtemperature. Also, can use warm water bath–do not exceed 100o F for more than 5 hours
ii. Do not leave bottles in direct sunlight during transport to farm.
iii. Gently agitate bottles thoroughly prior to use.

4.0 Conclusion

Strict sanitation and biosecurity are essential for successful poultry production. Vaccination is no substitute for effective management. It must be understood that vaccines may be effective in reducing clinical disease, but exposed birds, in most cases, still become infected and shed disease organisms.

5.0 Practical Assignment

1. List the precautions of handling and storage of vaccine of the poultry farmers you visited

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2. Under what condition and situations will you use any particular vaccination methods?

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6.0 Reference

http://www.cobb-vantress.com/docs/default-source/management-guides/cobb-vaccination-procedure-guide---english.pdf

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IDENTIFICATION OF FEEDSTUFFS USED IN FEEDING POULTRY AND PIGS AND FEED FORMULATION

1.0 Introduction

Feed formulation involves the judicious use of feed ingredients to supply in adequate amounts and proportions the nutrients required by poultry. Feedstuffs vary in composition. Feed costs can vary between 55 and 70 per cent of total operating costs. From a nutritional point of view, there is no "best" diet formula in terms of ingredients that are used. Ingredients should, therefore, be selected on the basis of availability, price, and the quality of the nutrients they contain. Certain ingredients invariably constitute the greatest part of diets, in terms of both amount and cost. Cereal grains and fats are the primary energy-supplying ingredients, and oilseed meals and animal-protein meals are used commonly as major sources of amino acids. Some important nutritional characteristics of many energy and protein-supplying ingredients are discussed in this chapter. Sulphur, which are common contaminants in feedstuffs, and their effects are discussed in the final section.

2.0 Objectives

Upon successful completion of this unit, you should be able to:

- practically learn the types of nutrients to be feed to non-ruminants like poultry for maximum growth
- formulate feeds for various classes of animal and understand the economic and safety regulations of a feed mill

3.0 Procedure

Generally, the sequence for feed identification and formulation are as follows:

i. Identify and prepare a list of important nutrient requirements
ii. Determine available feedstuffs
iii. Prepare a listing of nutrient composition of available feeds
iv. Balance the ration: Follow guidelines for Algebraic Equations, Pearson Square and Computer Assisted Formulation.

Note: To formulate actual/practical diets in most instances, need to balance for other major/important nutrients such as Ca & P! Also, may need to formulate a supplement or base mix [& also a vitamin and (or)

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mineral premixes?] that will be fed along with major energy and (or) protein sources. A simple approach used to formulate a diet with only

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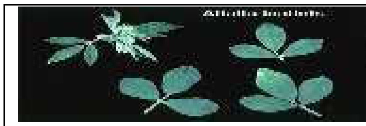
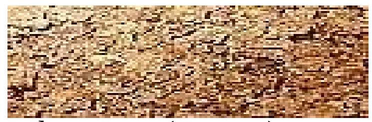
two ingredients can be used to (after some modifications, that is!) accomplish the task.

Feed Identification

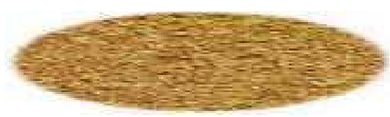

Alfalta


Barley

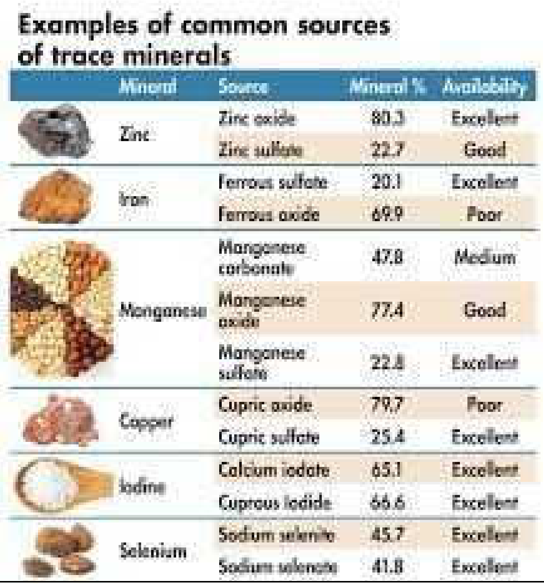

Grass(Legume)


Wheat Bran(Energy)

Whole Cottonseed


Soybean meal


(Protein)


Examples of common sources of trace minerals

Mineral	Source	Mineral %	Availability
Zinc	Zinc oxide	80.3	Excellent
	Zinc sulfate	22.7	Good
Iron	Ferrous sulfate	20.1	Excellent
	Ferrous oxide	69.9	Poor
Manganese	Manganese carbonate	47.8	Medium
	Manganese oxide	77.4	Good
	Manganese sulfate	22.8	Excellent
Copper	Cupric oxide	79.7	Poor
	Cupric sulfate	25.4	Excellent
Iodine	Calcium iodate	65.1	Excellent
	Cuprous Iodide	66.6	Excellent
Selenium	Sodium selenite	45.7	Excellent
	Sodium selenate	41.8	Excellent


Red rock salt

The Process of Feed Formulation

This involves calculation of the proportions of available raw materials, which have to be blended together to provide a mixture, which contains the appropriate concentrations of all the nutrients required for a particular class of livestock. Whilst it is possible for simple formulations to be done by mental arithmetic or manually using a small calculator this becomes impracticable as more nutrient specifications, for example amino acids, are added. It is now common practice to use computerized linear programing which has the advantages of speed, accuracy and low cost (compared with the time spent on manual calculations). lt also enables the prices of different raw materials to be taken into consideration

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so the proportions of raw materials in the mixture not only meet the nutrient specifications, but do so at the lowest feasible cost

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given the prices of the raw materials available, that is, a least-cost formulation.

The information required to carry out least-cost formulation includes details of raw materials (quality, availability and price) and nutrient specifications relevant to the livestock systems utilizing the feed. The steps involved in least-cost formulation include listing of raw materials, listing of nutrient specifications with maximum and minimum values, listing of constraints on raw material inclusion, linear programing and manipulation of formulations after linear programing.

4.0 Conclusion

Feed formulation and operation of the mill may be balanced to supply non ruminant animal with a feed that is acceptable, available, and easily digested. The inter-dependent variables present in ingredient selection are subjects for proper understanding and practical application by farmers for sustainable balanced diets feed formulation.

5.0 Practical Assignment

Visit a feed mill in your area. Write out the ingredients commonly used as sources of these nutrients for poultry, pigs, and rabbits in the farms you visited.

6.0 References

Cooke, B. C. (1985) Prediction equations: their potential for estimating the energy content of compound animal feeds. Feed Compounder, November, pp. 7-9.

Gohl, B. (1981) Tropical Feeds. Rome: Food and Agriculture Organization of the United Nations.

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FEED FORMULATION AND FEED MILLING

1.0 Introduction

Feed manufacturing and the associated quality control programme are keys to successful animal husbandry. Farmers' understanding and specification of the activities of the feed mill is a major key to sustainable profitable rearing of animal.

There are different types of feed milling machines (Grinding) namely: Hammer, Attritions, Roller, Cutters and Screening mills. Grinding or particle-size reduction is a major function of feed manufacturing. Many feed mills pass all incoming ingredients through a grinder for several reasons: (a) clumps and large fragments are reduced in size, (b) some moisture is removed due to aeration, and (c) additives such as antioxidants may be blended. Dry feeds may be ground, sifted, screened, mixed, compressed, expanded, texturized, coloured and flavoured. By one or more of these processes, a wide variety of ingredients can be prepared into a standardized product.

The mixing can be done using horizontal mixers or vertical Mixers. Feed mixing may include all possible combinations of solids and liquids. Within each ingredient are differences in physical properties. For solids there are differences in particle size, shape, density, electostatic charge, coefficient of friction as represented by the angle of repose, elasticity or resilience and, of course, colour, odour, and taste. For liquids there are differences in viscosity and density.

2. 0 Objective

At the end of this section, you should be practically be exposed to:

- the rudiments of feed milling machine, the processes of milling livestock feed.
- basic information as to how feed milling machine can be designed, assembled and maintained
- various ingredient processing methods.

3.0 Procedure

A feed mill is a very large investment and new buyers can often be overwhelmed by the different types of machinery needed, the processes and uses of each these machinery/equipment, and the components and parts of these machinery/equipment. Below are Pelleting, Mixing, Grinding and Extrusion machines.

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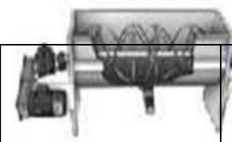
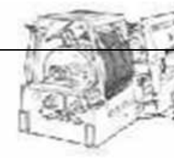
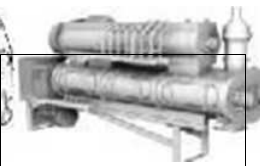
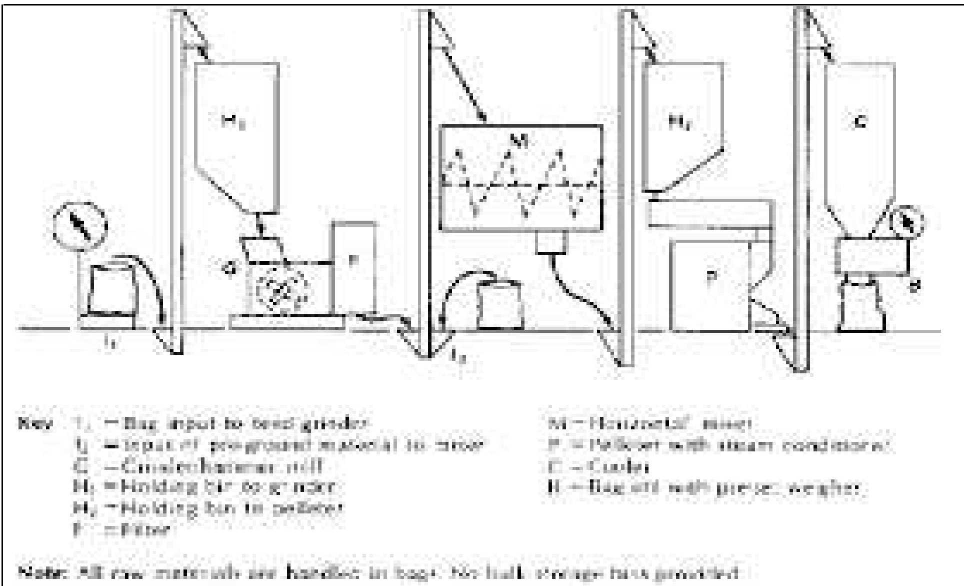
 **Pelleting**	 **Mixing**	 **Grinding**	 **Extrusion**



Procedure of Feed Manufacturing in a Feed Milling

The feed manufacturing process may be considered to be made up of several unit operations which, in almost all circumstances, include the following:

a) Raw material, storage and selection: The proper storage of raw materials and of finished feeds is not only essential to prevent physical losses, but is also an important aspect of quality control

b) Raw material weighing: The accurate weighing of raw materials according to the formulation for a given ration is perhaps the most important unit operation involved in feed manufacture, since no amount of mechanical processing can make up for any deficiencies in nutrients which have been omitted from the mixture. Large bin-type weighers are often used for raw materials which have been pre-ground or are free flowing and discharge readily from storage bins or silos. Bin-type weighers may be mobile or stationary.

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c) Raw material grinding: In the sequence of unit operations involved in feed milling, raw material grinding may occur before or after weighing. It is a process with high power requirements

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which is often noisy and dusty. The design of machine most commonly found in the feed manufacturing industry is the hammer mill. Inside the grinding chamber, hammers, which may be fixed rigidly to the central shaft, or more often swinging on steel pins, rotate at high speed. The impact of the raw material on the hammers and the continual high-velocity impact of particle on particle results in material breakdown until it is small enough in size to pass through a perforated screen.

d) Mixing of dry ingredients and addition of liquids: It is the job of the mixer to produce a homogenous blend of all the raw materials desired in a formulation, such that at each feeding period each animal receives a balanced mixture of nutrients. The smaller and younger the animals to be fed, the greater the need for good mixing. Not only are their requirements more demanding, but the daily nutrient intakes of those eating small amounts of feed will be subject to much greater variation as a result of poor mixing. Mixing often improves feed palatability if one or more of the raw materials is unpalatable to livestock.

e) Pelleting of mixed feed (optional): Pelleting involves the compression of a mixed feed through holes in a hardened steel ring or plate (a die) by means of hardened steel rollers. The die forms the feed into pencil-like extrusions which are cut by knives into pellets of desired length on leaving the die. In a ring die pelleter, the rollers or the die may be driven but in a plate die pelleter the rollers only are driven. The die and rollers of a ring die pelleter may operate in a horizontal or vertical plane according to machine design. Pelleters with horizontally running dies are most commonly found in farm-scale feed mills. The pelleting process is very energy intensive, demanding up to 50% of the total power required for feed manufacture. The diameter of feed pellets is governed by the diameter of the holes in the die ring but the smaller the die holes the greater effort is required to force meal into these holes, hence the greater the power demand, that is, the smaller the pellet, the greater the cost of manufacture.

f) Blended feed bagging, storage and dispatch: Compound feeds, whether in meal or pellet form, are usually distributed in sacks in developing countries, although for on-farm use or for distribution to a large livestock unit distribution could be in bins or trucks. Bags may be filled directly from mixers or from holding bins and may be weighed on a scale balance or through an automatic pre-set weigher and bagging unit set to weigh, for example, 25 kg of meal per bag. Bags may be of jute; cotton or paper and can be hand- or machine-stitched or tied with a string or metal tie. Stitching machines do not stand up to abuse and require a

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constant supply of appropriate needles and thread and are therefore more applicable to the larger feed mill models in this

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bulletin. Polythene bags are not normally recommended for storing animal feeds because of the risk of sweating and mould growth. If old bags are re-used, care should be taken that they have not been used previously for the storage of fertilizers, pesticides, or other chemicals.

4.0 Conclusion

Compound feed mills may be linked to a source of raw materials, such as a wheat mill or oilseed crushing plant; to a market outlet, such as a poultry or dairy enterprise; or they may be independent. Traditionally the feed industry has been linked to the supply of the raw materials, as these were generally the by-products of other processes and of low value relative to the main product.

The process of manufacturing animal feed is a means whereby raw materials of widely ranging physical, chemical and nutritional composition can be converted into a homogenous mixture suitable for producing a desired nutritional response in the animal to which the mixture is fed. The process is basically a physical one and chemical changes are few. It should be remembered however that some raw materials will have undergone extensive processing prior to inclusion into a mixed feed, for example, extraction of oil from oilseeds by solvent or mechanical extraction, heat treatment of soya beans or other beans to denature anti-nutritive factors, or the production of fishmeal and meat meal.

5.0 Practical Assignment

Highlight the different types of feed milling machines in feed manufacturing industries in your area.

From your assessment, write out the procedure of feed milling in th industry you visited e

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Are other companies active in other area manufacturing animal feeds?

What are the sizes of these companies (estimated output of feed in tonnes/day)

Would you consider them to be competitors for a limited market or is the demand for feed greater than the ability to supply?

Is the market likely to increase?

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At what rate?

6.0 References

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DISEASE CONTROL

1.0 Introduction

A disease is an unhealthy or abnormal physical state and/or appearance. Diseases are often a product of living organisms (infectious agents) or faulty environments due to poor management. Non-ruminant, like human beings are subjected to many diseases and parasites such as cholera, pox, typhoid, hepatitis etc. Chickens are also known to suffer from internal and external parasites. Some poultry diseases and parasites can be prevented while others cannot be prevented. Some cannot be controlled and cause death when contracted; others can be isolated and controlled. Poultry diseases can be classified under the following headings: Viral diseases; Bacterial diseases; fungal diseases; Parasitic and diseases and nutritional diseases.

2.0 Objectives

At the end of this practical section, you should be able to:

- identify common poultry diseases and parasites
- understand the appropriate preventive or control measures.

3.0 Procedure

Disease Identification Procedure

Identifying signs of disease in poultry is the best method of detecting diseases in non-ruminant animals. There are common signs of disease that you can use to detect potential illness in chicken and other poultry.
Some of these include: feather loss (unless birds are going through a natural moult), general inactivity, discharges, abnormal droppings, dull and/or closed eyes, ruffled feathers, drooped wings, sitting on haunches or lying down. The following are the procedures for disease identification in poultry or other non-ruminant animals:

i. History. A good history will often provide clues that will help solve a problem. Get information on the type of bird, age, feed and water source and consumption rate, growth, production, morbidity and mortality, the description of the case, previous problems, vaccination program, medicine being used etc. The problems may relate to management, environmental factors, and stress rather than to infection so examine the yard and housing conditions. Is the ventilation adequate? Are ammonia fumes a problem? Is it too hot or too cold? Is the litter wet or is it too dry

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and dusty? Is the pen too light or too dark? Are there sufficient hours of light for best production? Is the nest area darkened? Are

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the roosts too high? Do the birds appear comfortable? Chickens can talk and the sounds they make can indicate comfort, hunger, pain, panic, or disease.

ii. Examination of Live Birds. Check the general appearance of the individual or group and try to determine which organ or system is involved in the illness. Note any signs or lesions that might point to a diagnosis, such as small size with poor feathering that suggests infectious stunting (malabsorption syndrome). If the birds show lameness or paralysis, is the lesion in the nervous system, bones, joints, muscles or skin? Some conditions, particularly those affecting locomotion, are easier to diagnose in live birds. Botulism which produces neck paralysis in chickens (leg and wing paralysis are more obvious in turkeys, ducks and pheasants) is an example. Examine the skin of the head, body and legs for lice and mites, injury (particularly cannibalism), blood, mottling, swellings, anemia, cyanosis, or dermatitis. Listen for unusual breathing sounds (snicking, gurgling) and look for gasping or head-shaking that might indicate respiratory distress. Mouth-breathing (panting) is normal in chickens in hot weather. Exudate from nostrils and eyes and dirty feathers also suggest respiratory infection, or if just the eye, ammonia burn, ILToreyeworm. Examine the droppings for evidence of diarrhea or other abnormalities. Take a blood sample for hematology or serology if indicated.

iii. Necropsy. If a postmortem examination is to be carried out, birds that are representative of the problem in the flock must be selected. If birds have died, both sick and dead birds should be opened. Cull birds will not provide the answer. If the problem is a drop in production, try to find birds that look like they have recently stopped laying. It is important to do both an external and internal examination and to follow a specific routine to avoid missing important lesions.

iv. Live birds may be killed by cervical dislocation except when anemia or respiratory disease is suspected.

Disease Prevention Procedure

Diseases caused by infection with a living microorganism such as bacteria, virus, mycoplasma, parasite, etc. are infectious diseases. Most infectious diseases are also contagious, that is, they spread from one chicken to another but a few, like Staphylococcus infection, and aspergillosis, are not.

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i. Prevention By Sanitation: Sanitation is used to reduce the numbers of disease organisms, which the chicken contacts to the level where they will no longer cause disease and to provide a

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clean, healthy environment. This can be done by cleaning and disinfecting, by adequate ventilation to reduce the number of organisms in the air and by reducing contact with other chickens by keeping them in cages. Sanitation affects all levels of the birds' environment:

(a) Building and Equipment
(b) Feed
(c) Water: Open troughs are a source of contamination from the nasal and oral secretion and feces, etc. and must be cleaned regularly.
d) Air: Clean, germ-free air is a very important part of a healthy environment.
(e) The Caretaker: Workers can carry infection to birds on their hands, clothes, boots, and equipment. Good isolation requires shower-in and no contact with other chickens or other people who have chickens or work with chickens.

Sanitation is a method of eliminating or reducing the number of disease causing organisms from contacting the birds.

When the microorganisms which cause a disease are eliminated from an area or country, the disease is said to be eradicated. Whether or not a disease can be prevented by isolation depends on:

(a) Where the microorganisms that cause the disease live.
(b) The way the disease organism is spread.

Sanitation and isolation procedures are:

a. Have only one age group on the farm (an all in, all out program). Buildings over 100 meters apart can be treated as separate units if proper isolation and sanitation procedures are followed.
b. Obtain chicks or replacements from a disease-free, adequately isolated, single source or raise replacements in a different area with separate caretakers.
c. Have no neighboring poultry buildings or free ranging chickens within 300 meters.
d. Clean and sanitize buildings and equipment between crops. (wet down litter before removal to protect neighboring poultry and do not store or spread litter near poultry buildings).
e. Screen buildings against wild birds and keep out rats, cats, and dogs, and control insects. Remove dead birds from the

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pens at least twice a day and dispose of sick and dead birds at least 100m from the poultry buildings. Make sure dogs, cats and wild birds or animals cannot drag or carry dead chickens onto the farm.

f. Limit the movement of workers from one building to another.

g. Bring in only new or sterilized egg cases and flats.

h. Make sure employees do not keep poultry or pet birds or come in contact with free-range chickens or their droppings and do not visit other poultry farms.

i. Keep out visitors (particularly those who may visit other poultry farms) and provide boots and protective clothing for persons entering the poultry area.

j. Disinfect necessary vehicles (feed trucks etc.) and restrict them to the loading and unloading areas which should not be near the building entrance. Keep the driver in the truck or provide boots and coveralls.

k. Make sure poultry service crews disinfect equipment, shower, and change clothing before entering the poultry area (except at cleanout).

l. Shower and change clothing after taking chickens to market or meeting with poultry workers from other farms.

ii. Prevention By Isolation: This method of disease control is simple. Stop the microorganisms that cause disease from contacting the chickens. 3. Prevention By Vaccination: Poultry have a good immune response to many diseases and to vaccination. They also pass immunity to offspring through the egg. Breeders require a special vaccination program.

iii. Prevention By Medication:

a) Preventive medication Some diseases such as coccidiosis, necrotic enteritis and enterohepatitis can be prevented by medication. Preventive medication is most useful when protection is only required for a limited time as in broiler chickens or when immunity does not develop such as in necrotic enteritis.

b) Therapeutic medication Therapeutic medication can be considered preventive when it is used to control the spread of serious infectious diseases such as coryza or cholera. Medicines given by injection should not be given into the abdomen or leg. They can be given under the skin of the back or into the muscle of the breast. Medicine given in the drinking water can be poured into the drinkers. In an automatic system they can be mixed in a large container and

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run into the system by gravity or a pump. Medicine can be added to a pressure system with a proportioner.

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Birds drink more water in hot weather. The level of medicine must match daily consumption and should be reduced in hot weather. It could be given for just 8 to 16 hours a day. Medicine is often added to the feed at the feed plant. Most preventive medicine is used this way. In a disease outbreak medicine can be added to the water until medicated feed is available.

4.0 Conclusion

In this unit, you have been introduced to the diseases of poultry, their causes, symptoms, effects, prevention and treatments where applicable with a view to showing the importance of prevention of diseases.

5.0 Practical Assignment

Visit a veterinary unit of a large poultry farms, Use the procedure above to identify five (5) Viral, Bacterial, Fungal and Parasitic diseases of poultry broilers and their preventive measures. State your findings using the format below:

S/N	Diseases of Poultry	Symptoms	Control	Treatment
A	Viral			
1				
2				
3				
4				
5				
B	Bacterial			
1				
2				
3				
4				
5				
C	Fungal			
1				
2				
3				
4				
5				

 95

D	Parasitic			
1				
2				
3				
4				
5				

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NATIONAL OPEN UNIVERSITY OF NIGERIA

FACULTY OF AGRICULTURAL SCIENCES

DEPARTMENT
OF
Crop and Soil Sciences

FPY/SIWES PRACTICAL GUIDE

SLM403 FARM DESIGN SURVEY AND LAND USE PLANING

Writer: Dr. Keswet Andrew

INTRODUCTION

This practical guide is designed for students of agriculture who are in 300 level and need to know about land survey and farmstead planning. As student of agriculture, land plays an important role in agriculture as there can be no agricultural production without the use of the land. By going through this practical students will have a hand-on some of the equipment used and know the concept of what land survey and farmstead planning is all about. Students will learn about the tools equipment use and learn about some of the procedures employ.

OBJECTIVES OF LAND SURVEY

1. it enables the farmer know the area of farm land
2. it enable the farmer know about the hydrology of the land
3. it enable the farmer have security over his farm land
4. it adds to the farmers security against intruders
5. it is good for collateral
6. it enables the farmer secures the boundaries of his land
7. it helps the farmer know how useful is his land
8. it is basis for farm design
9. it allows for decision making.

according to the American congress and surveying and mapping (ACSM) land surveying is the sand and out of making all essential measurements to determine the relative points and or physical and cultural details above, on beinsth the surface of the earth and to depict them in a usable farm, or to establish the position of points and or details. The techniques use land survey are

- distance measurement
- angle measurement
- leveling
- determining
- reference network

DISTANCE

Objectives:

1. Given a measure of length expressed in a particular unit, be able to express the given length in any unit (inches, feet, yard, rod, mile, meter, kilometer).
2. List and described the methods and equipment used in measuring distance and be able to work problems involving measuring by odometer, pacing or stadia.
3. Be able to write a distance measurement in terms of “full” or “plus” stations.
4. Describe the procedure for horizontal taping on sloping ground.

PRINCIPLES

Measuring distance is probably the most common procedure used in agricultural surveying. The instruments used are simple, but a high degree of accuracy can be achieved with practice and careful work. Greater errors are introduced in agricultural surveying by inaccurate measurement of distance than by any other cause. In this section you will become acquainted with the basic methods and techniques of measuring distance.

INSTRUCTIONAL TASK (PROCEDURES)

Since several common units of length or distance are used in agricultural surveying, you will need to become familiar with the different sizes of length units and be able to change from or make connections from one unit to the other.

Common English units are

1 toot (ft)	=	12 inches (in)
1 tard (yd)	=	3 feet (ft)
1 rod = 16.5 (ft)	=	5.5 yd
1 mile (mi)	=	5280 ft = 1760 yds = 320 rods

Metric system of measure

1 centimetre (cm)	=	10 millimetre (mm)
1 Meter (m)	=	100 centimetre (cm)

1 Kilometre	=	1000 metres (m)

Conversion of one system of unit to the other

1 m	=	39.37 in	=	3.28ft
1 ft	=	0.306m		
1 km	=	0.621 ml		
1 ml	=	1.609km		

Practice

Express 550 yds as rod

Express 10km as yd

Express 75 rods as meter

Express 12600 ft as kilometre

Instructional Task II

The principal methods of measuring distance are:

(1) Odometer readings

(2) Pacing

(3) Stadia

(4) Taping or Chairing

Odometer

A device that counts the revolutions of a wheel rolled along the line to be measured. There are special types of wheels with counters but a bicycle or any round object may be use.

To be accurate the wheel must roll along the ground without slipping. The circumference of the wheel must be known and is equal to II (3.14) times. The diameter the measured distance is then the product of the wheel circumference and the number of wheel towns. This is expressed in the following equation.

MD	=	$(\pi D) \times (N)$
MD	=	Measured distance in ft or in
D	=	Wheel diameter in ft or cm/m

N = number of wheel revolutions.

Pacing

This is the oldest, simplest and easiest method of obtaining a measured distance. You must determine your pace distances (pd) and this can be found by multiplying the number of steps between two points by a predetermined pace factor (pf). The pace factor vary with individuals. Pace factor varies with the topography of the land and its shape. Pace factor can be determined by pacing a measured length severally say 3 to 4 times and taken the average. Pace factor vary with individual. Pace factor can be determined by using your normal stride or walk length. For example; to determine his pace factor, a man takes 62, 60 and 64 steps on 3 trials to travel a measured distance of 200ft what is his pf.

The average steps is $\frac{62 + 60 + 64}{3} = 62$ steps

His pace factor is $\frac{200\text{ft}}{62 \text{ steps}} = 3.23$ft per step

St he counts or measured 400 steps on a ground, what is the pace distance covered.

pd = steps x pf

= 400 x 3.23

= 1292 ft

Taping

This is the most common and most accurate method of measuring horizontal distance using a steel tape. Tapes come in various sizes and graduations some come in meters or feet or both.

Before attempting to measure with a tape, it is important to note the marks or graduations, especially where the tape is sub-divided into tenths and hundredths of feet or metres. There are six basic steps involved in taping. There are:

(1) Lining in (2) applying tension (3) plumbing (4) marking tape length (5) reading the tape and (6) recording the distance

Surveyor’s steel tape 100ft or meters long

1. Metallic tape: made of high grade linen re-inforce with fine copper wire.
2. Mostly found in soft long and comes in a leather case with a keel
3. Chaining pins: sometimes called “surveyors” arrows” are used to mark the and of each tape length. They are made of heavy gange wire and are 12 to 15
4. in long. Mostly painted red and white and have bright plastic cloth attached to help locate them in tall grass.
5. Range poles: usually lin diameter tubular steel or wooden shafts 6 to 10ft long with one end pointed. They are painted red and white and are mostly used “lining in” when taping or measuring angles.
6. Plum bobs: has 6 to 10ft of cord attached and are used when taping on sloping or irregular ground to transfer the distance from the horizontally held tape to a point on the ground.

Station in survey

Survey distances are referred to as “STATION” A distance of 100ft is called a “Full station” and is written as 1+00. Similarly a distance of 200 ft is written as 2+00. A fractional part of a distance between full stations is called a “plus station” .4216.8 ft is called station 2 +16.8

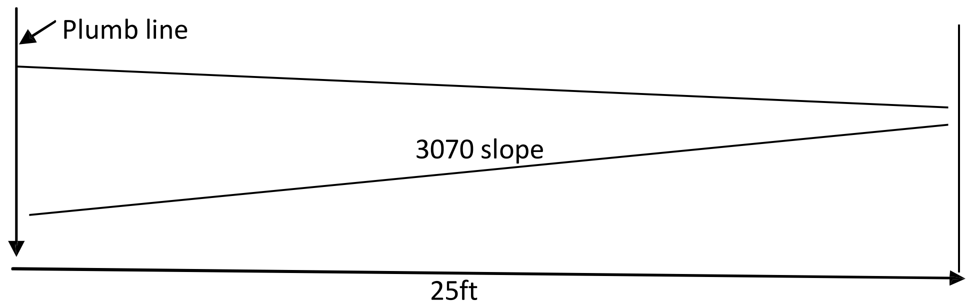
Express the following survey distance in terms of full and plus stations.

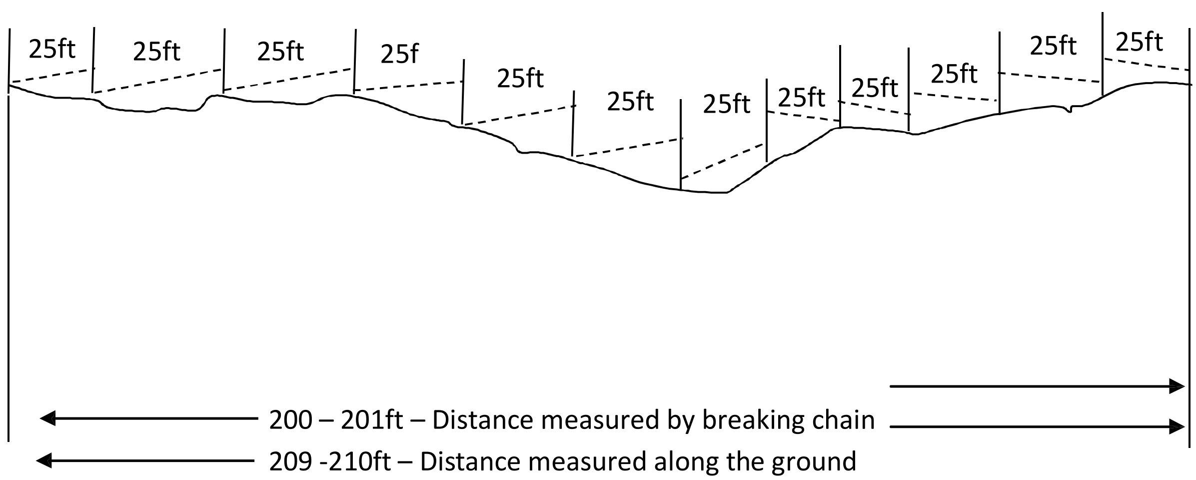
1) s1081.5ft = 10+ 81.5
2) 65.7ft = 0+65.7
3) 927.0ft = 27.0
4) 230.0ft = 2+30.0

Instructional Task

All distances in surveying are measured horizontally there are two methods 1) tape held horizontally, and 2) tape on the sloping ground. Of the latter method is used the percent slope must be measured and the horizontal distance calculated by trigonometry or obtain from tables.

With the horizontal tape method one end is held on the ground, while the other end may be a considerable elevation above the ground the fave distance is transferred to the ground from the elevated end of the tape by a plumb 606. If the slope is more than 5 or 6% it is necessary to use a process called “breaking chain” in this method the head chain man lays out the full length of the tape. The 100ft length is then divided into convenient increments, always plumbing down to the ground from the horizontal tape. (see diagram below).





The 100ft length is then divided into convenient increments, always plumbing to the ground from the horizontal tape.

Taping equipment

← 200-201ft – distance measured by breaking chain →

← 209-210ft – distance measured along the ground →

Hand level: this consists of a small sighting tube 5 to 6 in long equipped with a spirit level. The image of the bubble is reflected by a trism and can be observed by the operator as he/she looks the rough the tube. The instrument is held to the operator's eye and is leveled by raising.

RULES FOR TAPING

1) Line in the tape carefully and keep the tape and the line being measured
2) Keep a uniform tension of about 15k pull on the tape for each measurement.
3) Keep in mind the type/style of tape being used to avoid error of measurement.
4) "Break chain" on slopes as necessary to keep the tape level, or calculate the percent. Slope if measuring with the tape on the ground.
5) Carefully mark each station and keep an accurate count of the stations

AREAS

Objectives

1. Be able to express the given area in any of the units earlier talked about
2. Given a hit of area formulas as (e.g triangles, rectangles, circle, trapezoids etc) and appropriate data (description or sketch of an unknown area be able to select the correct formula to calculate the area.
3. Given a dimensioned sketch of an rectangular field (with straight and curved sides) be able to subdivided the land into various sizes and use correct formula to calculate their areas.

Objective

One of the most common applications of surveying is to measure the area of a given land field or farm. If great accuracy is required, a professional engineer or land surveyor should be employed. He will measure the angles with a transit and the distance with a steel tape, and calculate the areas accurately.

1. Express 200 square rods as acres

   1 sq rod = $\frac{1}{160}$ area

200 sq rod = 200 x $\frac{1}{160}$ ac

= 1.25 qcre. (ac)

2. Express 890 acres as sq mile

3. 1 ac = $\frac{1}{160}$ sq ml.

890 ac = 890 x $\frac{1}{160}$ sq ml

= 1.39 sq. ml

Express 640 acres as hectares

1 ac = 0.405 ha

640 ac = 640 x 0. 405 ha

= 259 ha.

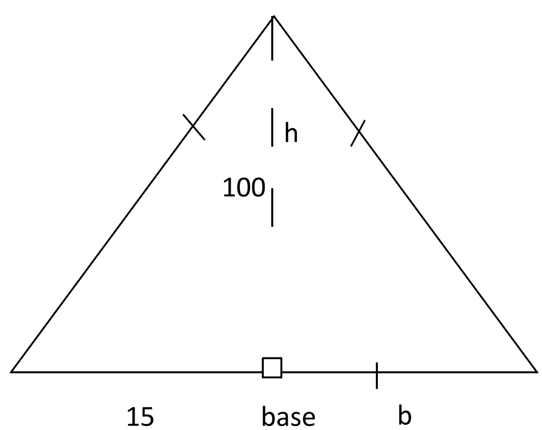
TRIANGLES:

Formula for calculating triangles with equal sizes. find the areas in meters of a triangle with a base 15m and height 10m

A = $\frac{1}{2}$ (b x h)

B = base

H = height



Area = $\frac{1}{2}$ (b x h)

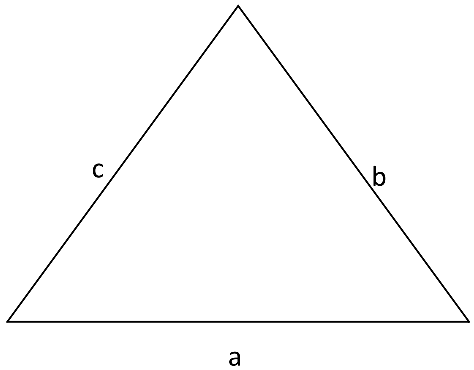
= $\frac{1}{2}$ (15x10)

= $\frac{1}{2}$ x 15 x 10

= $\frac{150}{2}$

= $75m^2$

With the length of the three sides known but not equal.



A – $\sqrt{s\ (s-n)s-b)\ (s-c)}$

A = Area

S = Total sum of $\frac{a+b+C}{2}$

For example; find the area of triangle in areas and hectares whose size are given as 650, 428, 282

S = $\frac{650+428+282}{2}$ = 680

A = $\sqrt{680\ (680-650)(680-428)(680-282}$

= $\sqrt{(680)(30)(252)(398)}$

= $\sqrt{20.4x10^8}$

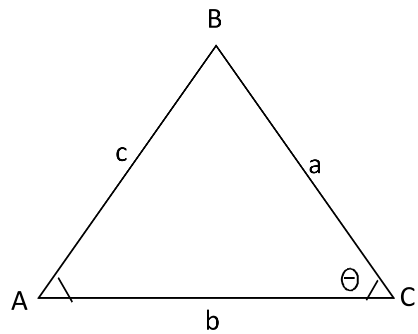
= 4.52 x 10^4 sq ft

Since 1 sqft = $\frac{1}{43560}$ ac.

4.52 x 10^4 sqft = 4.52 x $\frac{1}{43{,}560}$ ac

= 1.04 ac.

Triangle: with two sides plus an angle known



A = area

A and B = know side

θ Angle between sides

Find the area of a triangle, in hectares, having sides measurement 555m 350m and 450 angle.

A = $\frac{1}{2}$ (ab sin ø)

= $\frac{1}{2}$ (350 x 555 x 0.707).

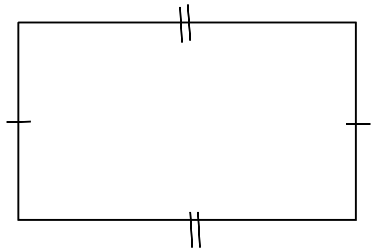
= 6.87 x 10^4 sqm

Since 1sqm = $\frac{1}{10{,}000}$ ha

6. 87 x 10^4 sqm = 6.87 x 10^4 x $\frac{1}{10{,}000}$ ha

= 6.87 ha

Rectangle: either square or parallelogram



A square rectangle has 7 sides equal.

Area = a x b

Find the area in acres of a rectangular area measuring 1320ft by 660ft.

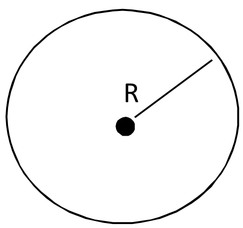
A = 1320 x 660

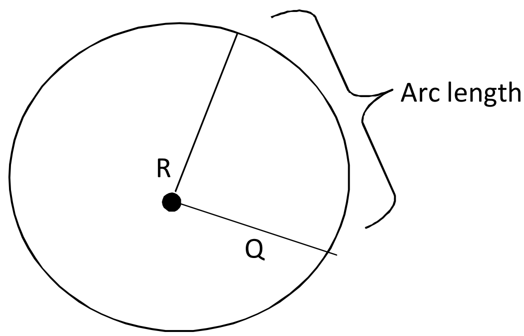
= 8.71 x 10^5 sqft

1sq.ft = $\frac{1}{43,560}$ a

= 20 ac.

Circle or part of a circle





Ana whole circle

A = πR^2

Circular sector

A = $\frac{Arc\ (lenght)}{2}$ A= $\frac{\pi R^2 (angle)}{360}$

Find the area of a circle in sqft having a radius of 75ft.

A = πR^2

= 3.14 (75 x 75)

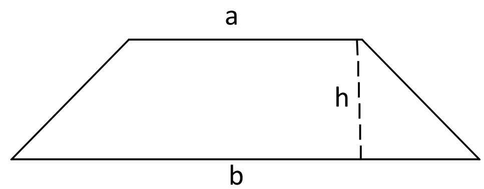
= 17,663 sq ft

Find the area of a circular sector, in sq meters. Having a radius of B5 meters and an angle of 60^0

A = $\frac{\pi R^2 (angle)}{360}$ = $\frac{\pi (B5)(135)(60)}{360}$

A = 9538 sq m

Trapezoid:



A = h $\frac{a+b)}{2}$

A = area

H = perpendicular distance

A x b = length of parallel size

What is the area in acres of a trapezoid whore sides are 300ft and 450ft and a perpendicular distance of 120ft.

H = 120

A = 300

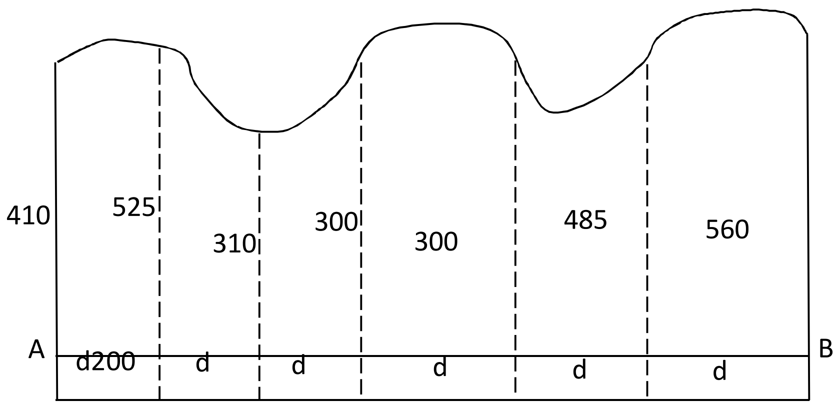
B = 450

Area = $\frac{300+450}{2}$ = A.5 x 10^4 sq ft

= 4.5 x 10^4 sq ft = 4.5 x 10^4 x $\frac{1}{43{,}560}$ ac

= 1.03 ac.

The trapezoid formula is used to find the area of a triangular shape area having three straight sides and curved side



Area = d $\frac{ho}{2} + \epsilon h + \frac{hn}{2}$

A = Area

D = equal distance between offset

ho and hn = and of offsets

£h = sum of all interior offsets minus and offsets

Area = d $\frac{ho}{2}$ + £h + $\frac{hn}{2}$

Ana = 200 $\frac{410}{2}$ + 510 + 310 + 300 + 500 + 485 + $\frac{560}{2}$

= 200 (205 + 2105 + 280)

= 200 (2590)

= 518,000 sq ft

Since 1 sq ft = $\frac{1}{43560}$ ac

A = 11.89 ac.

Differential leveling

Objectives:

1. Be able to describe what is meant by
    a. Differential leveling
    b. Bench mark (Bm)
    c. Back sight (Bs)
    d. Height of instruments (Hi)
    e. Foresight (Fs)
    f. Twining point (Tp)
    g. Be able to describe the procedure used in differential leveling

PRINCIPLES OF DIFFERENT LEVELING

Leveling is the process of determining the differences in the elevation of points on below or a as the above the surface of the earth e.g such as the ground tops of stakes of various part of a building. Leveling ranks next to the measurement of distance in importance as a surveying technique. Practically no planning or construction can be due without prior leveling differential and profile leveling are two surveying methods very useful for agricultural and horticultural project

The two main purposes of leveling are:

1. For planning: to establish the necessary elevations to develop plans for such structures as buildings roads and terraces etc.
2. For layout: prior to construction of structures such as building to the elevations shown on the plans the equipment used in leveling consists of 1 leveling instrument 2 leveling rod. The leveling instrument is a telescope to indicate when the instrument is in a level position. The level many be tripod – mounted or hand – held. The leveling rod is a wooden scale about 13ft bug graduated into feet, tenths and hundredths of feet/meters or 4.5 6m long adro graduated in meter tenths hundredths of meter.

Differential leveling is the process of finding the different in elevation between two points. Two rod reading, must be made for each up of the leveling instrument. The difference in rod readings represent the difference in elevation between the two points

Profile leveling is the process of determining the elevation of points at measured distance along a selected line. This line may be the counter of a proposed ditch, street, tile line, teviace channel etc. using the information gained by this type of surveying we can plot the elevation and distance of each point on a graph called a profile. With the aid of the plotted profile we can make studies relating to grades, depths, high or low spots, and make estimation of cuts and fills.

Topographic leveling: is the process which the elevation of spaced grid points in a field are determined. This information is need to plot a topographic map of the field by contour lines we can show the natural and artificial features in the field such as hills, valleys, ridge, slopes, dams, etc

INSTRUCTIONAL TASK / PROCEDURE

All leveling sway, there are certain terms used which students must be formula with to make the survey work easier, quicker and faster.

Bench may (BM): A permanent point of known elevation above sea level in which all elevation of other sway work are done.

Back sight (BS): A rod reading taken on a point of known elevation it is the vertical distance between the line of sight and the point of known elevation on which the rod is held.

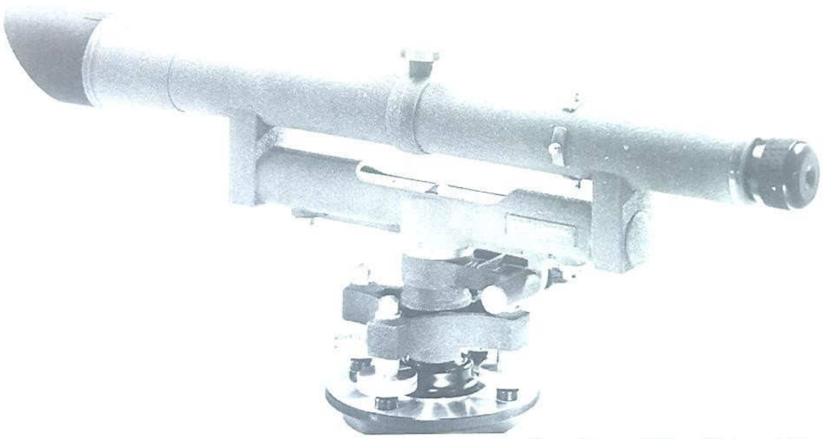
Twining point (TP): is a temporary bench mark upon which tore sight and book sight rod reading are taken for the purpose of continuing the line of levels

Fore sight (FS): is a rod reading taken on any point. The elevation of which is to be determined.

Height of instrument (HI): is the elevation of the line of sight when the instrument is leveled. It is found by doing the BS rod reading to a known elevation.

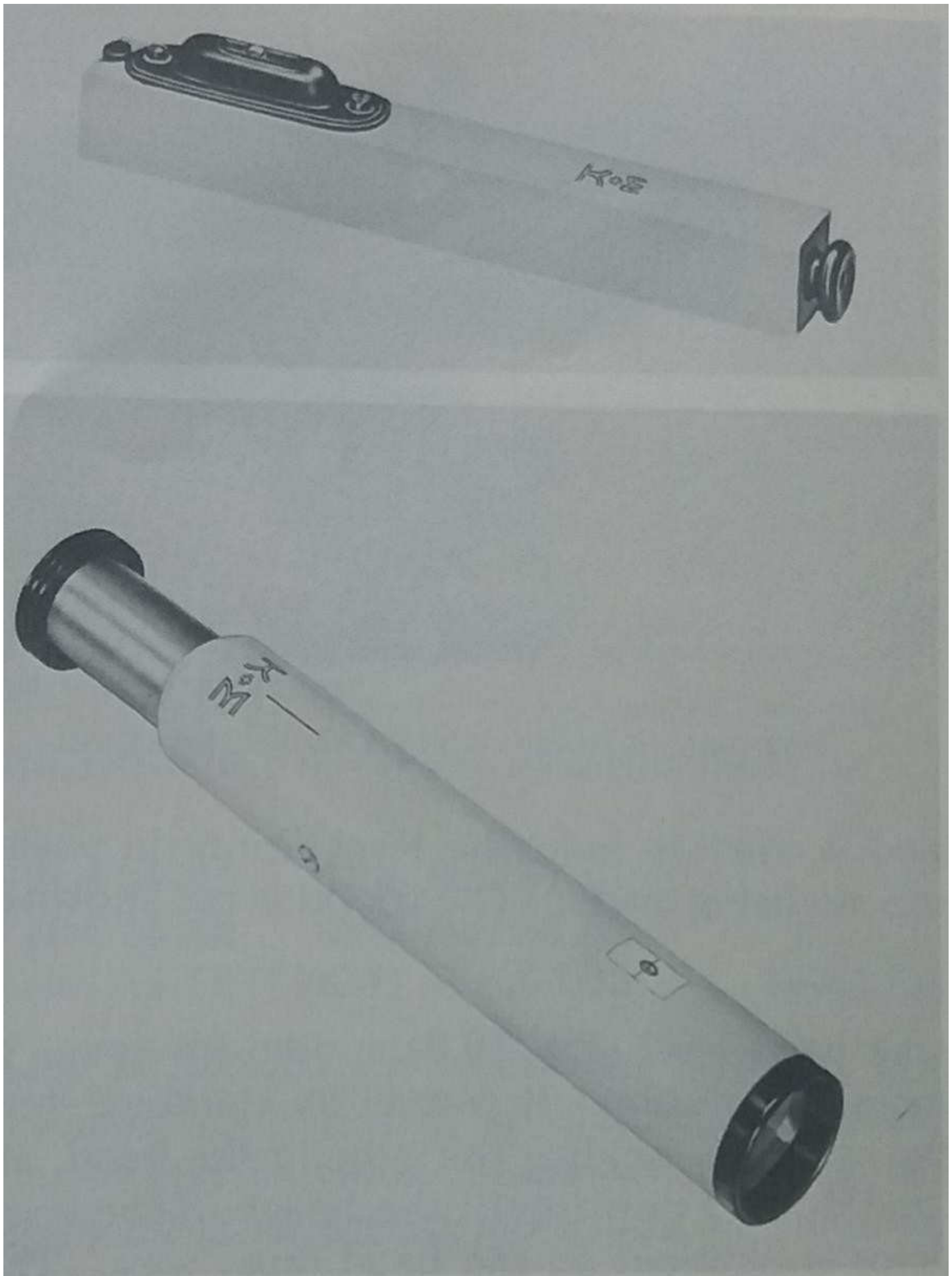
PROCEDURE FOR DIFFERENTIAL LEVELING

Below are the instruments for differential leveling



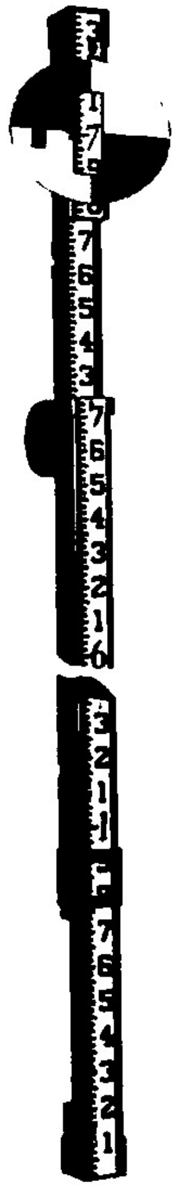
Courtesy of Keuffel and Esser

A Dumpy-Type Engineers Level



Courtesy of Keuffel and Esser

Two types of locke hand levels



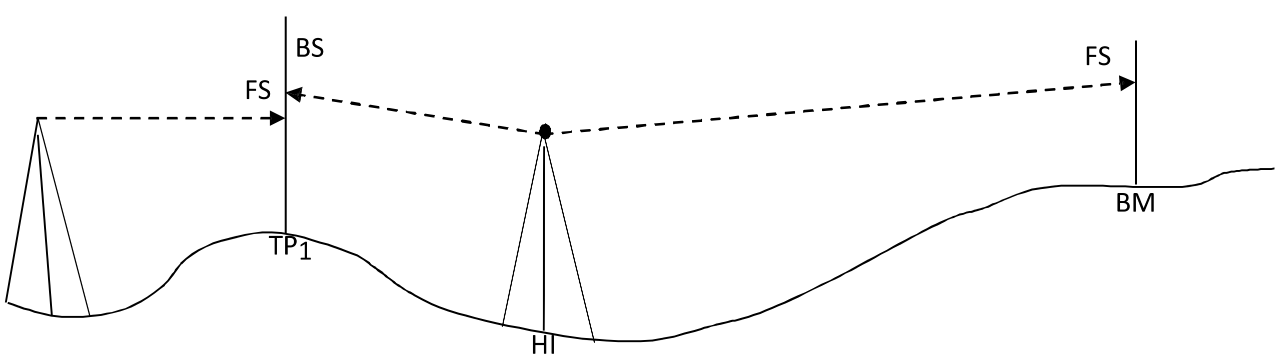
Courtesy of Keuffel and Esser

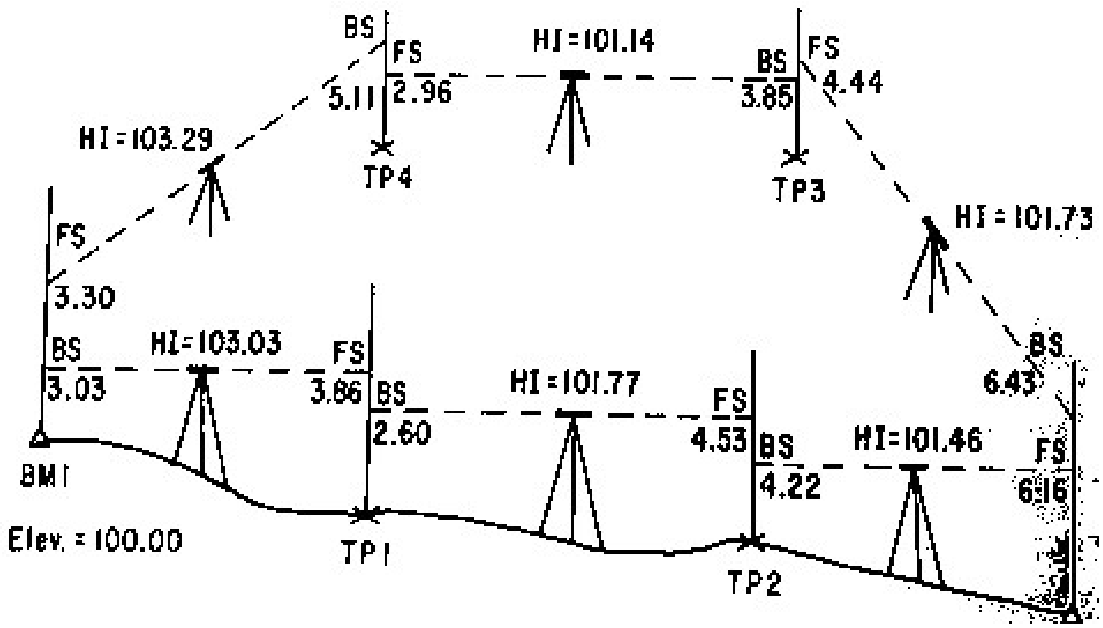
A PHILADELPHIA-TYPE LEVELING ROD

The survey begins with the instrument man setting the level a distance say 300 – 400ft away farm the Bm. The rod man sets the rod on Bm, and the level is set to look towards the direction of the rod where is takes a reading on the rod as shown by the cross hairs in the level. Assuming this reading is 3.03 this is called BS reading so the BS reading is added to the BM known elevation (100.00) to give a HI 103.03 the rodman goes toward in HO direction of taken the survey area sets the rod some distance from the instrument man the instrument man twins his level and sight the rod and takes a reading. Where the crosshairs of the level meets the rod. This is the FS reading say 3.86. it is subtracted from the previous HI to give 99.1 where the rodman sets the rod after the BM, if called the TP, the instrument man can now move forward and sets up the level; takes a reading on TP I. this reading becomes BS (2.60) reading and is added to reading at TP_1. Say 99. 17 + 2. 00 = 101.77 this is the HI reading at TP_1. Again a new TP_2 is selected and a rod reading is taken to be 4.53 is recorded as FS reading. This reading is subtracted from HI 101.77 to give a new elevation (101.77 - 4.53 = 97.24) for TP_2. This process is repeated until the lavation for BM_2 is established to be 95.30

Note keeping procedure for leveling sway.

Five columns are needed from left to rights and the column headings are station (STA), back sight (BS), higher of instrument (HI), foresight (FS), and elevation (elev).





BM2

Elev = 95.30

Differential leveling

STA	BS	HI	FS	ELEV
BM_1	303			
π		103.03		
TP_1	2.60		3.86	99.17
π		101.77		
TP_2	4.22		453	97.24
π		101.46		
π	6.43		6.16	95.74
π		101.73		
TP_3	3.85		4.44	97.25
π		101.14		
TP_4	5.11		2.96	98.18
BM_1			3.30	99.99

£BS =25.4   £FS 25.5

£BS - £FS 25.24 – 25.25 = 0.01

BM_1

100.00 BM_2 (end)

99.99

Check 100.00 – 99.99 = 0.01

= 0.01

Summary of leveling procedure

.

1) Set up instrument
2) Establish BM, and take BS reading
3) Establish TP and take FS reading
4) Move instrument also set up again
5) Take BF on TP
6) Establish next TP and take FS reading
7) Move instrument and set up again
8) Repeat step 5.1

BM elevation + BS = HI

HI – FS = TP elevation

TP elevation + BS = HI

HI – FS = TP elevation

And so forth

In profile leveling there are several foresight (FS) reading and few back sights (BS) several FS reading can be taken an any given BM. Or TP, before profile can be made sway crew set stakes where the rod reading are to be o obtained. The stakes are set at equidistance apart e.g 25,50 or 100ft apart. In profile leveling a station marking a full 100ft is called a full station and the other points along the line are called plus station e.g 225 = 2 + 25.0

Instructional task/procedure for profile leveling

The procedure for profile leveling and note keeping are practically the same as in differential leveling. With the level set up near the line to be profiled, the rod was held on the BM and the

BS reading (3.66) is taken the HI was observed (HI = 100.00 + 3.66) next the rod was held on the hub stake for station 0 + 00, 1 + 00, 2 + 00 and so on and rod reading of 5.23, 3.76 and 3.42 were taken. The elevation of each point was calculated by subtracting the red reading from the H1.(note the some H1was used for all the stations up to 6+00):

When it becomes necessary to select a twining point the rod was held on the top of stake and a FS(4.12) is taken, the elevation of tp, was determined by subtracting the FS from the H1(TP, elevation=103.66-4.12=99.54).The level was moved forward and set up at a new location and a BS (1.38) taken on the tp. The new H1 (100.92) was observed. This procedure is repeated in the same way until the elevation of BMZ was calculated

Example of profile leveling and note keeping

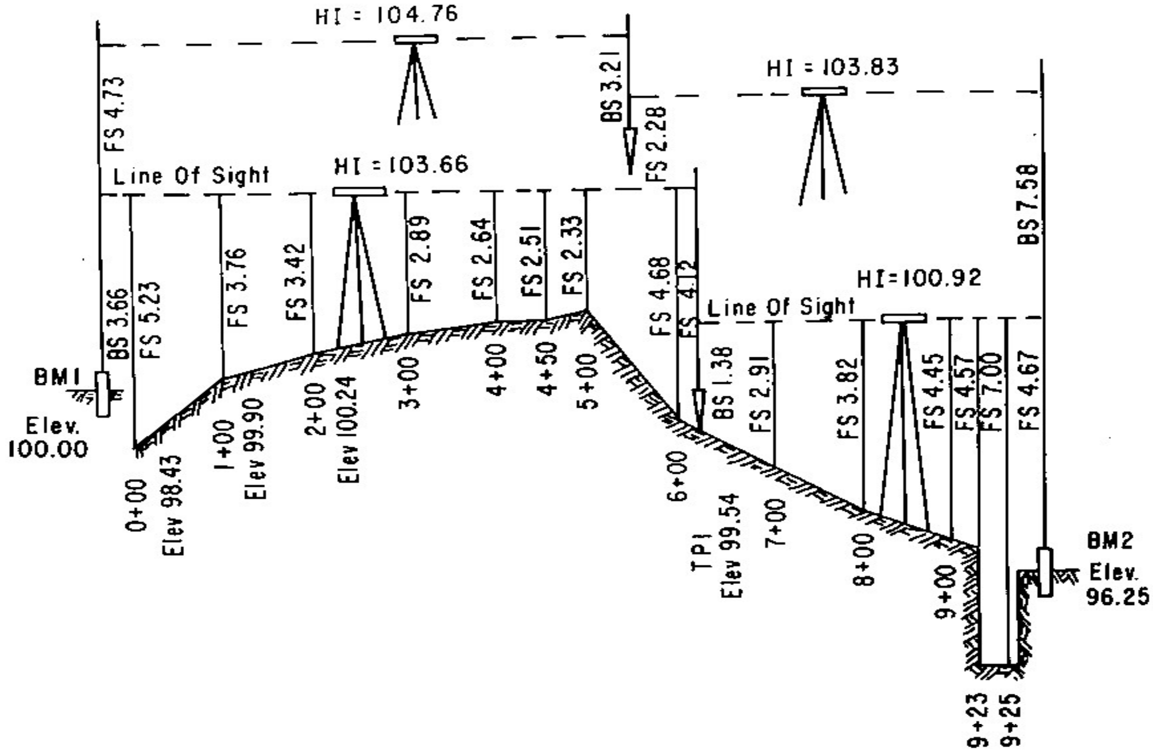


FIG. 20.1. PROFILE LEVELING

PROFILE LEVELING North Side Of Farm Road					Oct. 7, 1974 Fair, Clear, Calm — Brown Jones Smith
Sta.	B.S.	H.I.	F.S.	Elev.	
BM I	3.66	103.66		100.00	BM I Nail in post
0 + 00			5.23	98.43	SE corner of lot
1 + 00			3.76	99.90	
2 + 00			3.42	100.24	
3 + 00			2.89	100.77	
4 + 00			2.64	101.02	
4 + 50			2.51	101.15	
5 + 00			2.33	101.33	
6 + 00			4.68	98.98	
TP I	1.38	100.92	(4.12)	99.54	Top of stake
7 + 00			2.91	98.01	
8 + 00			3.82	97.10	
9 + 00			4.45	96.47	
9 + 23			4.57	96.35	Natural ground
9 + 25			7.00	93.92	Bottom, conc. culvert
BM 2	7.58	103.83	(4.67)	96.25	"X" in SW corner of
TP 2	3.21	104.76	(2.28)	101.55	concrete headwall
BM I			(4.73)	100.03	
ΣBS =	15.83	ΣFS =	15.80		
Error	of closure:	15.83	- 15.80 =	0.03	

Field notes for profile leveling

ESSENTIAL FACTORS IN FARMSTEAD PLANNING

I. WATER; very important for domestic animals and farm use. Quantity and quality very important. Keep source flowing. water is essential for use.

II. DRAINAGE: surface and subsurface drainage is a top priority to avoid pounding hence sickness and diseases. proper drainage is good keep town steed dry

III. DON'T BUILT IN HOLES =can cause problem of drainage, collapse of facilities of building.Difficult to maintain plus (+) and or a minus(-) effect on all activities in the farm

OFF FARMSTEAD FACTORS

Farmstead development at a particular site may be limited by off-farm factor. Consider rural housing ;urban subdivision ; local state and federal building and zoning codes ;air and water pollution control requirements. A legal restrain can close your operation and may prevent recovering your investment . always clear your plans with appropriate authority.

MAKING A PLAN

Preparing a good farmstead plan takes time and effort. it can be a rewarding and interesting experience : some tools to accumulate are ;

1. GOALS-identify your instead goals and set priorities
2. MEHANICAL ITEMS-all the requirements for paperwork, survey etc.
3. INVENTORY; prepare a scale map of the farmstead area, showing slope' underground utilities lines, building location, electric power lines, drives, service and other important physical features review present building-usefulness, condition, location and adaptability

4. INFORNATION; identify facilities needed, additional services registered, traffic routes, feed handling methods family living desire and tax and insurance considerations. Establish realistic space requirement for activities and enterprises within the farmstead area.

FARM STEAD PLANNING

What is farmstead: this is a farm house and the binding near it.

Planning is the part of or process of arranging or putting things together. Planning includes all the elements of research e.g how, what, when, where and who. Farmstead planning is a process or a systematic process of arranging things and putting those things together in order to achieve a purpose or goal.

Farms stead planning like in any planning activity usually starts with a problem: e.g can this be done; how do you achieve your goals or objectives. Where do you get what you want. The objectives of planning include expansion, improved performance higher capacity and better use of labor.

Careful planning includes reviewing the present assessing the near future and providing for the more distant future. For agricultural activities, farm stead planning means looking at the whole problem, the whole farm business as objectively as possible and as far into the future as possible it is better to plan on paper where a mistake can easily be changed.

In farmstead planning it is good for you to look ahead as far as you confidently can. Think big about space, mechanization, processes and operational changes that might occur so there can be adjustment when the need arises.

Farms stead planning includes mapping where things are and evaluating how useful they are. As you plan use all the factors, look closely at all farm activities, for example, a building in the wrong place is 20 years mistake and this can be very expensive

DEVELOPING A FARMSTEAD

Farmstead planning once started, is a continuing part of farm management adjustment and additions to your plan buildings equipment, land, and management will reflect farming changes.

First develop an accurate an accurate plan of what the farmstead looks like now. Then decides what is good and what's bad, analyze current needs, and anticipate future needs.

PROCEDURE FOR ZONE PLANNING

Before starting detail planning, get or prepare at least one map of any site to be considered.

Areal photographs are helpful and this will show major surface features etc.

Contour maps are useful in planning drainage, building location, and adequate slope for drives, lots and drainage lines.

Use several different overlays and return to your plan from time to time to think of new arrangements that may be better. Take proposal to the field for a visual check. Look for ideas or other farmstead plans with situations similar to your own. Stake out proposals. Lay out proposal road, binding or distance zone to help visualize your revised farmstead. The best method is to use zone planning.

ZONE PLANNING

Zoning is a useful tool in planning new or remodeled farmstead after the general site has been selected. For a farmstead with a family living area, place the house at the centre of the planning zones, for a farmstead without a house, the farm court is usually the center, because vehicles, materials and labor tend to work from the court.

ZONE 1: family living lawns, recreation space and vegetable gardens, and guest parking are close to the house. Protect zone 1 farm noise, order, and dust as much as possible.

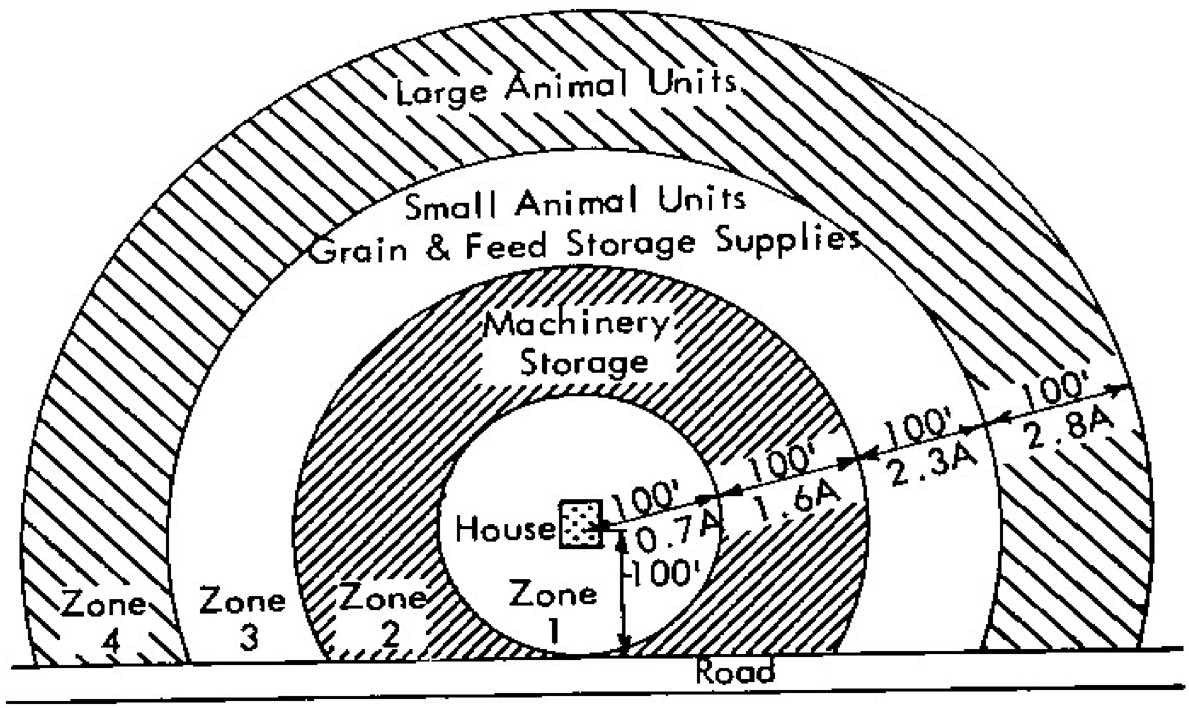
ZONE 2: machinery centre, shop, storage and related services that are relatively quiet dry and odor free are in zone 2. Consider screening the center from family view.

Much of the driveway and farm court may be in zone2 put fuel and clerical storage toward the outer edge near the machinery, but removing ordors, fire danger, and some hazards to children 40 – 60m from the home.

ZONE 3: grain, feed and some livestock. These areas come dust, noise, traffic and odor there tons they are moved another zone further form the house.

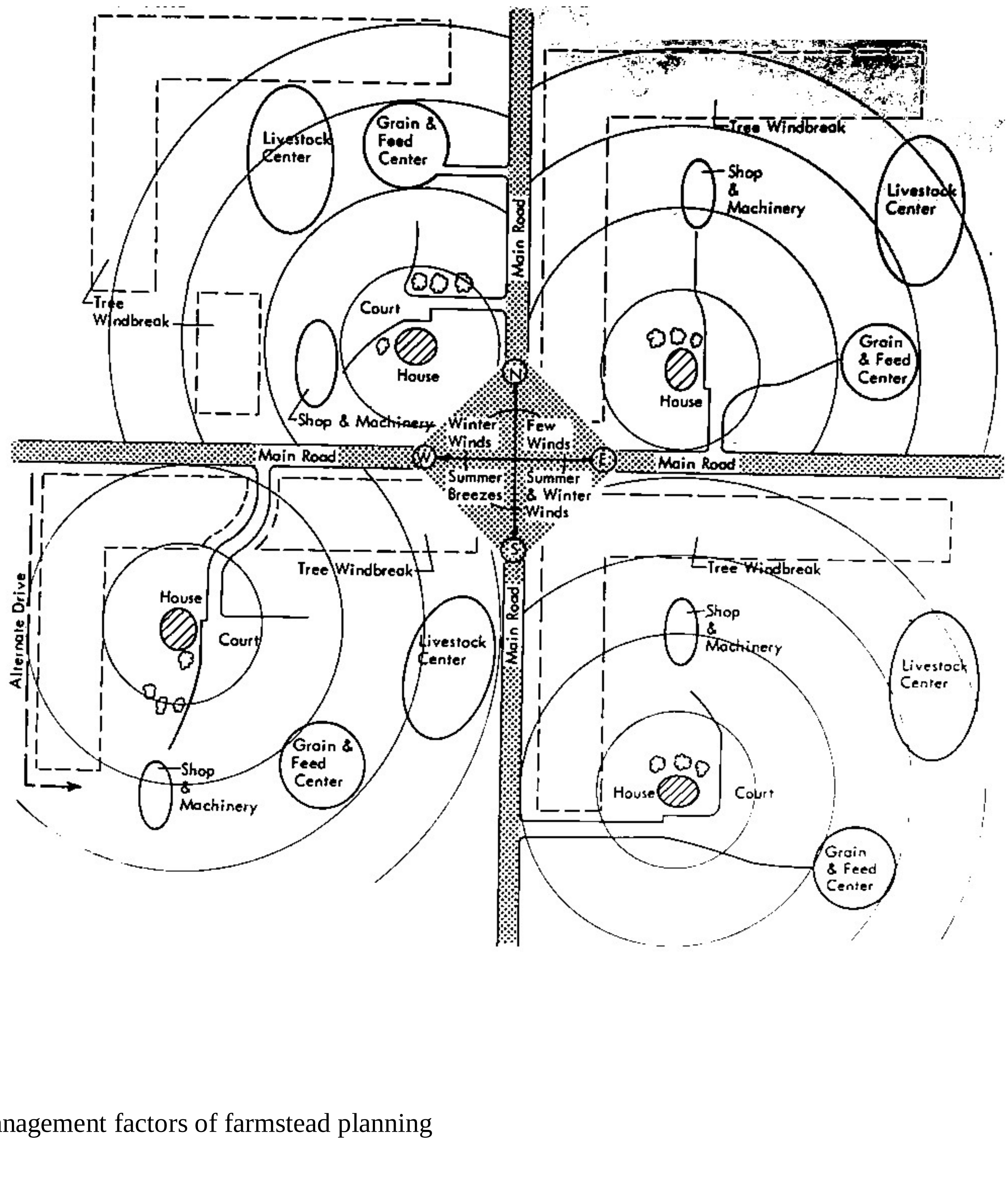
Small animals or small animal unit may be in zone 3 a livestock unit close to the house is convenient for active management of maternity and nursery units or for care of pets or hobby animals

ZONE 4: Major livestock facilities. A large unit, whether confined to building or an dry lot, aerates demand for adequate space drainage waste management, access, loading facilities, feed distribution and other service. It also creates noise, dust, traffic and odors. Space for expansion is usually important.



Curtsey Mid West Plan Service (USA)

Four planning zones



Management factors of farmstead planning

The type and volume of enterprise or combination of enterprises will determine type of farmstead and its management. Factors to manage are:

1. Size of enterprise: if small size locate in zone 2 0r 3 but large size locale further away because of noise , use of heavy trucks and or equipment, heavy traffic etc
2. Pollution: air and water can be polluted easily with waste management chemicals storage including fertilizers / pesticides and fuels. Keep them for away residential area
3. Nuisances: this include noise dust chaff insects and heavy traffic locate annoying activities so they do not detract comfort of living
4. Appearance: location, paints, lawn and type of building affects appearance

Topographic Factors: these are concerned with the lay of the land. Site selection is finding the best location for an enterprise with enough space, good drainage, access to water and other utilities and their proximity. Also consider view, access to neighbors of using same to topography.

Drainage: surface and subsurface drainage very important features of an effective farmstead. Natural drainage and preferable but artificial or man made may sometimes not to be available. Drainage keeps the farmsted clean an ideal slope for drainage should be between 2%. It should not cause erosion.

Slope: enough space is important for all major farmstead activities and for expansion. Avoid location near river, rough topography, sandy sub-soils, rocky or mountainous areas.

Climatic factors: these include wind, sun and rainfall they affect temperature and humidity which can have either a negative or positive effect on farmstead.

Service factors: the connecting links between farmstead buildings and activities; they help the farmstead operate effectively. They include drives, utilities, water, electricity, gas, telephone fire prevention and security.

Planning activity center.

A) family living center essentials to be considered include

- Water
- Drainage
- Site location

B) Fuel chemical and fertilizer storage essential consideration include

- Distance
- Topography
- Service factors

Livestock production: essential considerations include

- Water
- Drainage
- Production volume
- Waste disposal

NOTE: the general consideration in farmstead planning is safety, this affects every aspect of the enterprises. Safety from the view point of theft, fire, flooding, wind, heat from the sun, cold, intruders, poor drainage, wind, animals etc. safety is important to safe guard the investment.

SUMMARY

Land survey and farmstead planning is an important agricultural tool necessary for the success of any agricultural enterprise. While land survey deals with knowing the details of the land such as soil type, topography, slopes, land and its measurements and sizes etc. Farmstead planning deals with how the farm business is suppose to be organized or arranged for effective management and for profit maximization. Farmstead enables the farmer mitigate risks taking that may eventually become very expensive in the future.

NATIONAL OPEN UNIVERSITY OF NIGERIA

FACULTY OF AGRICULTURAL SCIENCES

DEPARTMENT OF CROP & SOIL SCIENCE

FPY/SIWES PRACTICAL GUIDE

CRP 405:

AGRICULTURAL PRODUCT PROCESSING AND STORAGE

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FACULTY OF AGRICULTURAL SCIENCES

400 LEVEL (FPY/SIWES) PRACTICAL GUIDE

CRP 405: AGRICULTURAL PRODUCT PROCESSING AND STORAGE

POST HARVEST PROCESSING

1.0 Introduction

Agricultural product processing and storage plays an important role in food and feed preservation for the continual survival of man. Through the development of modern storage facilities, food crop preservation becomes easy and simple to follow. The practical will be conducted with the aim to look into processing procedures and find possible solutions to the problems facing the students and agricultural machine operators in Agric business. Low level of mechanisation will be observed to be high in areas visited during the period of this research.

Considering the challenges of increase in human population, low yield due to pest and disease attack on cultivated crops and poor level of mechanized agricultural activities. Then product processing and storage in other to meet these necessities becomes of crucial importance. If we process and store our food crops we make it more durable, attractive and add value to it, this can go a long way in mitigating global food insecurity. Agricultural produce and by-products is an essential demand and means of survival for the world's agro-based industries, as it plays a greater role in almost all aspect of life.

Unprocessed raw materials are raw materials for the intermediate industries with processed food/consumables as the finished product. Energy use in Agriculture and food processing is high; hence, mechanization is essential to reduce the level of drudgery especially in the local processing factories and mills. Rice and oil palm processing will be discussed in details during the course of practical. Agricultural Products processing and storage is the stage immediately following the harvest. It determines the final quality of product and it activities basically include:

- Drying
- Threshing
- Transportation
- Storage

Agricultural Processing

Agricultural Product

In Agriculture, product refers to processed agricultural produce (animal or crop) which has been turn into finish goods either for human/animal consumption or for industrial uses.

Processing

Processing in agriculture involves the biological, physical, mechanical, and biochemical manipulation of agricultural produce in other to preserve it for further use. It involves the series of operations taken to change agricultural products into a consumer-finish product.

Agricultural processing involves both scientific and traditional manipulation of agricultural produce so as to make it to be more useful and be able to store them for future uses.

Processing Techniques

These are some of the different processing techniques involved in processing of Agricultural produce. Here, different machines are used in the processing

Why We Process our Food Crops

- Processing helps to make food available even during the off-season.
- When food is processed it taste and look very attractive
- Processing helps in the durability of food crop products- when food crop is been processed like in dehydration of a food crop, micro-organisms becomes absent thereby preventing spoilage.
- Processing adds value to the agric produce.
- Processing helps in producing income to individual and foreign exchange to a country
- It creates room for commercial agriculture, thereby promoting agricultural activities.
- If we stand to process our food crop regularly, then more food will be in our food reserve which is an aid in adaptation and mitigation of climate change.
- Processing provides raw materials for further studies and for industrial uses.
- Through processing some materials are produced (by-products) which can be used for formulation of animal feed.
- The science of processing can aid in drugs and medicinal purposes
- Agric produce processing gives Income to a farmer and improve his standard of living
- When a country processes her food crops then exportation will be high, thereby improving her foreign exchange earning
- Processing provides employment for individual and the masses
- Through agricultural processing of crops like sugarcane bio-fuel and power is produce which is use for generation of farm or industrial power.
- If a processing factory is sited in a rural area, it creates development of that rural areas.

Prior to handling test materials, performing equipment setups, and/or conducting this method, testers are required to read “SAFETY AND HEALTH” in Section F of this method. It is the responsibility of whoever uses this method to consult and use departmental safety and health practices and determine the applicability of regulatory limitations before any testing is performed.

2.0 Objectives

The main objective therefore of acquiring Practical knowledge is to help in solving practical agricultural problems. Specific objectives of the Practical are:

1. Is an essential aspect of our educational set up
2. it educates youths on the impact and opportunity in the Practical and agro-business.
3. It also exposes them to vast store of knowledge available for anyone contemplating owing or managing a farm.

- This practical aim at promoting sustainable agricultural management for economic development.
- It seeks to support local food processing, in-other to improve local knowledge on agricultural mechanization.
- The practical seeks to aid food security, this is because food will betage and spoilage can be cut-down through processing.
- Looking at the amount of food produced yearly, this practical on processing will aid in conservation and re-organisation of any agricultural produce, while contributing in the development and promotion of agricultural activities.
- If greater percentage of our agricultural produce are processed then, importation of many other foreign processed food will be minimised.

- Since climate change is one of the greatest challenges to our food crop production, processing will aid in adaptation and mitigation, creating new ways in which our food crop can be properly managed.

3.0 PROCEDURE FOR CONDUCT OF PRACTICAL

Work Practice: Determination of Moisture Content

A. APPARATUS

1. Weighing device: A balance or scale sensitive to 0.1 % of the mass of the test sample, and having a capacity equal to, or greater than, the wet mass of the sample to be tested.
2. Drying device: An oven or other suitable thermostatically controlled heating chamber capable of maintaining a temperature of 110 ± 5°C.
3. Containers: Any pan or other container, that will not be affected by the drying temperature, and is suitable for retaining the test sample without loss while permitting the water to evaporate.

NOTE: A broad shallow pan is normally most suitable for promoting drying; however, containers with moisture-tight covers are required when the mass of the test samples are not determined immediately after preparation or after cooling following the drying period.

B. TEST PROCEDURE

1. Prepare a representative portion of the material to be tested.

a. Unless other amounts are specified, the following minimum test sample sizes are suggested.

Material	Minimum Sample Size
(1) Soil	100 g
(2) Fine Aggregate – nominal maximum size of 9.5 mm or smaller	500 g
(3) Coarse Aggregate – maximum particle size larger than 9.5 mm sieve.	1000 g

(4) Miscellaneous Materials (straw, chips, etc.) : Sufficient bulk to be representative

b. When testing lightweight, bulky materials, such as straw, hand pack a substantial amount of material into a suitable container having a capacity of approximately 3.8 L.

2. Determine the mass of the test sample and record this mass as the “wet mass”.

a. The most convenient procedure for determining the mass of the sample before and after drying is to place it in a tared container where it will remain throughout the test. The mass of the container and sample are determined and the mass of the container subtracted.

b. If the mass of the test sample is not determined immediately after preparation, place the moisture-tight cover on the container to prevent evaporation.

3. Dry to constant mass at 110 ± 5°C.

a. The drying time required to achieve constant mass will vary depending on the type, quantity, and condition of the material. In most cases, an overnight (16 h) drying period is sufficient. Large clay lumps may require significantly longer drying periods.

b. To reduce the drying time, break lumps of material into small fragments and spread in a thin layer over the bottom of the containers. Position the containers in the drying device to allow the maximum air circulation and exhaust of the moisture laden air.

c. Constant mass has been achieved when less than 0.1 % of the test sample wet mass is lost during an additional exposure to the drying process. Subsequent drying periods to verify constant mass shall be of at least 1 h duration.

d. Verification of constant mass will not be necessary for each sample, provided the drying time exceeds the minimum time established for similar materials and conditions in the same drying device.

4. Remove the sample from the drying device and cool to room temperature. NOTE: If the mass of the test sample is not determined immediately after cooling, place the moisture-tight cover on the container to prevent absorption of moisture from the air.

5. Determine the mass of the test sample and record this weight as the “dry mass”.

D. CALIBRATION

Determine the moisture content of the test sample as follows:

1. Mass of water in sample = wet mass minus dry mass

2. Percent moisture = Mass of Water Dry Mass of Sample ´100

E. PRECAUTIONS

The drying rate of test samples will be affected by the moisture conditions and number of samples in the drying device. When wet samples are placed in the drying device with nearly dry samples, completion of the drying may be restarted.

F. SAFETY AND HEALTH

Soils and aggregates may contain bacteria and/or organisms which can be harmful to one's health. Wearing dust masks and protective gloves when handling materials is advised. The use of heat resistant gloves/mitts or pot holders to remove samples from the ovens is recommended.

4.0 CONCLUSION

By the end of this practical the students should be able to:

- The practical can help to enlighten or widen students scope on the knowledge of agricultural product, giving possible recommendations and practical advice to students, students and agricultural machine operators.
- Through this practical a student can get an ideal practical inside of different ways of preservation and their advantages and disadvantages as applied in real life.

This test is used to determine the water content of a materials by drying a sample to constant mass at a specified temperature. The water content of a given soil is defined as the ratio, expressed as a percentage, of the mass of the pore water to the mass of the solid material (or "solids").

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MILK PROCESSING AND HANDLING

1.0 Introduction

Dairy Technology is a vocational/professional course and therefore practical aspect of this course has been given greater emphasis. This practical guide is designed to supplement textbook on “Fluid Milk Processing” for XI students and is an integral part of the Dairy Technology curriculum. The exercises in this book to impart practical knowledge to the students. Practical covered in this book is the platform tests only and Schools may set up a small lab with pilot scale equipment and models. Educational visits to dairy processing plant may be arranged for the students.

2.0 Objective

Platform tests of milk are the commonly used tests carried out at collection and/or reception for rapid evaluation of quality of the incoming raw milk. These are carried out at the Milk Collection Centres and at Milk Processing Plants. This is important in dairy processing as single lot of milk of poor quality can spoil the whole mixed milk lot. Platform tests do not directly involve the laboratory analysis of raw milk samples. The suspected milk will be segregated and will not be mixed with bulk milk. The milk not fulfilling the compliance with previously set quality standards is subjected to rejection.

3.0 PROCEDURE FOR CONDUCT OF PRACTICAL

A. Organoleptic tests

Quality of milk judged by a person's senses view, smell, and taste is called organoleptic tests. The tests are the first screening of incoming raw milk at reception dock. No equipment is required for conducting the tests. Trained and experienced person yield the reliable results. The appearance of milk and lid of milk can is observed and inspected instantly after removal of lid. Judge smells the milk, observes the appearance, checks the can for cleanliness, looks for sediment, flies, etc. and tastes if necessary. For classifying the milk according to cleanliness, milk is filtered with a special milk filter. If there is any doubts the milk samples are subjected to other laboratory tests for confirming the quality.

Procedure

1. Open the can/ container of milk.

2. Immediately smell the milk.

3. Observe the appearance of the milk.

4. If still unable to make a clear judgement, taste the milk, but do not swallow it. Spit the milk sample into a bucket provided for that purpose or into a drain basin, flush with water.

5. Look at the can lid and the milk can to check cleanliness.

Observations/Judgement

- Condition of containers/cans: ____
- Appearance of milk: ____
- Colour of milk: ____
- Extraneous matter: ____
- Accept/reject milk: ____
- Comments: ____

Abnormal smell and taste may be caused by:

- Atmospheric taint (e.g. barny/ cowy odour).
- Physiological taints (hormonal imbalance, cows in late lactation spontaneous rancidity).
- Bacterial taints.

- Chemical taints or discolouring.
- Advanced acidification ($pH < 6.4$).

B. Indicator test

The acidity developed in milk due to bacterial activity is measured in terms of pH value as indicated by special indicator dyes, e.g. brom thymol blue and brom-cresol purple.

Observation

Acidity of milk: ________________________

Accept or reject milk: _________________________

C. Sediment test

Milk is passed through a funnel containing a filter disc and the amount of dirt and dust collected is compared visually or by weight. The test indicates the gross impurities and dirt in milk as a result of unhygienic conditions of production.

Sediment test

Presence of sediment: ___________________________

Accept or reject milk: ___________________________

D. Lactometer or density test

During the organoleptic inspection, if the milk appears to too thin and watery and its colour is "blue thin", it is suspected that the milk contains added water. Lactometer test serves as a quick method to determine adulteration of milk by adding water. The test is based on the fact that the specific gravity of whole milk, skim milk and water differ from each other.

The density or specific gravity of milk is determined by lactometer reading. At 15 ºC the normal specific gravity of the milk ranges from 1.028 to 1.033. Below the value indicate the possible addition of water to the milk. It is also possible the lactometer reading can be combined with the fat test to have the total solid levels in milk. Density of fat is lower than that of milk. Results of the low-fat test and higher specific gravity indicate the possible skimming of milk. Results of low fat test and low specific gravity indicate the possible addition of water in milk. Always read the temperature of the milk first; the lactometer reading varies according to temperature.

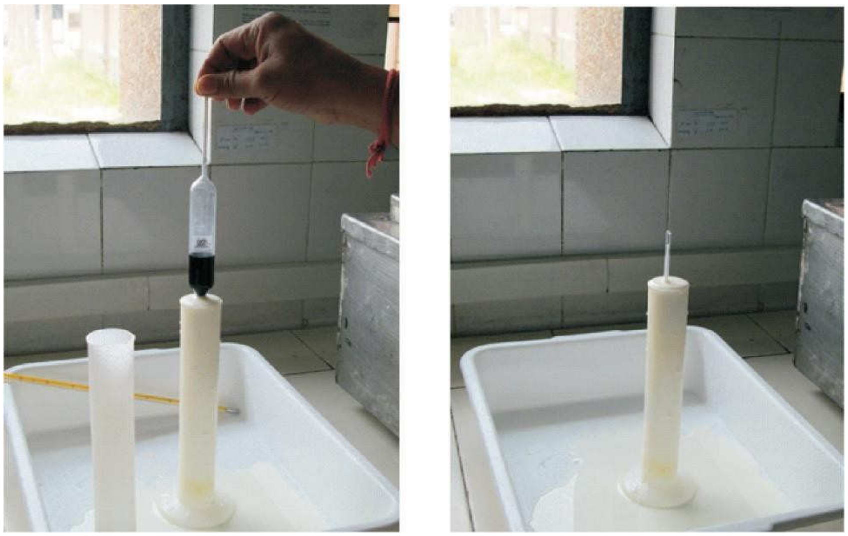

Fig. Measurement of density of milk using lactometer

Observations

1. Type of lactometer: ____________________________

2. Temp of milk: ____________________________

3. Lactometer reading: ____________________________

4. Specific gravity of milk: ____________________________

4.0 CONCLUSION

Quality of milk judged by a person's senses view, smell, and taste is called organoleptic tests. The tests are the first screening of incoming raw milk at reception dock. No equipment is required for conducting the tests. Trained and experienced person yield the reliable results. During the organoleptic inspection, if the milk appears to too thin and watery and its colour is "blue thin", it is suspected that the milk contains added water. Lactometer test serves as a quick method to determine adulteration of milk by adding water. The test is based on the fact that the specific gravity of whole milk, skim milk and water differ from each other.

5.0 REVIEW QUESTIONS

1. Define platform tests?

2. What is the need of platform tests in a milk reception doc?

3. How are water addition/ skimming of milk checked?

4. What is the importance of 10 min Resazurin test?

5. What is importance of alcohol test?

6. Define developed acidity of milk.

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AGRICULTURAL PRODUCT STORAGE

1.0 Introduction

"Storage" means the phase of the post-harvest system during which the products are kept in such a way as to guarantee food security other than during periods of agricultural production.

The main objectives of storage can be summed up as follows:

- at the food level, to permit deferred use (on an annual and multi-annual basis) of the agricultural products harvested;
- at the agricultural level, to ensure availability of seeds for the crop cycles to come;
- at the agro-industrial level, to guarantee regular and continuous supplies of raw materials for processing industries;
- at the marketing level, to balance the supply and demand of agricultural products, thereby stabilizing market prices.

In order to attain these general objectives, it is obviously necessary to adopt measures aimed at preserving the quality and quantity of the stored products over time.

Influences of environmental factors

To conserve the quality of products over long-term storage, degradation processes must be slowed down or even stopped.

Degradation of grains during storage depends principally on a combination of three factors:

- temperature,
- moisture,
- oxygen content.

During storage, as during other phases of the post-harvest system, the combined effects of these three factors can sometimes cause severe losses.

Temperature and moisture

Temperature and moisture are determining factors in accelerating or delaying the complex phenomena of the biochemical transformation (especially the "breathing" of the grain) that are at the origin of grain degradation.

Furthermore, they have a direct influence on the speed of development of insects and microorganisms (moulds, yeasts and bacteria), and on the premature and unseasonal germination of grain.

In the general diagram of conservation designed by Burges and Burrel, the relationship between temperature and moisture content is established in order to determine the area of influence of certain important degradation phenomena, such as: the development of insects and moulds, and the germination of grain.

Diagram of cereal conservation

It is easy to observe that the higher the temperature, the lower must be the moisture of the grain in order to ensure good conservation of the products.

In view of their influence on the speed of development of these degradation phenomena, the temperature and moisture content of the grain condition the maximal duration of storage.

DURATION OF WAREHOUSING (in days)

	TEMPERATURE					
MOISTURE	**5°C**	**10°C**	**15°C**	**20°C**	**25°C**	**30°C**
13%				180	115	90
14%			160	100	50	30
15%			100	50	30	15

16%		130	50	30	20	8
17%		65	35	22	12	5
18%	130	40	25	17	8	2
19%	70	30	17	12	5	0
20%	45	22	15	8		
21%	30	17	11	7		
22%	23	3	8	6		
23%	17	10	7	5		
24%	13	8	4	4		
25%	10	8	6	3		

As an example, the preceding table shows the recommended durations of warehousing, according to the temperature and moisture content of the grain.

The temperature depends not only on climatic conditions but also on the biochemical changes that are produced inside a grain mass, provoking undesirable natural heating of the stored products.

As for the moisture content of the stored grain, it depends on the relative humidity of the air, as shown in the air-grain equilibrium curves.

With a relative air humidity below 65-70 percent, many grain-degradation phenomena are slowed down, if not completely blocked.

In this sense, the "safeguard" moisture content is defined as that corresponding to an equilibrium with the air at 65-70 percent relative humidity.

The following table shows the moisture content recommended for long-term storage in hot regions of various sorts of grain.

GRAIN	MOISTURE	GRAIN	MOISTURE
Paddy	14.0%	Sunflower	9.0%

Rice	13.0%	Wheat	13.0%
Maize	13.0%	Millet	16.0%
Sorghum	12.5 %	Coffee	13.0%
Beans	15.0%	Cocoa	7.0%
Groundnut	7.0 %	Copra	7.0 %

Oxygen content

Like grain, micro-organisms and insects are living organisms that need oxygen.

Storage of grain in places that are low in oxygen causes the death of insects, cessation of development of micro-organisms, and blockage, or slowing down, of the biochemical phenomena of grain degradation. This favours the conservation of grain, but may affect its germinating power.

Agents causing deterioration of stored grain

The principal enemies of stored grain are micro-organisms, insects and rodents.

Micro-organisms

Micro-organisms (moulds, yeasts, bacteria) are biological agents present in the soil which, when transported by air or water, can contaminate products before, during and after the harvest.

Their presence and growth cause severe changes in the nutritive value and the organoleptic features of grain (taste, smell, aspect).

Furthermore, they are responsible for the alteration of important germinative properties of seeds (vigour and capacity to germinate) and, in the case of moulds, for the potential formation of dangerous poisons (mycotoxins).

Impurities, and cracked or broken grains, foster the development of micro-organisms.

Furthermore, temperature and humidity have a determining influence on the growth rate of these degradation agents.

It has been observed that micro-organisms develop at temperatures between -8°C and +80°C, when the relative humidity of the air is over 65 percent.

On the contrary, atmospheres that are low in oxygen help check the development of these degradation agents.

Insects

Insect infestations can occur either in the field, before the harvest, or in the places where products are stored.

In some cases, these infestations are difficult to discern with the naked eye, since the damage is provoked by the larvae developing inside the grain.

The insects most likely to infest stored products belong to the following families:

- Coleoptera (damage by larvae and adult insects);
- Lepidoptera (damage only by larvae).

Insects can be responsible for significant losses of product. Furthermore, their biological activity (waste production, respiration, etc.) compromises the quality and commercial value of the stored grain and fosters the development of micro-organisms.

Insects can live and reproduce at temperatures between +15°C and +35ºC.

On the contrary, low humidity slows or even stops their development, and a low supply of oxygen rapidly kills them.

Rodents

Rodents invade and multiply in or near storage places, where they can find an abundance of food.

They cause serious damage not only to stored products but also to packaging and even to storage buildings.

The principal rodents, those most common and likely to attack stored products, belong to the following species:

- black rat, also called roof rat (Rattus rattus),
- brown or Norway rat, also called sewer rat (Rattus norvegicus),
- mouse (Mus musculus).

Prolonged attacks by these pests inevitably results in serious quantitative losses of stored products.

To these losses must be added those arising from the decrease in quality of the foodstuffs, caused by the filth (excrement, secretions) rodents leave behind in the stored products.

This contamination is as important from the marketing standpoint as it is for hygiene and health. Indeed, rodents are often the vectors of serious diseases (rabies, leptospirosis).

Storage methods

There are basically two methods of storage: in bags and in bulk.

Bags can be stored either in the open air or in warehouses; bulk grain is stored in bins or silos of various capacities.

The choice between these methods and the degree of technological sophistication of the storage buildings depend on many technical, economic and socio-cultural considerations.

The traditional storage systems used by small farmers must also be mentioned. With their use of artisanal construction techniques and local materials, these are the systems that prevail in the rural communities of many developing countries.

As post-harvest losses are still a major issue for farmers, lack of electricity and poverty in Nigeria, processing of perishable agricultural produce becomes a very big problem. As population increases, there is need to increase food production without much effort on how what has been produced in excess are stored.

Locally constructed Evaporative coolers are not very expensive to produce and can be used for the preservation of vegetables. When water evaporates from the surface of a body, that surface becomes much cooler because it requires heat to change the liquid into vapour. Evaporative cooling, therefore, works by evaporating water into air-steam. The chilling effect that is felt when you come out of a swimming pool and a breeze blows across your body best illustrate this principle (evaporative cooling). The more moisture that is present in the air, the less the chilling effect because the less the evaporation of water. Also, the less moisture that is present in the air, the more the chilling effect because the more the evaporation of water from the surface of the body (Liberty et al., 2013)

Figure . Locally constructed Hygrometer

2.0 Objectives

The main objectives of storage can be summed up as follows:

- at the food level, to permit deferred use (on an annual and multi-annual basis) of the agricultural products harvested;
- at the agricultural level, to ensure availability of seeds for the crop cycles to come;
- at the agro-industrial level, to guarantee regular and continuous supplies of raw materials for processing industries;
- at the marketing level, to balance the supply and demand of agricultural products, thereby stabilizing market prices.
- Is an essential aspect of our educational set up
- it educates youths on the impact and opportunity in the Practical and agro-business.
- It also exposes them to vast store of knowledge available for anyone contemplating owing or managing a farm.
- This practical aim at promoting sustainable agricultural management for economic development.
- It seeks to support local food processing, in-other to improve local knowledge on agricultural mechanization.
- The practical seeks to aid food security, this is because food will betage and spoilage can be cut-down through processing.

- Looking at the amount of food produced yearly, this practical on processing will aid in conservation and re-organisation of any agricultural produce, while contributing in the development and promotion of agricultural activities.
- If greater percentage of our agricultural produce are processed then, importation of many other foreign processed food will be minimised.
- Since climate change is one of the greatest challenges to our food crop production, processing will aid in adaptation and mitigation, creating new ways in which our food crop can be properly managed.

3.0 PRACTICAL PROCEDURE FOR PRACTICAL

Work practice NO 1 : Construction of A Local Evaporative Coolers

Materials

- Two (2) thermometer for each hygrometer
- Plywood, hard wood, wick and bottle.

Procedure

- Cut the wood into 30 × 5cm
- Cut 2 plywood and cover one side
- Bore 2 holes on the upper and lower parts of the hygrometer
- The hole should be 1cm apart
- Nail 2 of the board on each side of the wood such that the wood having holes are located first and second followed lastly by the wood without holes.
- Insert 2 thermometers on the holes and make one of the thermometer wet bulb by fixing a wick on the bulb and inserting the wick in the bottle containing water.
- Put one of the hygrometer in the trolley and the other one outside the cooler for recording of ambient temperatures (both dry and wet bulbs).

Work practice No.2: CONSTRUCTION OF THE EVAPORATIVE COOLER

Materials: - jute bag, trolley, hygrometer and weighing balance.

Figure. Locally Constructed Evaporative Cooler For Agric Produce Storage

Procedures

- Soak the jute bag in clean water and wipe off excess water
- Wrap the jute bag round the trolley such that no part of it is exposed.
- Put freshly harvested and weighed vegetables (100g) into the second chamber of the cooler. The vegetables are fluted pumpkin, water leaf and garden egg (egg plant).
- Also, put one hygrometer into the second chamber of the cooler.
- Finally, place the entire arrangement in the greenhouse.
- The readings must be taken and recorded for 7 days and summary made in tables.
- The vegetables should be weighed 6am and 6pm daily while the both wet and dry bulb temperatures are to be taken every 2 hours from 6am to 6pm daily.

4.0 CONCLUSION

Agricultural product processing and storage plays an important role in food and feed preservation for the continual survival of man. Through the development of modern storage facilities, food crop preservation becomes easy and simple to follow. The practical was designed with the aim to look into processing procedures and find possible solutions to the problems facing the students and agricultural machine operators in Agric business. Low level of mechanisation will be observed to be high in areas visited during the period of this research.

Practical assignment on various agricultural processing and storage are to be conducted by the students at the end of the exercise which will amount to six work practice.

By the end of this practical the students should be able to:

- The practical can help to enlighten or widen students scope on the knowledge of agricultural product storage, giving possible recommendations and practical advice to students, students and agricultural machine operators.
- Through this practical a student can get an ideal practical inside of different ways of preservation and their advantages and disadvantages as applied in real life.

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MEAT PRESERVATION AND HANDLING

1.0 Introduction:

Meat can be defined as animal flesh used for human consumption. Usually, the skeletal muscle and the fat attached to it are referred to as meat, but some organs, like, lungs, liver; kidneys, brain, skin, bone marrow, etc. are also included in this term. It is a collective term, used to denote a wide range of meat, obtained from different animals and birds.

The most common sources of meat are domesticated animal species such as cattle, pigs and poultry and to a lesser extent buffaloes, sheep and goats. In some regions other animal species such as camels, yaks, horses, ostriches and game animals are also eaten as meat. To a limited extent, meat is also derived from exotic animals such as crocodiles, snakes and lizards.

For thousands of years, poultry supplied meat and eggs, cattle, sheep and goats provided meat and milk, and pigs provided a source of meat. These species are the main sources of animal protein for humans. The meat derived from cattle is known as beef, meat derived from pigs as pork and from chickens as poultry.

In physical terms, drying is the lowering of the water activity aw in meat and meat products. Water activity is the measure of free unbound water available for microbial growth. Microorganisms need certain amounts of free water for growth, and their growth is halted below defined minimum levels of moisture. Minimum levels vary from species to species of microorganisms.

Meat drying is not a clearly defined technology. Drying may be done for the single purpose of dehydrating fresh meat for extension of storage, but it may also be one of various processing steps during the manufacture of specific meat products.

The manufacture of fermented meat products, such as raw hams or dry sausages is an example, where drying is one processing component amongst several others. To have an extended shelf life, fermented products need to lose moisture during their fermentation, they are dehydrated or “dried” to a certain extend. Drying and fermentation must go hand in hand to achieve the desired flavor and shelf life. The drying of such products is mostly done in climatized chambers with exact temperature and humidity parameters. Drying under natural conditions is increasingly rare. Another example is the drying of meat preparations in ovens with temperatures in the range of 70-80°C, to become fast-dried products such as beef sticks formed of ground, salted and flavored meat. Furthermore, for a number of indigenous meat products, moderate drying is part of the manufacturing technique with the aim of lowering the water activity (a), thus curbing microbial growth.

2.0 OBJECTIVES

Objective of dry meat

- To make dry meat available in market
- To increase the product quality
- To increase shelf life

3.0 PROCEDURE FOR CONDUCT OF PRACTICAL

MATERIALS & METHODS

- Ingredients, Solvents, Chemicals & Equipment
- Meat
- Common salt
- Distilled water
- Knife
- Ring
- Desiccators
- Crucible
- Selling machine
- Digital weight machine
- Micro oven
- Three layer package

Procedures

1. **Preparation of meat for drying**

The meat is exposed to the open air and intermittent solar radiation and quickly loses substantial amounts of its tissue moisture. The drying process will be faster the shorter the distance from the centre of the meat piece to its surface. In order to accelerate the drying process in particular from the inner layers of the meat, it is therefore common practice to cut the meat in narrow strips or in flat pieces.

2. Sun drying procedure

The basic traditional drying method is called sun drying, characterized by direct solar radiation and natural air circulation on the product. Meat pieces are cut into strips or flat leaf-shaped pieces as described above. Then suspended in the open air or spread on drying trays made of fibre or wire mesh with a wooden or metallic frame. For sun drying, in particular for the suspension method, the meat is sometimes dipped in salt solution (approx. 14% common salt). This helps to limit microbial growth on the meat surfaces and protects to some extend against insects. The drying of such products is mostly done in climatized chambers with exact temperature and humidity parameters. Drying under natural conditions is increasingly rare. Another example is the drying of meat preparations in ovens with temperatures in the range of 70-80°C, to become fast-dried products such as beef sticks formed of ground, salted and flavored meat.

Simple methods of chemical analysis
(Protein, fat, water, ashes)

Chemical analyses to determine the content of protein, fat, water and minerals (ashes) of processed meat products are carried out to establish the nutritive and economic value of the products. Samples of the meat product are finely ground and weighed accurately for each respective chemical analysis.

The determination of the moisture content (or water content) is done by drying an appropriate amount of the sample. The difference in weight between the fresh and dried samples represents the water content. For rapid determination of moisture content a microwave oven is useful

Moisture analysis
(Microwave Drying)

General:

Samples are dried in a microwave oven and the loss of weight upon drying is expressed as percent moisture content.

Application:

This method may be used to determine the moisture content of fresh meat, semi-processed meat, meat mixes and processed meat products.

Equipment:

- Mincer with 6mm plates or heavy duty food processor
- Balance with at least 0.1g sensitivity.
- Desiccators with silica gel.
- Beaker
- Filter papers, 7cm diameter or open weave disposable kitchen cloth.

- Silicon carbide (carborandum) finely ground.

Approximate Drying Times for Sample Sizes of Meat

Weight of crucible = A

Weight of crucible + sample (before drying) in grams = B

Weight of crucible + sample (after drying) in grams = C

% Moisture = (B-C) / (B-A) = (weight of sample) x 100

Method

- Prepare the sample by mincing or chopping as described in sample preparation.
- Preheat the oven
- Determine the heating time necessary to completely dry the samples in the microwave oven.
- Weigh an empty crucible. Weigh about 10 grams of sample. For meat samples, spread the samples into a thin layer around the lower wall of the container with spatula or spoon. Place the samples in the preheated oven.
- Cool the samples in desiccators and accurately weigh the crucible & dried sample.
- Repeat drying until constant weight is obtained.
- Fat analysis
  Fat determination using samples dried from the microwave oven
- Get the weight of the dried sample.
- Put the dried sample.
- Place the dried sample inside the sox let extraction tube connected to the sox let flask.
- Pour enough ether into the extraction tube.
- Extract for 10 hours, at 3-4 drops per second.
- After extraction, take out the defatted sample from the extraction tube and air dry the sample for traces of ether. Dry further in an oven at 100°C and cool in a dessicator. Weigh the defatted cooled samples to constant weight.
- %Fat = Weight of dried sample – Weight of defatted sample / Original weight of the sample x 100
- Ash determination
- The defatted sample is placed in a constant weight porcelain crucible with cover.
- The crucible is then placed in a muffle furnace, and at a temperature of 600°C the sample is ignited for two hours.
- After ignition the crucible is placed in the oven to bring down the temperature for about 30 minutes, and then cool in a desecrator for another 30 minutes.

- The sample is then weighed to constant weight.
- % Ash = (Wt. of crucible with cover + ash) – wt. of crucible with cover / original wt. of sample x 100

Protein content

Calculation of the approximate protein content for pure meat and meat products

% Protein = 100% - (%water + % ash + % fat)

Microbiological sampling and testing

The purpose of microbiological testing is to determine the degree of bacterial contamination on surfaces of equipment, tools, and premises as well as in meat and meat products. This testing can be done qualitatively as microbiological screening, for example by contact such as using an impression plate or quantitatively by determining the exact number of microorganism per sample unit (in cm2 or grams) by using the swab or the destructive method. Quantitative testing can be either determination of the entire contaminating flora, also called “total plate count” or determination of a specific group of microorganisms out of the entire flora, also called “selective plate count”.

Microbiological Analysis

Total Plate Count (using nutrient agar)

For determination of the number of viable or living microorganisms in a sample

Meat sample (10 grams meat + 90 ml sterile distilled water or 0.1% peptone water). Homogenize in stomacher. First dilution.

Transfer 1 ml from first dilution (101) to second test tube (Test tube contains 9 ml. of sterile distilled water) (2nd dilution or 102) then from second test tube transfer 1ml to the third tube (3rd dilution or 103) and so on up to the 4th or 6th dilution.

Inoculate sample.

Pipette 1 ml from 3rd dilution and transfer to the sterile Petridis, also from the 4th dilution to another sterile Petri dish depends upon how many dilutions are
desired.

The inoculation is usually done according to the spread plate method. The diluted sample is released from the pipette onto the solidified agar and spread on the surface by means of a sterile bent glass stick. The alternative is the pour plate method, where the sample is first put into the Petri dish and 15 ml agar (liquefied in a water bath at 44-46°C) are poured into the plate afterwards. Agar and sample are thoroughly mixed by rotating the Petri dish.

Incubate for 12 to 24 hours at 35 to 37°C, alternatively 24-48 hours at 30°C.

Results

Count all colony forming units (CFU), including those of pinpoint size. Select spreader-free plate.

normal plates 25-250 counts

plates with more than 250 colonies for all dilution - too numerous to count

Plates with no CFU. Report as less than 1 times the corresponding dilution used.

4.0 CONCLUSION

Dry meat processing & preservation in food industries is the name of the project. Many materials, ingredient, methods & machineries are applied this project. Many methods are:

- Moisture Analysis, Result- Moisture Content 12%
- Fat Analysis Result- Fat Content 0.13%
- Ash Analysis Result- Ash Content 2.11%
- Protein Analysis Result- Protein Content 85.76%
- Also microbial analyses were applied such:
- Microorganisms
- The pH
- Relative humidity
- All kinds of tests & methods are carefully completed.

Acceptability of this type of products depends on sensory test report. If the products win by sensory test then it will be success in the market. According to this type of theory topic of study “dry meat” was won success. According to the raw materials these products are easy to manufacture in our country, because of that meat is the main raw materials of the products and this available in our around. Others raw materials of these items are available in our market. For this project needed to some light machineries. These types of machineries we will get in low cost, so we can manufacture the dry meat easily. After the products of good it will be tested by the quality control department. They will check appearance, color, odor & pH this product will pass or approved for sale and marketing. This product is beneficiary to us and the people of our country will benefited by the project.

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SECTION 3
(400LEVEL)

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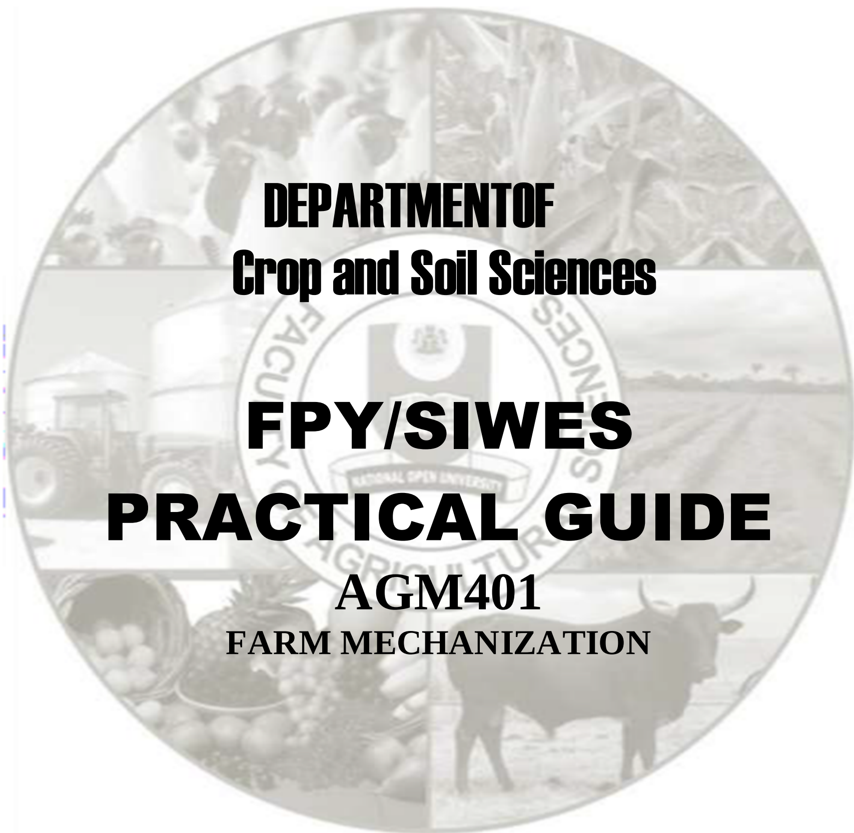

DEPARTMENTOF
Crop and Soil Sciences

FPY/SIWES PRACTICAL GUIDE

AGM401

FARM MECHANIZATION

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CONTENT **PAGE**

1. INTRODUCTION

The development of the machines used in modern agriculture has brought new demands on farmers, ranchers and other agricultural workers. They must be familiar with energy and mechanical forces and have mechanical skills. It is important that they be able to select machines for specific jobs and know how to safely operate, maintain and repair them. This practical guide will help assist towards achieving this goal. It is a practical guide meant for students in a university setting who are in 300 level and are taking the course “Introduction to Agricultural Mechanization” this course introduces students to the importance use and care of machines in agriculture.

The practical in this booklet are necessary to familiarize students with the working principles of the machines used in agriculture

2. BASIC MACHINES AND THEIR APPLICATIONS IN AGRICULTURAL MECHANISATION

Agricultural mechanization is a dynamic trade that involve the use of force to accomplish work. To make agricultural work easier, the use of machines become very important. To start with, let us look at the types of simple machines that are often applicable to most agricultural mechanization works science has developed these machines to simplify the various work use in agricultural mechanization.

There are:

1. The Wheel and Axle
2. The lever
3. The inclined plane
4. The pulley
5. The screw and
6. The wedge

To accomplished work, force must move certain distance force acting on an object in the direction of motion. This a machine makes work easier to perform by accomplishing are or more of the following functions.

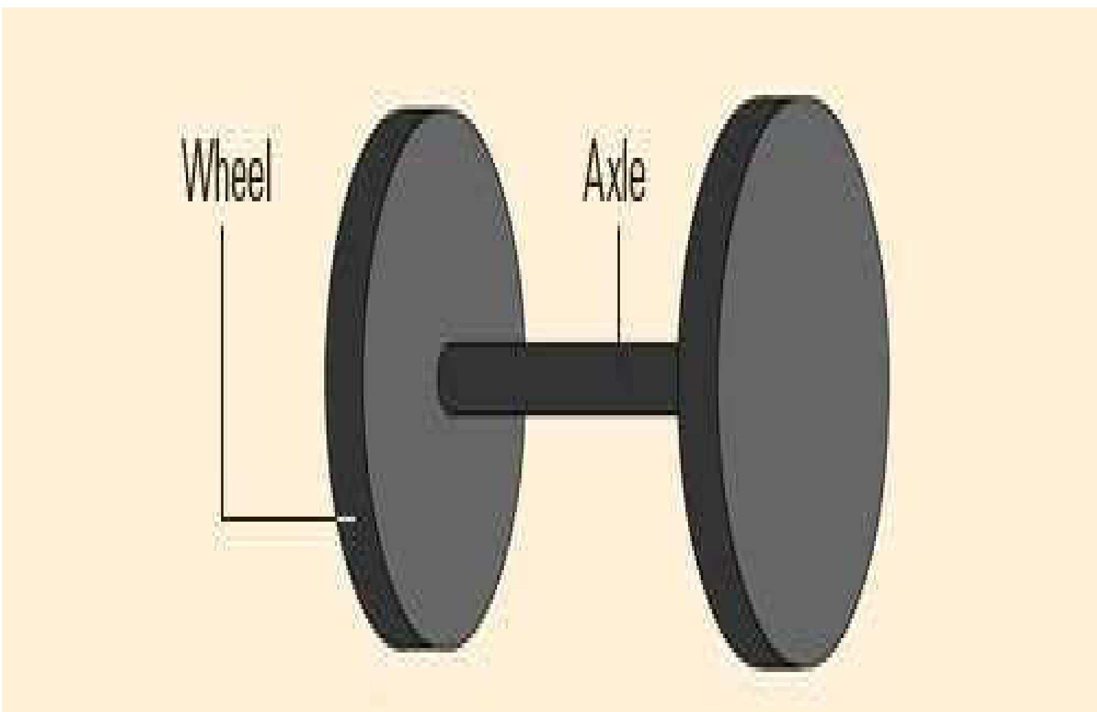
a. Transferring a force from one place to another
b. Changing the direction of a force
c. Increasing the magnitude of a force
d. Increasing the distance or speed of a force

Simple machines are devices with no, or very few moving parts that make work easier. These machines may look simple, but they provide us with the means to do many things that we could neverdo without them.

1. The Wheel and Axle

This is one of the most significant inventions in the world. Before then humans were limitedin how much and how far they could transport goods over land. “Wheeled carts facilitate agriculture and commerce by enabling the transportation of goods to and from markets and easing the burden of travelling long distances. The wheel greatly reduces the friction encountered when an object is moved over a surface.
The other five machines all help humans increase and or redirect the force applied to an object. “machines provide mechanical advantage” to assist in moving an object. Thus to accomplished work force must move a certain distance. Mathematically; Work $= \frac{force}{(kg)} \times \frac{distance}{(m)}$

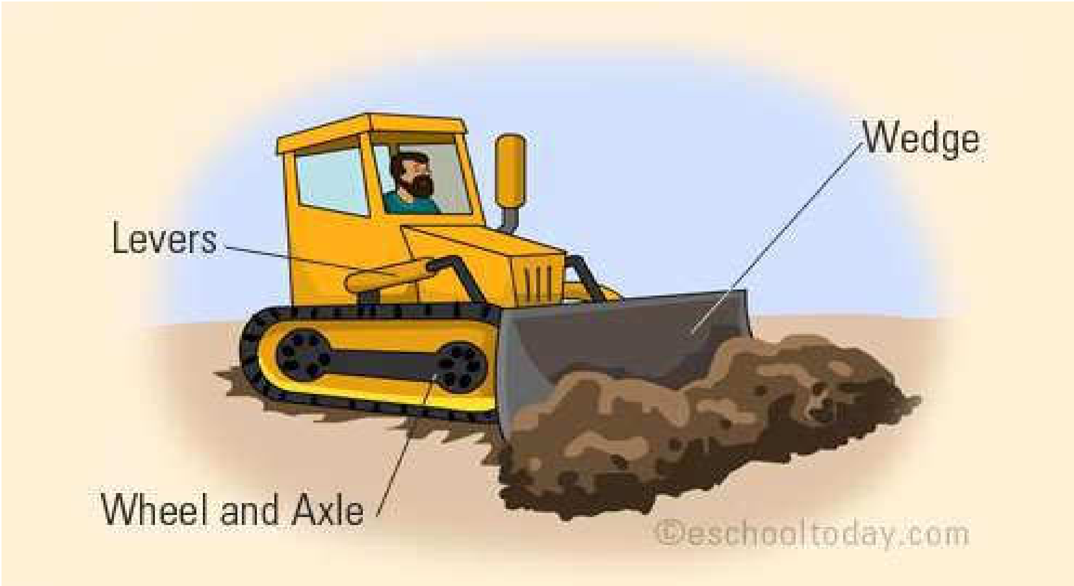
For example: to lift object we must do work to overcome the force of gravity and move the object to a certain distance.



Thus the main benefit of machines is that they allow us to do the same amount of work by applying asmaller amount of force over a greater distance.

The mechanical advantage of the wheel and axle can be calculated as the diameter swept bythe handle divided by the diameter of the axle or load divided by the force applied:

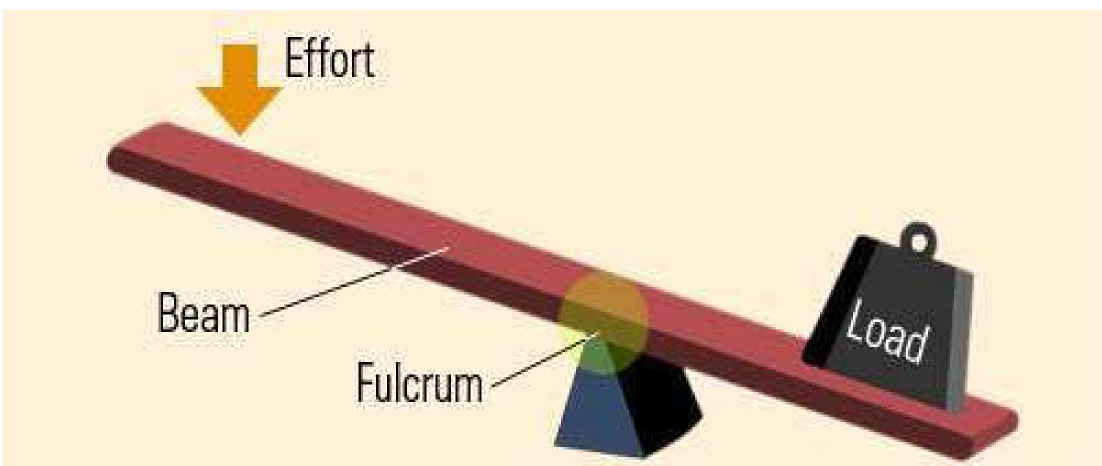
M. A = Load/effort
M. A =W/F



2. The Lever

This consists of a long beam and a fulcrum, or point. The mechanical advantage of the lever depends on the ratio of the lengths of the beam on either side of the fulcrum. Thus, mechanical advantage can be calculated as
M. A = Load/Effort(force)

=W/F



Class One Lever

In this class, the Fulcrum is between the Effort and the Load.The mechanical advantage is more if the Load is closer to the fulcrum. Examples of Class One

Levers include seesaws,boat oars and crowbar.

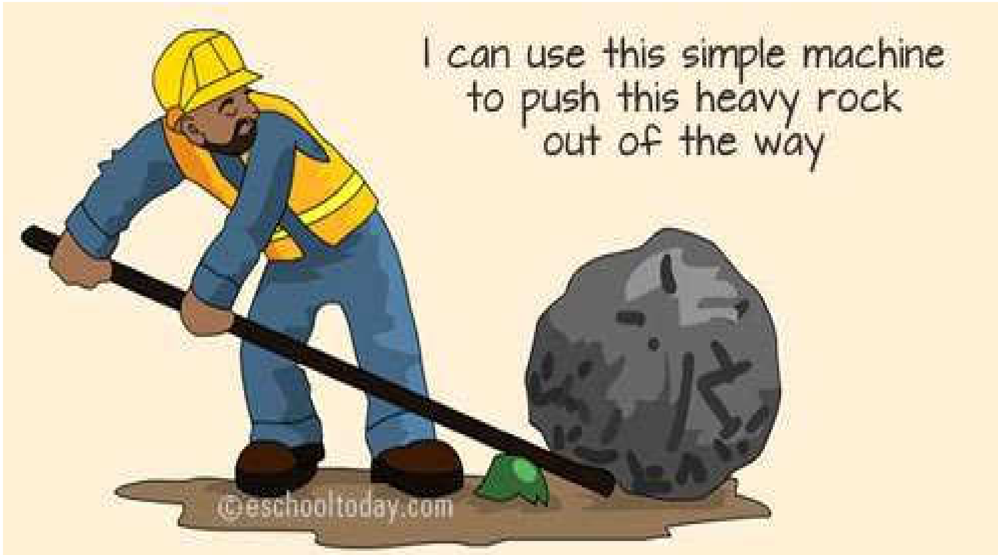
Class Two Lever

In this class, the Load is between the Effort and the Fulcrum.The mechanical advantage is more if the load is closer to thefulcrum. Examples of Class Two Levers include wheelbarrows. TRY THIS SIMPLE EXPERIMENT

Class Three Lever

In this class, the Effort is between the Load and theFulcrum. The mechanical advantage is more if the effort is closer to the load. An example of Class

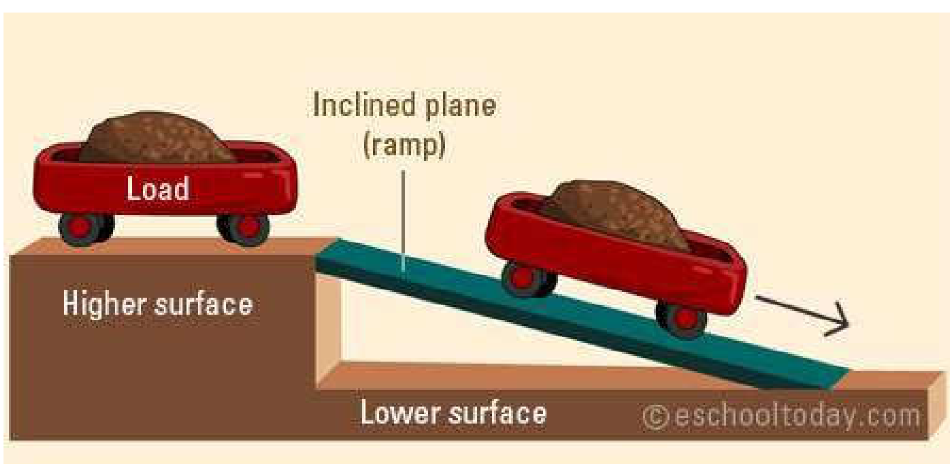
Three Lever is a garden shovel.



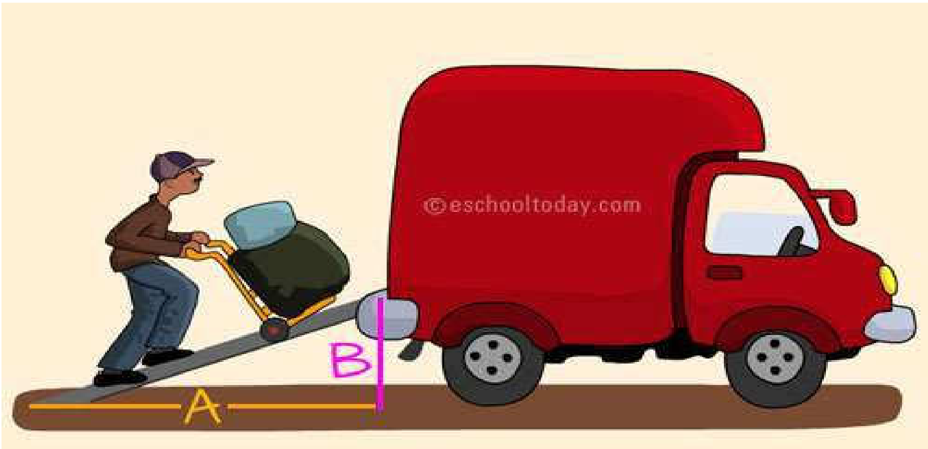
1. The inclined Plane

This is simply a flat surface raised at an angle like a ramp. Thus, an inclined plane is a way of liftinga load that would be too heavy to lift straight up. The angle (steepness of the inclined plane) determines how much effort is required to raise the weight or load. The mechanical advantage of theinclined plane is calculated by dividing the length by its weight

M. A = L/WL(m)
W(kg)
The velocity ratio of the inclined plane can be calculated as:
V. R = Distance moved by effort /Distance moved by load
V. R = F/W
L (M)



In the illustration below, the man uses a piece of metal as a ramp to move the hand-truck into the van.



3. The Pulley

These are used for moving heavy load. Pulleys are nothing but gears without teeth and instead of running together directly, they are made to drive one another by cords, ropes, cables or belts. In a pulley, instead of an axle, a wheel could also rotate a rope, cord or belt. In a pulley, a cord wraps around a wheel. As the wheel rotates the cord moves in either direction. Attach a hook to the codeand you can use the wheel rotation to raise and lower objects, making work easier

The mechanical advantage of the pulley is calculated thus

M. A = Load/ Effort

M
.
A
=
W
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M
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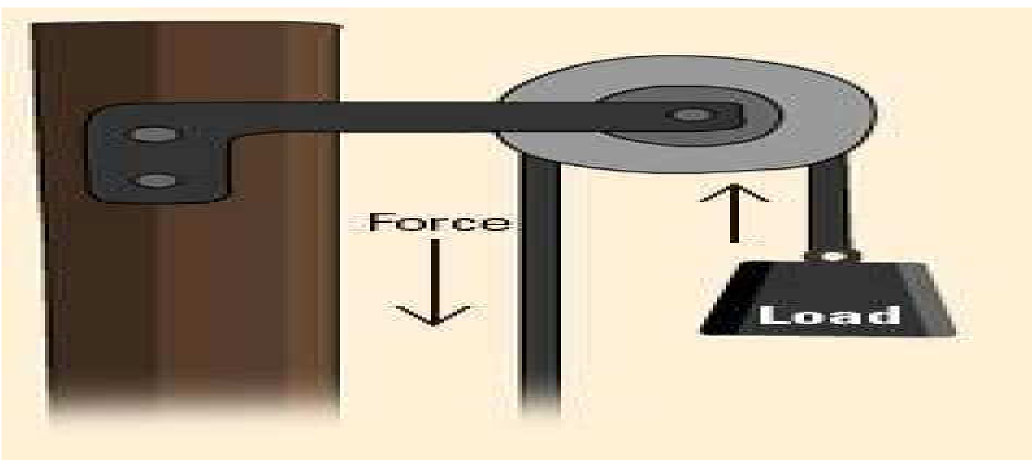
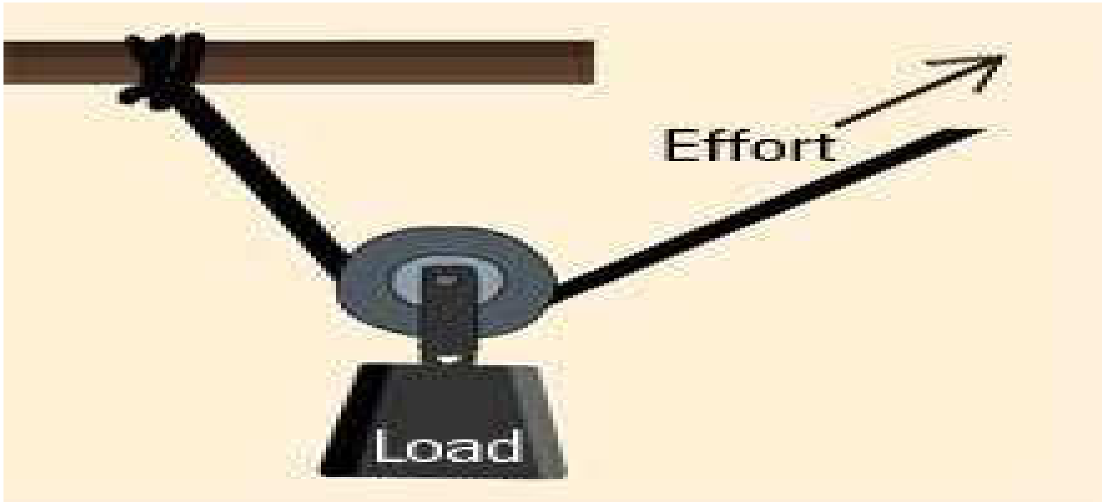
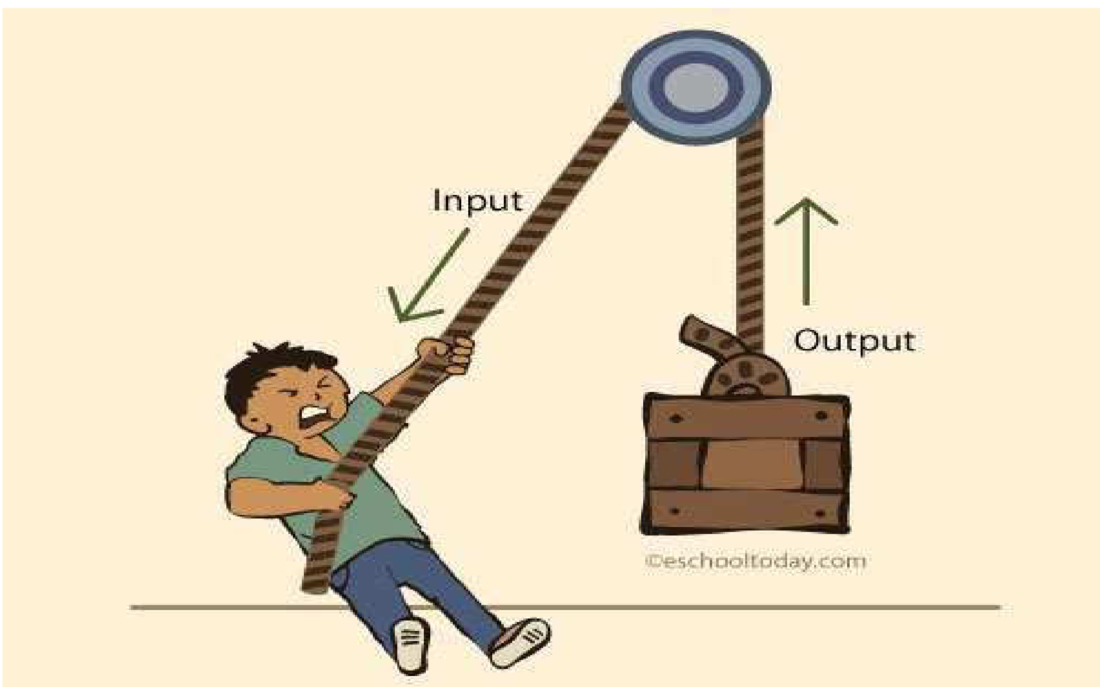



Effort
Load


Input
Output
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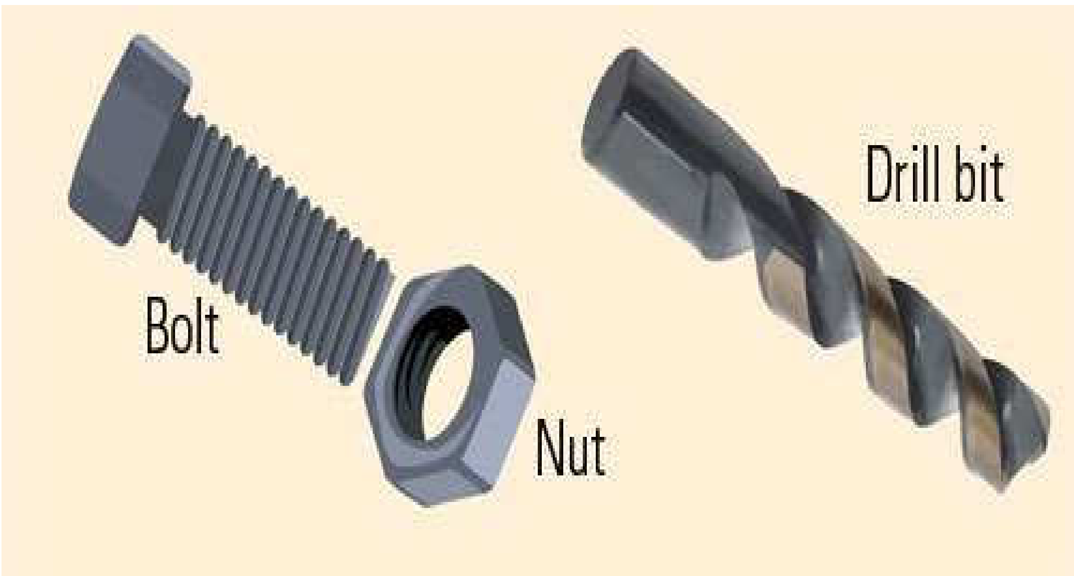
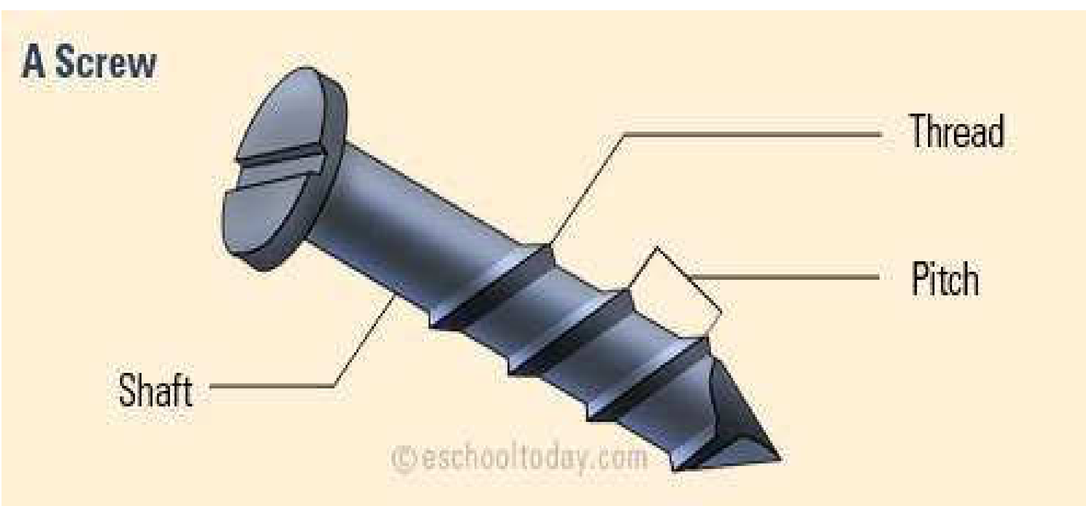
4. A Screw

This is essentially a long inclined plane wrapped around a shaft, so its mechanical advantagecan be approached in the same way as the inclined plane.
Mechanical advantage: Distance moved by effort divided by distance moved by load.

M. A = F/WF(kg)
W(m)



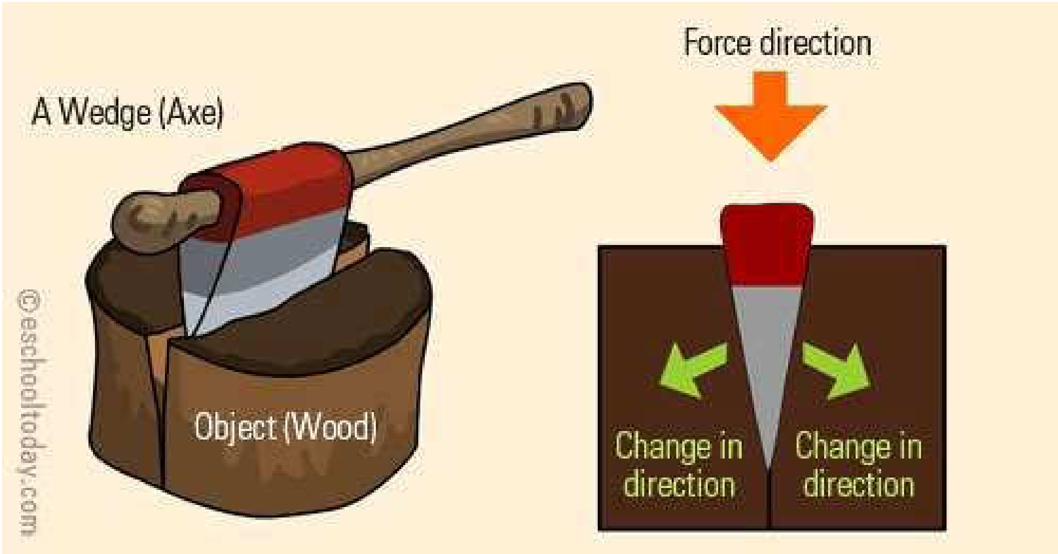


5. The Wedge

These is like a moving inclined plane that is driven under load to lift or into a load to split or separate. The main function of a wedge is to change the direction of the input force. Bello ware examples of a wedge.

A wedge can be used in many ways:

- To cut (knife)
- To split (axe)
- To tighten and to hold back (doorstopper)
- To hold together (nail)
- To scrape (blades on the snowplough or farm grader)
- Wedges work by changing direction and force applied to it. Here is an illustration:Diagram ofchange



-
From the above, you will notice that the force applied to the thick end of the wedge overcomes the resistance of the wood. The force is directed downwards, but the wedge directs the force sideways asit drives into the wood.

A wedge may be a single wedge or double wedge. Each does a slightly different job. An axe is adouble wedge (see diagram above) and a chisel is a single wedge.

2. SUMMARY

A machine is a mechanical device that changes the direction or magnitude of a force. In agricultural mechanization, the use of machines have become an integral part of all agricultural activities to achieve much greater work without stress. The six classes of simple machines in used include

- Lever
- Wheel and Axle
- Pulley
- Incline Plane
- Wedge

3. PRACTICAL ASSIGNMENT

1. Students are to visit a typical agricultural workshop or any workshop and identify the sixtypes of simple machines.

2. Students should engage each of the machines by trying to carry, lift or move a load with themachines and note how easy they allow work to be

accomplished.

4. WORKSHOP TOOLS

1. INTRODUCTION

There is an adage that says "anything worth doing is worth doing right". A corollary to that statement is the recognition that doing the job right requires the right set of tools.

The tools in your workshop will depend on your areas of specialty, interest and level of experience.

2. Typical Problems and Concerns of Students

1. Why should a farmer have a home-farm shop?
2. How can a home farm shop be established?
3. What are the essential requirements of a home farm shop?
4. What tools and equipment are needed?
5. How should the equipment be arranged in a shop?
6. How should the shop and equipment be maintained?
6. What safety precaution should be observed?

3. Why Have a Home-Farm Shop?

One of the objectives of farm mechanics is the establishment of home-farm shops. A farmer should take pride in maintaining properly the equipment on the farm and in the home and in keeping the farmstead neat and attractive in appearance. It is very important that a farmer keeps his farmmachinery and other equipment in satisfactory working condition for efficient operation. By being proficient in the use of tools and having suitable facilities to perform the needed jobs, a farmer can save time, inconvenience and money.

4.

5. Why a Home-Farm Shop

For the following reasons:

1. To provide a suitable place for storing and for using tools and equipment.
2. To provide suitable space for working farm equipment.
3. To provide storage space for shop supplies.
4. To provide adequate facilities for performing the shop jobs which can be done on the farmand in the home?

6.

7. Requirements of a Farm- Shop

A home-farm shop should

1. Provide simple space
2. Be of desirable construction
3. Have a suitable floor
4. Have a large main entrance
5. Have adequate lighting and ventilation

8. Objective of Workshop Tools

Workshop tools are necessary pieces of items that are needed in the farmstead. They make minor repairs easy (except for specialized repairs) they save time, inconveniences and money.

In a typical agricultural engineering workshop, there are two categories of tools commonly found. These are (1) tools for wood working(carpentry) and (2) tools for metal working.

Find below are some examples of the various tools used in the workshop. Students are encourage to go to the workshop and familiarize themselves with these Also, figures show the properarrangements of tools in the workshop for safe keeping and for easy access anytime a tool is needed.

9. Wood working Tools

The choice of wood working tools (hand and power) reflects personal choice and activities to becarried out. Common wood working tools usually found in the farm include:

- Hand tools
- Saw
- Planes
- Grading and sharpening tools

In woodworking and carpentry, hand saws, also known as "panel saws", "fish saws", are used to cut pieces of wood into different shapes. This is usually done in order to join the pieces together and carve a wooden object. They usually operate by having a series of sharp points of some substance thatis harder than the wood being cut. The hand saw is a bit like a tenon saw, but with one flat, sharpedge.

Importance of Tool Classification

Every student should familiarize himself with the name of the different kinds of tools and their uses. Much of a farmer's success in farm mechanics depends on the proper selection of tools and their proper use.

10. Importance of Proper Care of Tools

Know how to care for tools is very important because it helps keep the tools last longer.

- Keep tools well cleaned, oiled and free from rust
- Keep tools always in their cabinet when not in use.
- Tools must be properly sharpened for good results

11. Precaution in the Care of Tools

- Do not drop tools
- Keep tools clean and free from rust
- Keep tools sharp
- Don't bring cutting edge in contact with metalChoose the proper

tool

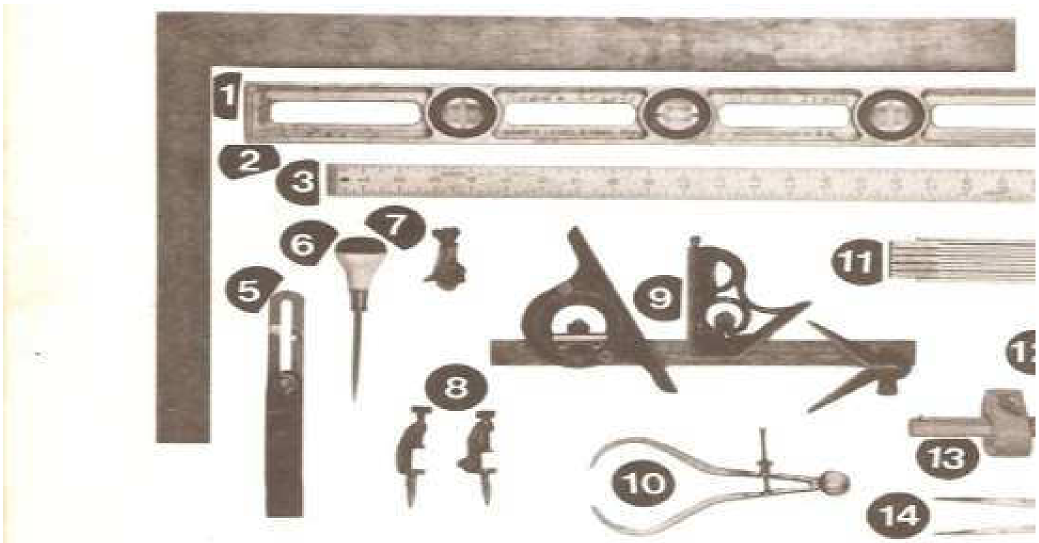


Fig. 10-5. **Carpentry tools:** 1. Framing square. 2. Two-foot aluminum carpenter level. steel tape. 5. T-bevel. 6. Scratch awl. 7. Auger bit gauge. 8. Trammel points. 9. Miter head, b Outside calipers. 11. Six-foot folding rule. 12. Try square. 13. Marking gauge. 14. Spring di

12. **Below are three types of ball pen wood hammers. They are use for driving nails or screws into awood**

13.

14.

15.

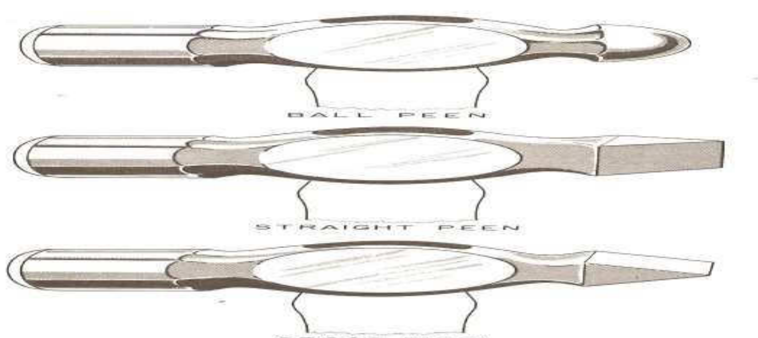


Fig. 6-3. Three kinds of peens.

Fig. 11-7. 1. Jack plane. 2. Smooth plane. 3. Block plane. 4. Wood chisel. 5. Spokeshave. 6. Cabinet scraper. 7. Wood rasp. 8. Jointer plane. 9. Hand scraper.

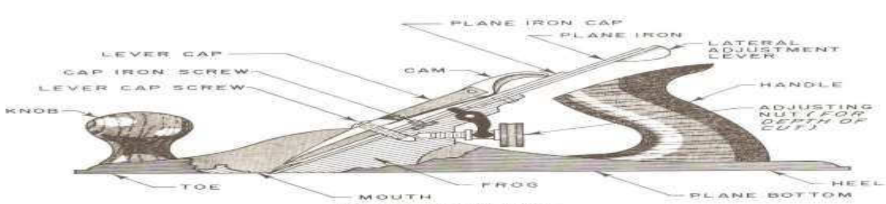


Fig. 11-8. Parts of a plane.

Plane: is a fool for shaping disk plow wood using mosle power to force the cutting blade over thewood surface.

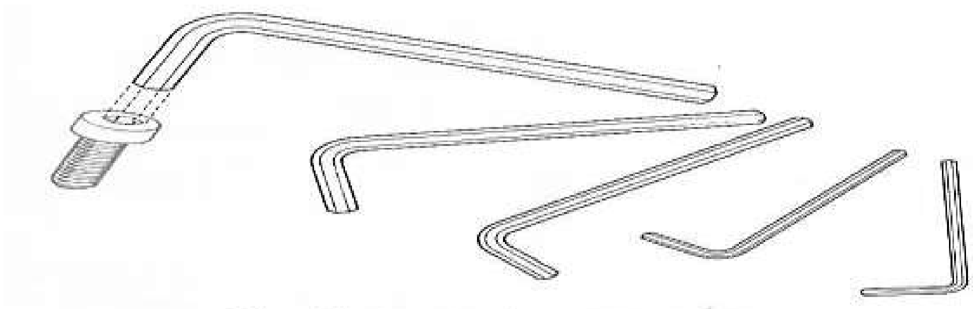


Fig. 76. A selection of "Allen keys".

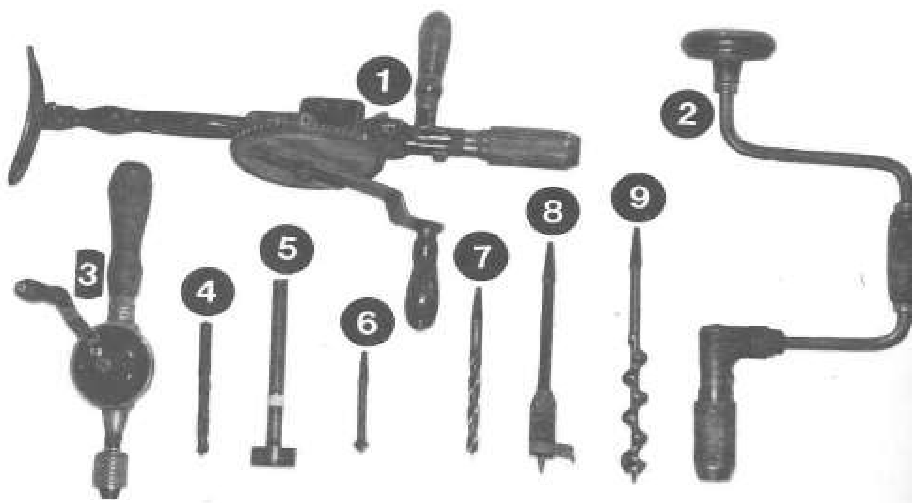


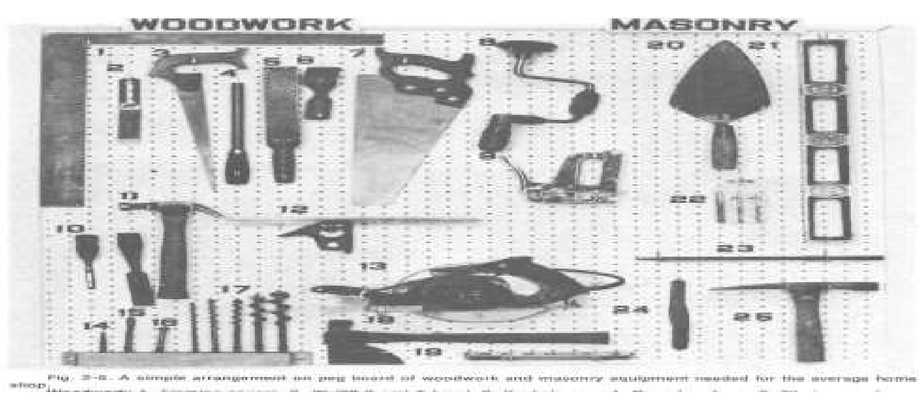
Fig. 11-19. **Wood boring tools:** 1. Breast hand drill. 2. Ratchet bit brace. 3. Hand drill. 4. Straight shank twis drill. 5. Straight shank Forstner bit. 6. Bit stock countersink bit. 7. Bit stock twist drill. 8. Expansive bit stock auger bit 9. Bit stock auger bit.

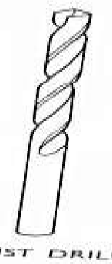
Allen Keys: Are used to fasten bolts and screws with hexagonal socket. They are hand tools andoften come in set with a range of sizes.

5.

6. SCREW

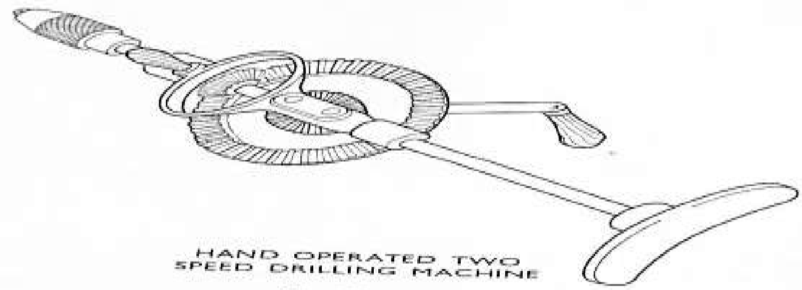
Screw: A screw is a type of fastener sometimes it looks like a bolt. This is used for holding objecttogether and to position objects. It has a head on one end that allows it to be turn with a screw driver.





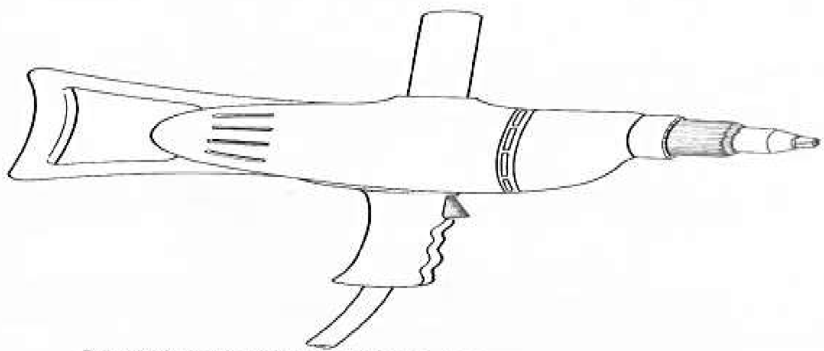
TWIST DRILL

Fig. 80a.



HAND OPERATED TWO SPEED DRILLING MACHINE

Fig. 80b.



POWER OPERATED HAND DRILLING MACHINE

Fig. 80c.

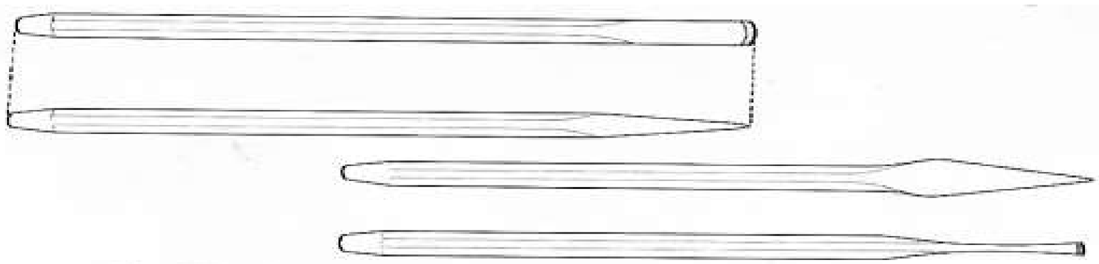


Fig. 77. Flat and cross-cut chisels for general work.

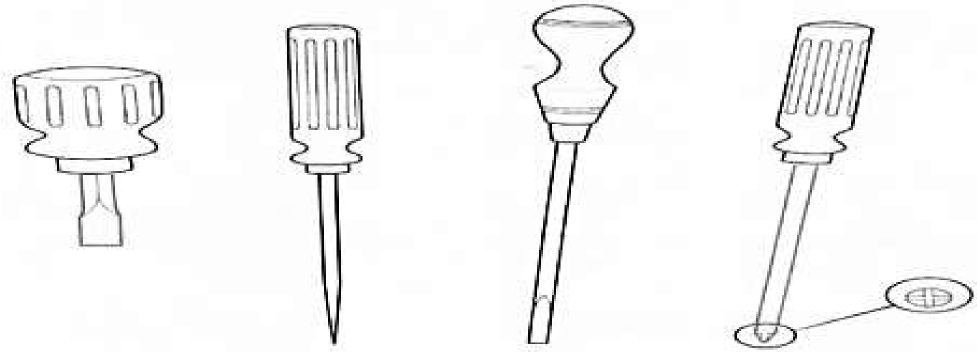


Fig. 78. A selection of screwdrivers.

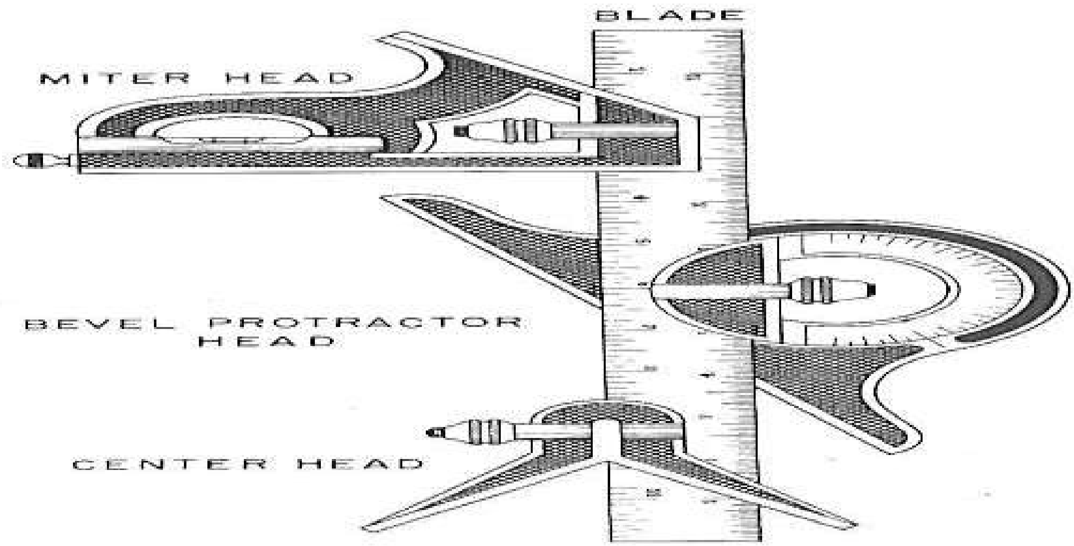


Fig. 6-2. Heads for combination-square blade.

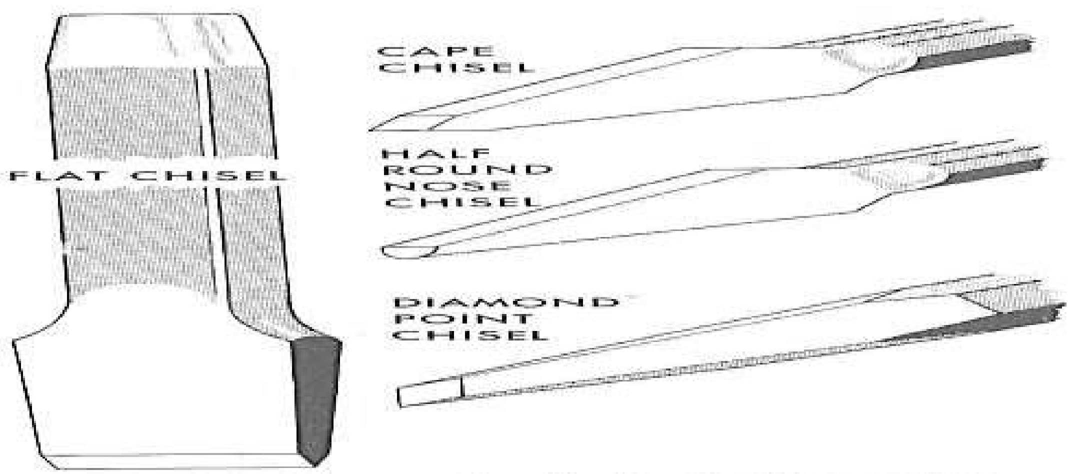


Fig. 6-5. Shapes of cold-chisel cutting points.

Hack Saw: It is a fine toothed saw originally and mainly made for cutting metal. Most handsaw aremade with a C-shape frame that holds a metal blade.

and have sharp, triangular teeth. They cut faster than, but not as smoothly as, the single-cut file. File teeth usually

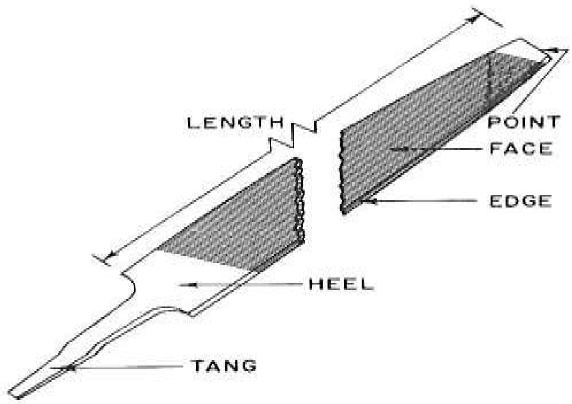


Fig. 6-8. The parts of a file.

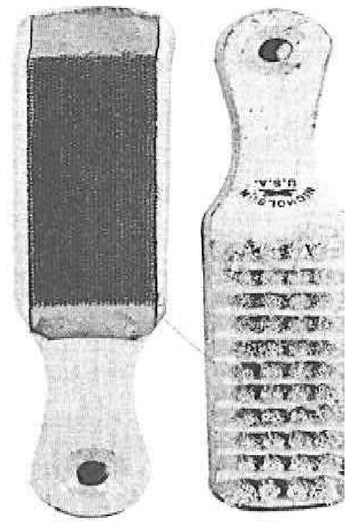


Fig. 6-9. Left, file card. Right, file

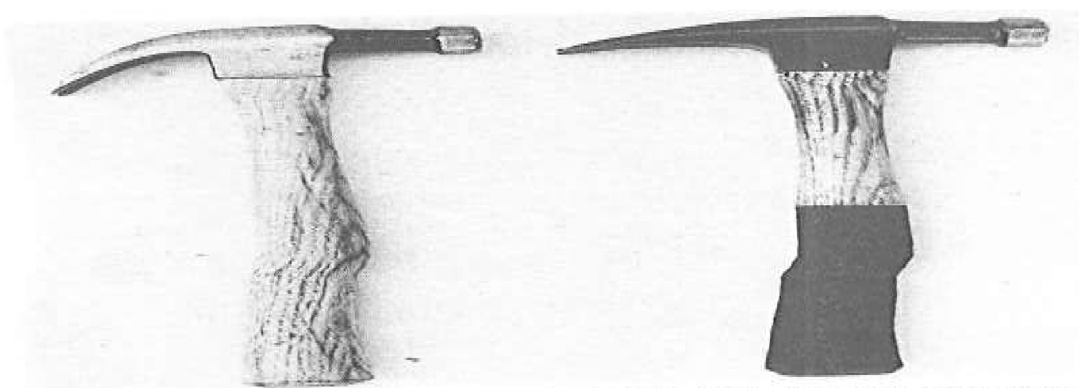
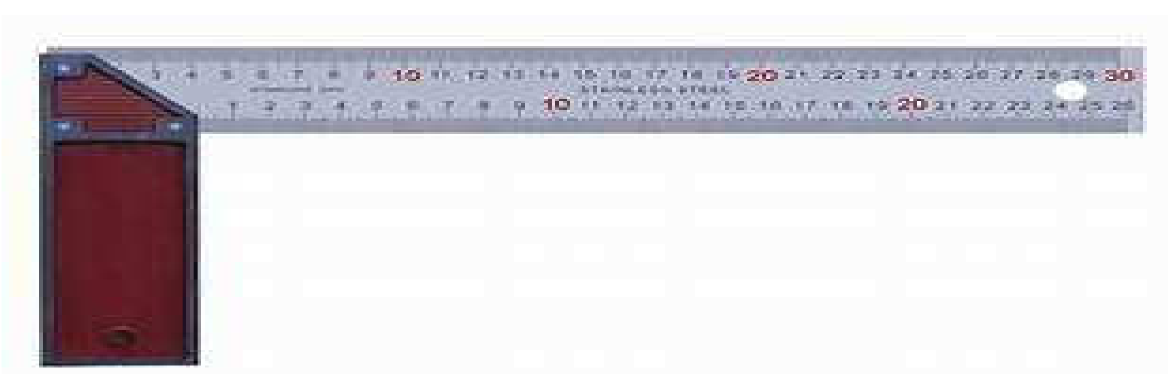
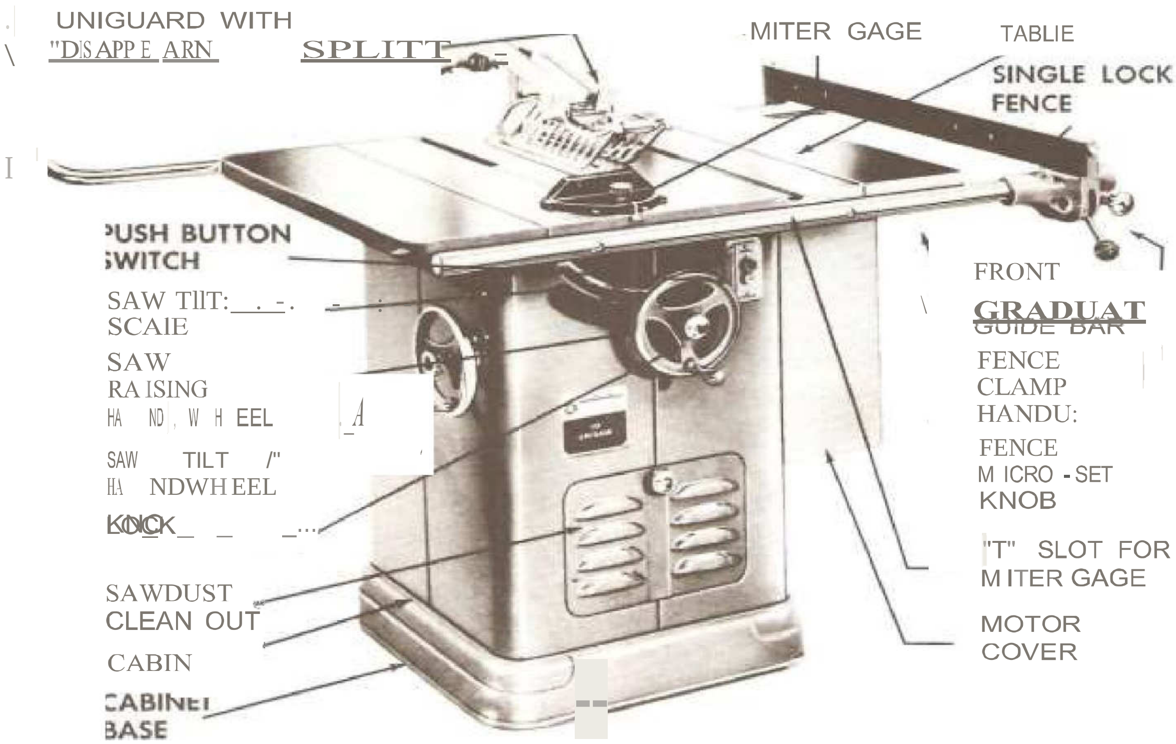


Fig. 10-35. Left, a claw hammer for general carpentry. Right, a straight claw for ripping.

Try Square: Is a woodworking or a metal working tool used for marking and measuring a piece ofwood. The *square* refers to the tool's primary use of measuring the accuracy of a right angle (90 degrees)





ROCKWELL DELTA 10" TILTING ARBOR UNI SAW

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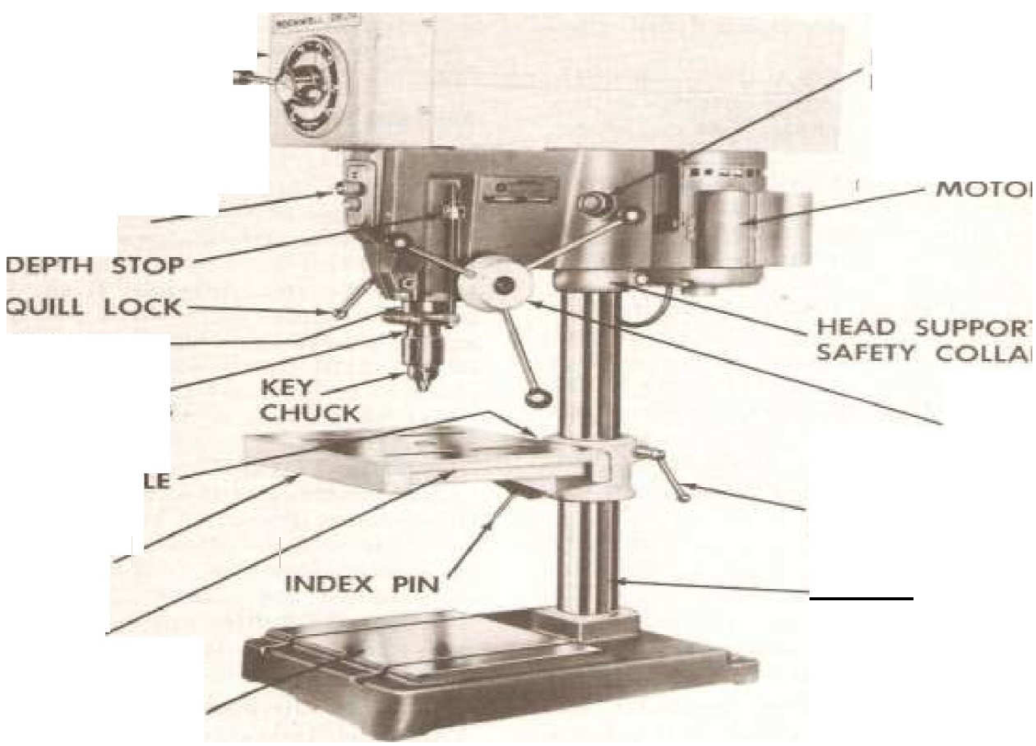


7. PRACTICALASSIGNMENT

1. Students should know the different tools and their uses.
2. Students should be taught practically how to maintain and store tools.
3. Students must visit a typical agricultural engineering workshop and see how tools arekept/stored.
4. Students must learn to use simple workshop tools by engaging in constructing a simple woodproject.
5. A demonstration of how to plane, cut, nail and chisel a piece of wood is good for a practical.

1. SUMMARY

Tools for farm mechanization come in handy and varied ranging from hand tools to power tools. They carry out different functions in the farm and so must be well kept especially in a tool box or cabinet. Common workshop tools for the repair of agricultural machines and other activities include wood working and metal working tools, for example wood walking tools such as saws, screwdriver, planes, trysquare, ruler, nails, drills chisel calipers are common in the farm workshop. Tools must be kept sharp and handle with care.

8. PRINCIPLES OF INTERNAL COMBUSTION ENGINE (ICE)

1. INTRODUCTION

Motor and or machines on farms have steadily increased in number and in importance. In fact modernagriculture depends heavily on the internal combustion engine for most of its activities. The farm tractor and auxiliary engines for farm machinery are used to till the soil, plant and cultivate crops, harvest food and fiber and process products for human or livestock use. The work on the farm dependson the application of power. The power of the machine relieves farmers of much physical emotion. There are some maintenance jobs, a farmer with little training and practical experience should be able to do.

2.

3. Types of Farm Power

- Animal power
- Wind power
- Solar power

- Water power (Hydro)
- External combustion engine – steam engines
- Internal combustion engine – gas engine

4. Engine Operation Principles

The internal combustion engines generate power by utilizing the force created by running a mixture of fuel and air. This force is confined or trapped n a combustion chamber. The expanding gases force the piston downward in the cylinder. Because the piston is connected to crankshaft by a connecting rod, this downward motion is changed to a rotating motion. Gasoline, diesel and liquefied petroleum gas (.LPG) engines use many of the same principles.

5.

6. Four-stroke Cycle Engine

The four stroke cycle engine is the most common type found on farms. An engine stroke is commonly thought of as the movement of the piston from Top Dead Center (TDC) to Botton Dead Center (BDC).Top Dead Center (TDC) is reached when the piston is at the end of the inward stroke. BDC is reached at the end of the outward stroke.

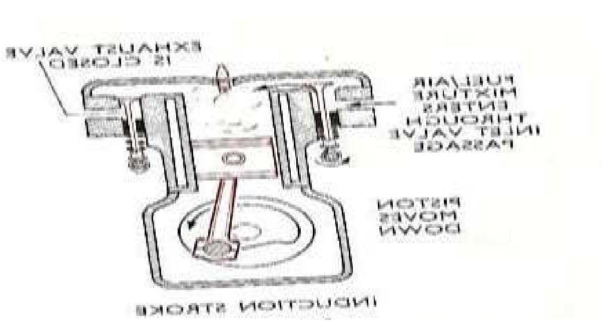
A stroke can be defined as one-half of a revolution of 180^0 of crankshaft travel.

An engine cycle is the complete set of movements necessary to generate engine power. The four stroke in a cycle are intake, compression power and exhaust.

7.

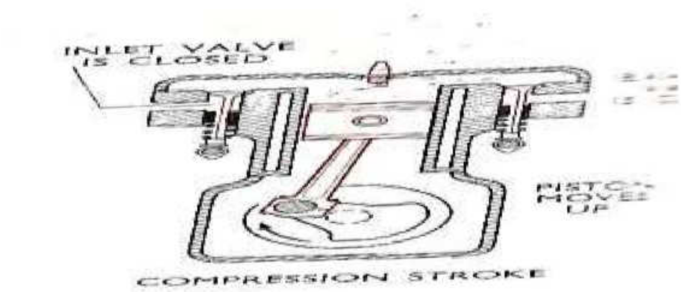
8. Working Principles of the Internal Combustion Engine.Intake stroke

With the intake valve opens, the piston moves outward in which draws a mixture of fuel and air intothe cylinder (in a diesel engine, only air is taken in).



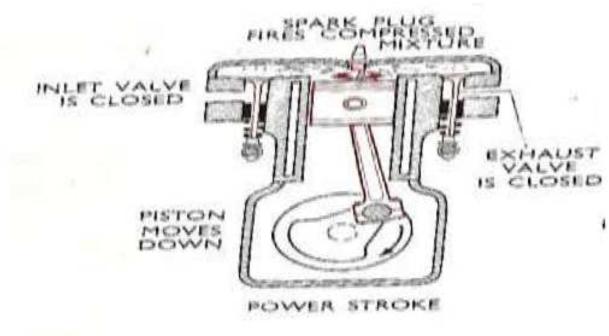
9. Compression stroke

As the piston reaches BDC and begins its inward motion (toward the cylinder head) both values intake and outlet are closed and the piston compresses the mixture between the piston and thecylinder head 9only air is compressed in the dies



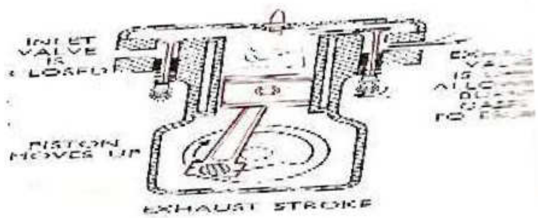
10. Power Stroke

As the piston nears TDC and electric spark ignites the compressed mixture, pushing the piston downward with great force (in the dieisel engine fuel is injected into highly compressed air, causing self-ignition).



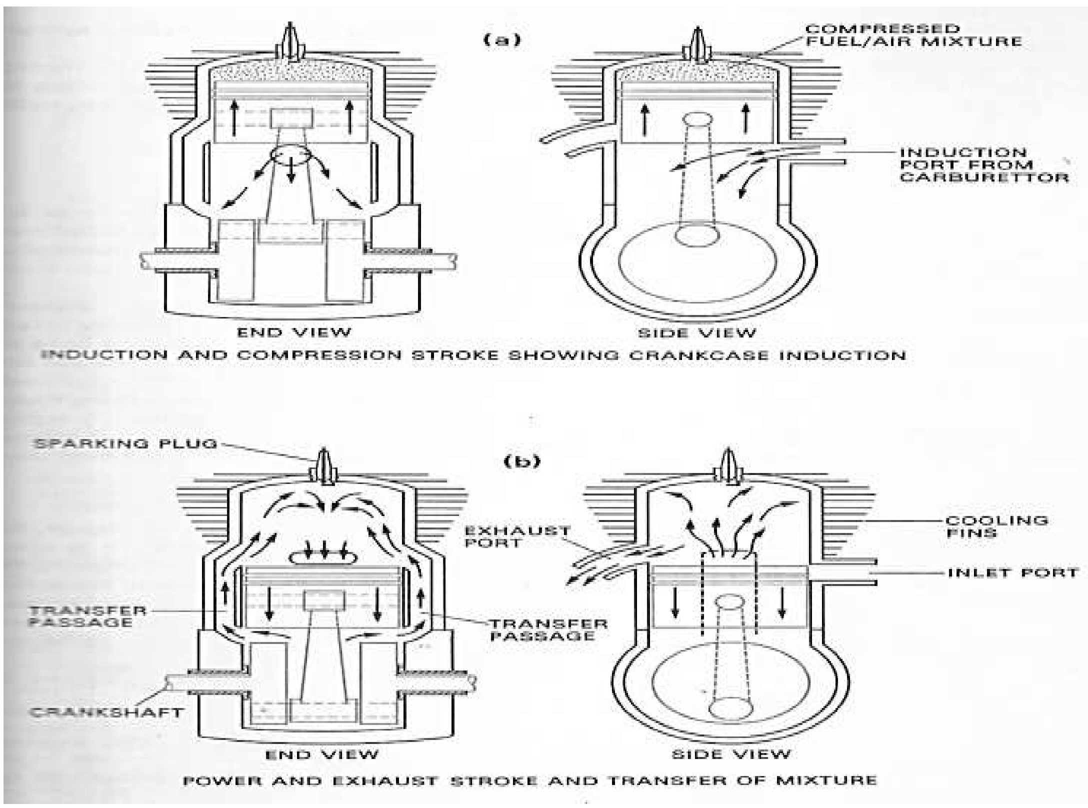
11. Exhaust stroke

The exhaust stroke occurs when the piston begins to move upward. The exhaust valve opens,allowing the piston to force out the burnt gasses; cleaning the cylinder for the start of another cycle. This is repeated severally until engine stop.



12. Two –Stroke Cycle Engine

A two-stroke cycle engine completes its cycle of operations in one revolution of the crankshaft. Thereis only a compression stroke and a power stroke between or during these events the intake of fuel and exhaust of gasses are accomplished, there is a power stroke every revolution



13. SUMMARY

Most farm engines are of the four-stroke cycle engine. The smaller engines are 2-stroke cycle type.To get the farm engine work efficiently, proper servicing and maintenance are most important.

14. Practical Assignment

Students should study the 2-stroke and 4-stroke cycle engines in order to determine differences in construction and principles of operations.

a. Use small one-cycle engine for the study, one 4-stroke cycle engine and one-two-stroke cycleengine.
b. Study the construction of the two engines.Note: the location or positioning of:
a. Fuel system
b. Valves and
c. Ports
d. Know the parts of d engine

Find below are the various parts that make up an engine and the working principles as discussedabove.

For any engine that has a piston whether one or more, that piston must go through the events ofintake, compression, power, and exhaust.

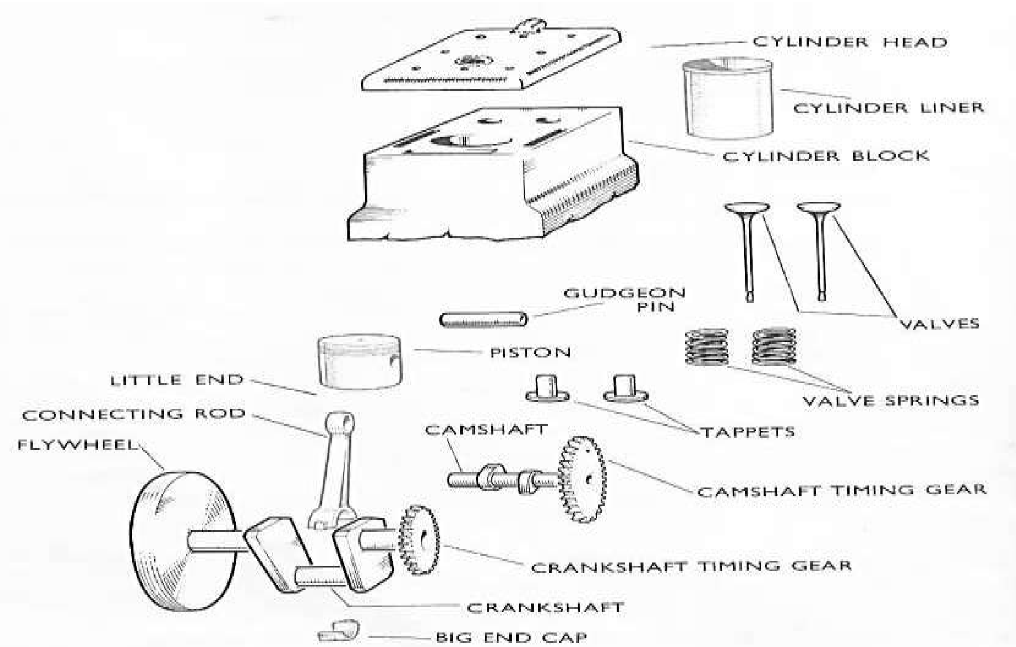


Fig. 3. Some of the main working parts of a side valve water-cooled single-cylinder engine.

The Agricultural Tractor

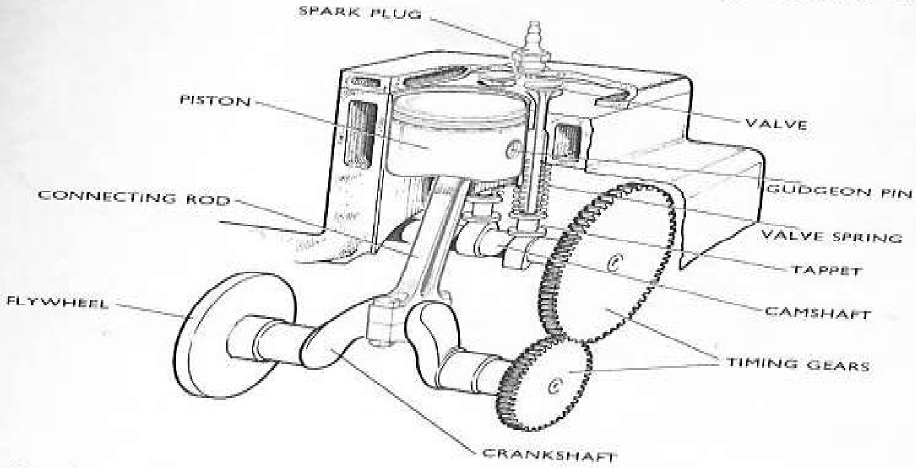


Fig. 4. A section through a single-cylinder engine showing the relative position of the working parts.

Fig. 5. Engine layouts and terminology.

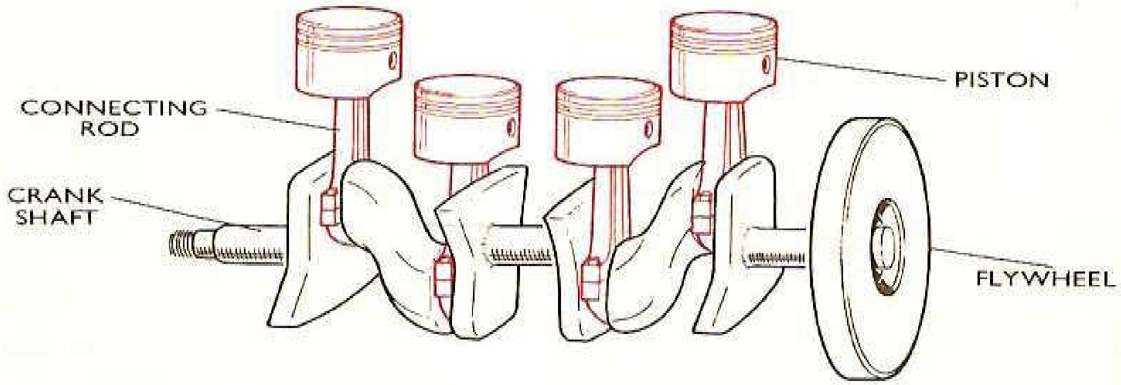


Fig. 6. A four-cylinder engine crankshaft with connecting rods and pistons.

9. FARM MACHINERY USE FOR TILLAGE.TRACTOR TYPES AND TRENDS

1.

2. INTRODUCTION

Modern farm tractors have undergone continual changes and improvements to become the up-to-date and effective agricultural power units today. New developments have helped to make tractors more efficient, versatile, safe, convenient, and powerful.The agricultural tractor provides a great source of power which has almost entirely replace the power of the horse or human for the many heavy andtime consuming tasks carried out in the farm.

Current tractors may be classified according to traction, used and size of the tractors.

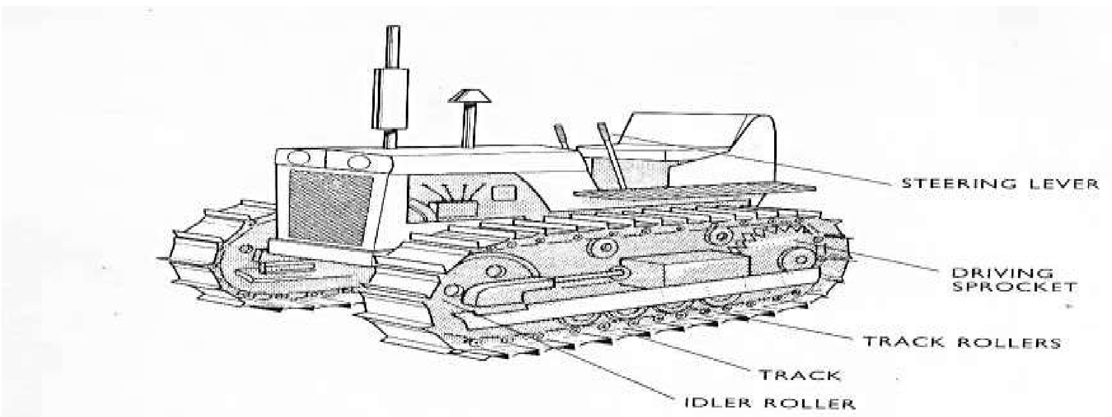


FIG. 1. A track-laying tractor.

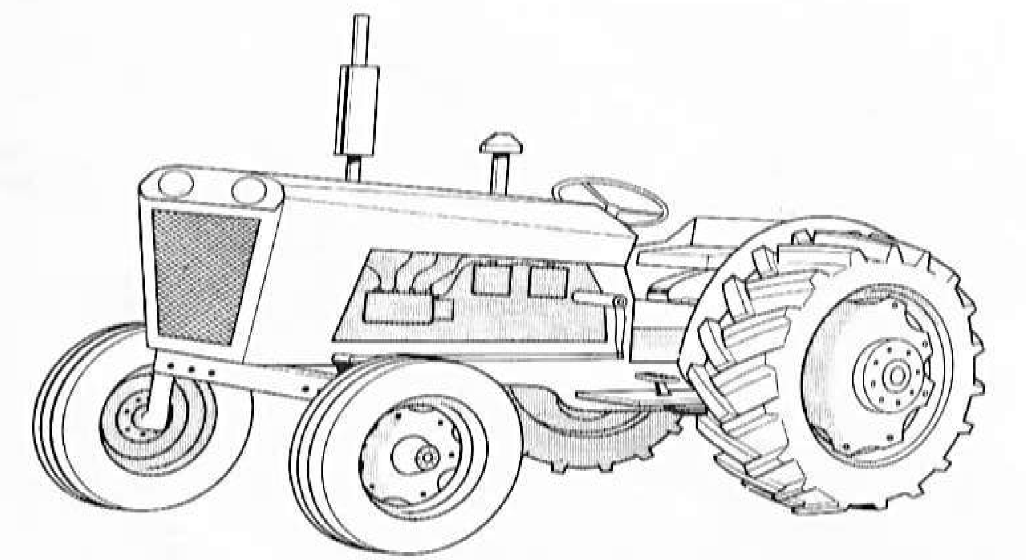


FIG 2. A general-purpose tractor.

3. Tractors Types According to Traction Member

Tractors types may be classified cording to wheel or track systems and these include:

1. Wheel tractors
   a. Triangle or 3-wheel
   b. Four wheel (20 wheel drive)
   c. Four wheel drive
2. Track type tractors

The wheel type tractor is by far the most widely used tractors for agricultural purposes. The 4-wheeltype is most common with both front and rear (back) wheel treads adjustable for use in row crops.

4.

5. Tract – Type Tractors:

They are propelled by heavy metal devices known as tracks not widely used in agriculture but arewell adapted to hilly areas and for earth moving and land clearing.

6. Tractors Types

Tractors may be classified according to use and/or size as follows:

1. Utility tractors
2. Large field tractors
   - o 2-wheel drive
   - o 4-wheel drive

3. Orchard and vineyard tractors
4. Lawn and garden tractors
5. Industrial tractors

FIG. 16-1. Small utility tractor. (*Courtesy* International Harvester)

FIG. 16-2. Utility tractor, 70 h.p., pulling baler. (*Courtesy* Deere and Company)

FIG. 16-3. Utility tractor, 65 h.p.; can be used for row crops. (*Courtesy* International Harvester)

4. Large 2-wheel tractor doing tillage. (*Courtesy* Allis-Chalmers Manufac-
mpany)

Tractor with extra-high clearance for sugar cane. (*Courtesy* Deere and

FIG. 16-6. Large 4-wheel drive tractor doing field work. (*Courtesy* Steiger Tract
Inc.)

FIG. 16-7. Two-wheel drive tractor with optional front wheel power drive. (*Courtes*
Deere and Company)

FIG. 16-8. Four-wheel drive tractor cultivating row crops. (*Courtesy* J. I. Case)

FIG. 16-9. Orchard tractor with low profile. (*Courtesy* Deere and Company)

FIG. 16-10. Vineyard tractor, narrow with low profile. (*Courtesy* Deere and Company)

FIG. 16-11. Lawn and garden tractor. (*Courtesy* FMC Corporation, Outdoor Power Equipment Division)

FIG. 16-12. Diesel powered garden tractor. (*Courtesy* FMC Corporation, Outdoor Power Equipment Division)

FIG. 16-13. Grounds maintenance tractor. (*Courtesy* Ford Motor Corporation)

FIG. 16-14. Low center of gravity tractor for highway mowing. (*Courtesy* J. I. Case)

7. SUMMARY

The present day farm tractor is a most useful machine, capable of supplying its power to numerous farm tasks. The most absorbing of these power is usually the basic cultivation or tillage of the land. The type of tractor on the land depends on the type of work to be done. Tractor types include both wheel and track-type tractors. Wheel types include utility size tractors, large 2-wheel drive tractors and four-wheel drive. Four wheel drive tractors are equipped with adjustable wheel treads for row crop use. Specially designed tractors are available for orchard, vineyards, lawn and garden, industrial and other specialty uses.

8. PRACTICAL ASSIGNMENT

a. Field trip to tractor dealership to view and discuss tractor types available.
b. Study a 4-wheel tractor and know the different parts
c. Learn how to drive the tractor
d. Learn the simple maintenance service.

10. FARM MACHINERY USE FOR TILLAGE

1. INTRODUCTION

Tillage is a mechanical manipulation of soil to provide favorable conditions for crop growth or production. This can be achieved by the use of certain specialized machines or implements.

Tillage machinery or implement is therefore use to till or stir the soil (loosen the soil) to make it suitable for the seed which is normally planted in the soil to grow well. Aconducive environment of a soil for crop growth means having the following available

1. Water
2. Air
3. Good soil texture and
4. Good temperature

In order to achieve these, there are certain tillage machineryareused. The tillage machines used are categorized according to the classification of tillage which are:

1. Primary tillage and
2. Secondary tillage

2. **Primary Tillage**

Primary tillage is the initial major soil working operation which cuts and shatters the soil with relativedeep penetrating tools and leaving a rough surface texture.

3.

4. **Primary Tillage Machinery**

For decades animals have been used to work in the farm. They are engaged in tillage of all kinds and in carrying farm products and other goods to and from distances places. They have specialized kind of tillage implements use for tillage. This implement is like the mouldboard plow and has wood attachments (fig)

The tractor drawn implement include:

- Moldboard plows
- Disk plows and
- Chisel plows

11.

12. ***MOULBOARD PLOW***

This is designed to cut, lift and invert a lamp of soil (approximately 36-to-51 centimeters). Thisaction burries the trash and crop residue. The moldboard lift twins, and pulverizes the soil.

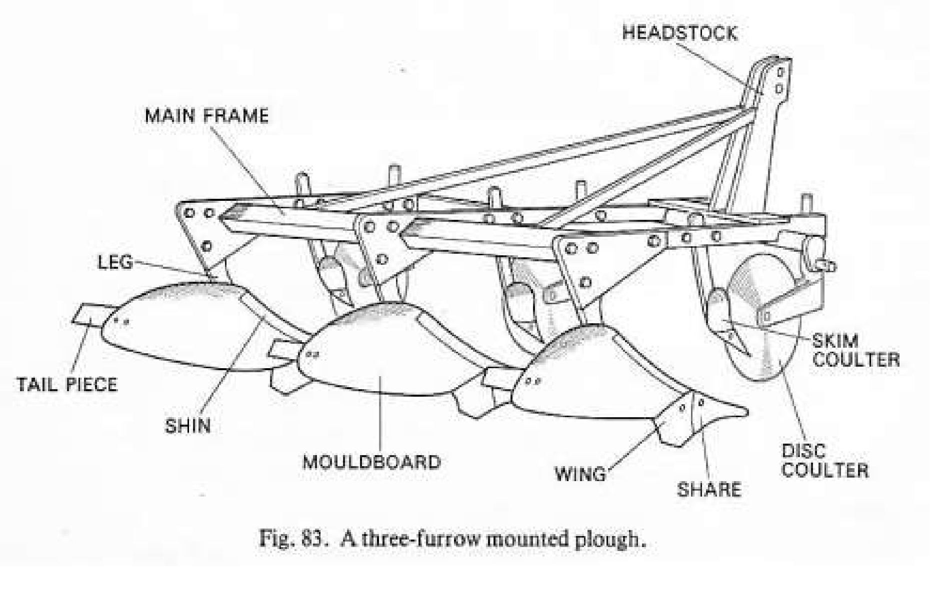


Fig. 83. A three-furrow mounted plough.

13. DISK PLOW

It has three or more individually mounted concave disks that are inclined backward to achieve maximum depth. They are particularly adapted for use in hard dry or sticky, shrubby or bushy land or on rocky land. Generally these plows are specialty and specifically designed for rough ground and heavy trash conditions where complete trash coverage is nor desired. There aggressive action chops and mixes trash into the soil.

14. CHISEL PLOW

The chisel plow is equipped with narrow double-ended shovels or chisel points, mounted on long shanks. These plows rip through the soil and stir it but do not invert and pulverizes as well as the moldboard and disk plow. These plows work

best when the soil is firm and dry

THE SUBSOILER

2. **A subsoiler is a tractor mounted implement used to loosen and break hard pan soil, It works up to the deapth of 12”() The sub soiler is a because roots penetrateprimary tillage tool which will improve growthin all crops where soil compaction is a problem. Subsoiler helps crops perform well during hot and dry seasons because roots penetrate soillayer deeperto reach moisture and nutrients. In wet condition, the water passes easier throughthe shattered areas reducing in wet condition the water passes easierthrough the shattered areas, reducing the possibility of crop drowning.**

3.

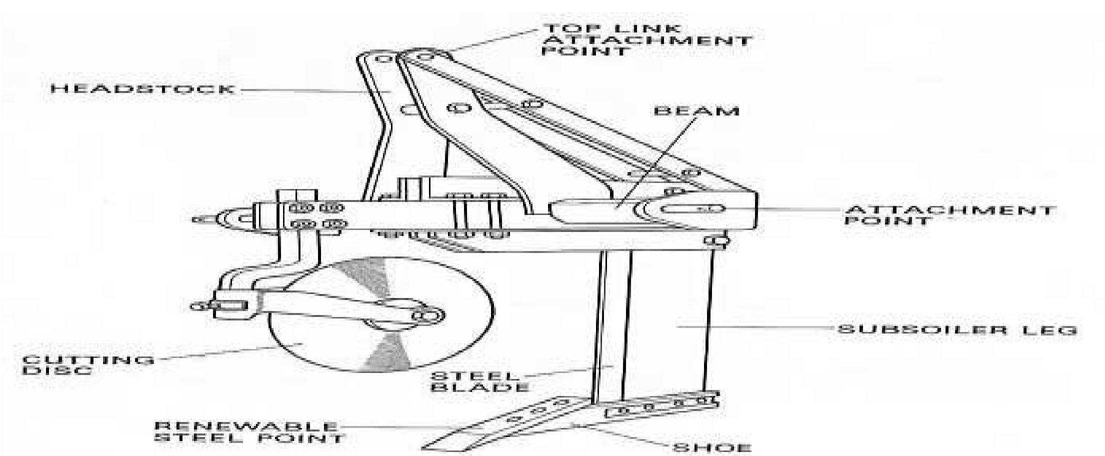


Fig. 94. A typical sub-soiler.

1. SECONDARY TILLAGE MACHINERY

Secondary tillage tools are grouped into the following types:

1. Disk harrows
2. Cultivators and
3. Rotary tillers

These implements pulverizes, level and firm the soil to prepare good seed bed, control weed and conserve soil moisture.

2. DISK HARROW:

Disk Harrow: very effective in penetrating hard soil and in rocky or root or stump infested land. It cuts left over crop residue into pieces and with other trsh mixes them well with the soil.

3.

4. CULTIVATORS:

Generally, these implements are used to control weeds in crops. They help stir the soil, aerate and toimprove water intake into the soil.

Practical Assignments

Students should go to any agricultural machinery dealer to see the different types of tillageimplements.

Students should be taught or see a demonstration of how these tillage implements workStudentsshould learn the proper maintenance culture of these implements.

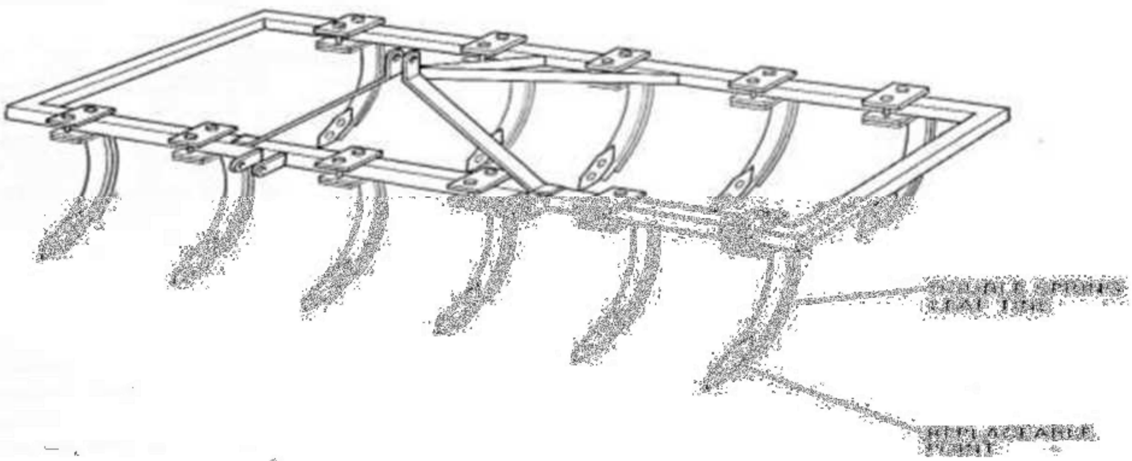


Fig. 98. A mounted spring-tine cultivator.

Fig. 99. The action of different types of cultivator tines.

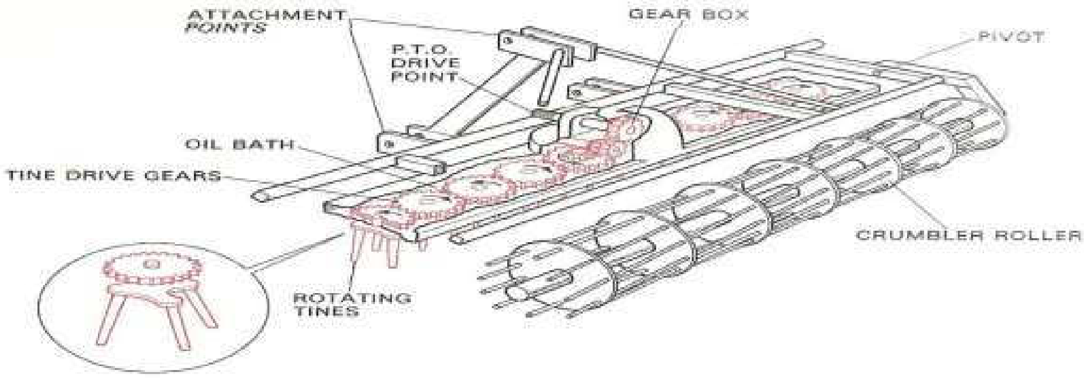


Fig. 104. Working components of a mounted rotary cultivator.

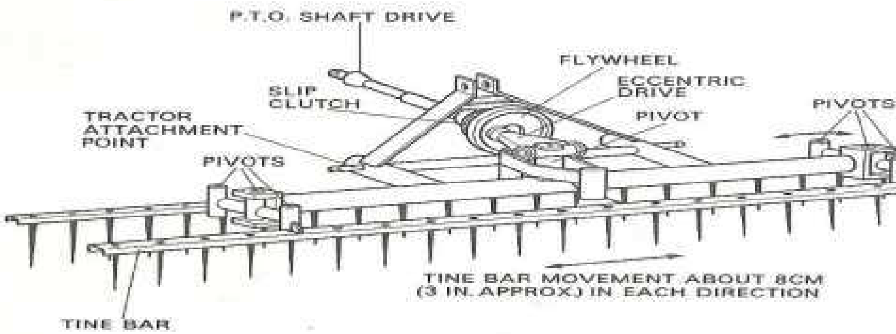


Fig. 105. A power harrow.

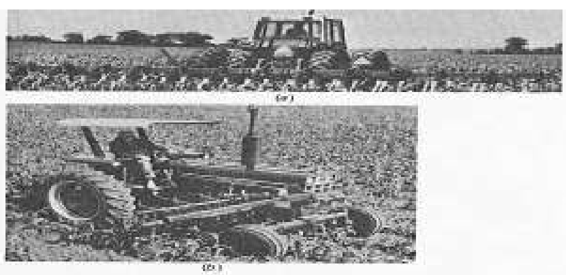


Fig. 18-26. Row-crop cultivators: (*a*) rear-mounted and (*b*) front-mounted. (*International Harvester Co.*)

nected to a tool bar. The tool bar may be rear- or front-mounted (Fig. 18-26). Control of the cultivator on hillsides is easier with the front-mounted type.

Field Cultivator Field cultivators are similar in use and appearance to chisel plows, except that the frame is much lighter and they are intended to operate at a depth of approximately 4 in [102 mm] (Fig. 18-27). In contrast with a row-crop cultivator, they are used for preparing a seedbed in soil that has been previously worked with a plow disk or chisel plow. In some instances planting equipment is mounted on a field cultivator for till-plant operation.

The shank of a field cultivator is spring-cushioned. The spring provides aggressive, vibrating action for excellent trash clearance (Fig. 18-27*a*).

Special coil spring shanks equipped with anhydrous ammonia soil points or knives are used to apply fertilizer and other chemicals 4 to 5 in [102 to 127 mm] below the surface, where it will be accessible to plant roots (Fig. 18-28).

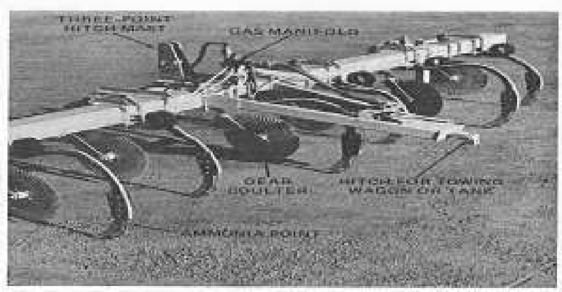


Fig. 18-28. A special type of mounted field cultivator equipped for anhydrous ammonia fertilizer application. Note the coil shank with ammonia points or knives. (*Orthman Manufacturing Co.*)

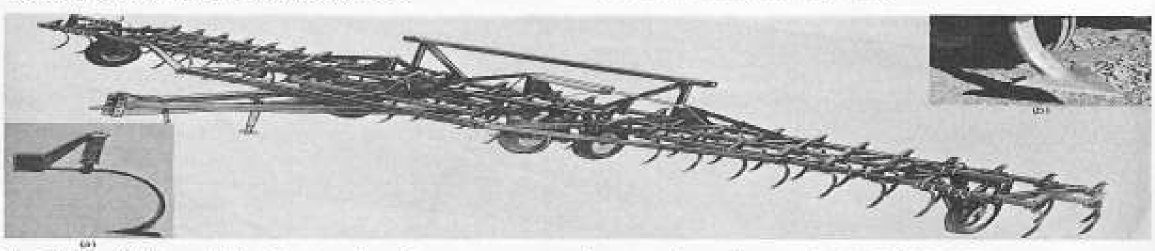


Fig. 18-27. Pull-type field cultivators have become very popular secondary tillage tools for field finishing or seedbed preparation working 2 to 5 in [50 to 125 mm] deep. Outside wings fold for transport and flex for even penetration across the full width of the unit. (*a*) Shanks are spring-cushioned (insert) for vibrating action and trash removal. Shank points are $1\frac{3}{4} \times \frac{1}{4} \times 11$ in [$44.45 \times 6.35 \times 279.4$ mm] and are used for shattering crust ahead of planting. (*b*) V-sweeps are 4 to 12 in [101.6 to 304.8 mm] wide and are used for weed control, leaving crop residue on or near the surface. (*Deere & Co.*)

1. Harvesting and Processing Machines

When crops matured in the field and have reached the stage where they can be harvested and taken home for storage and latter further processing depending on the end us There are several crops that are harvested when still maturing in the farm. In all, harvesting machines are used.

In Nigeria most crops are harvested locally either by locally made hand tools e.gsickles, cutlass, axe, knife etc. This type of harvesting makes the work easier but takes longer time to get the work done.

However, there are improved machines made that help to drastically reduce the hours spend in harvesting. With the modern machines, the harvesting work is made easier or simpler, drudgery is reduced to the barest minimum and the work of harvesting is accomplished faster thus saving timethat can be used for other productive activities.

After crops are harvested they have to be processed either to be used immediately or keep in storage for later use. Processing of crops can be dome locally or with hand machines or modern machines. The equipment for processing are varied and many.

2. Harvesting Equipment (Machines)

Machines for harvesting can be classified on the basis of the crops to be harvested

1. Animal feeds

These are majority grasses (dried or wet). There are three forms of grasses feed to animals.

- Fresh grass
- Dried grass (hay)
- Process or fermented grass/and other crops (silage)

3. Machines for Harvesting Animal Feed

In general, most animal feeds in the field are harvested locally and by modern machines.

4. Types of Machines for Harvesting Animal Feed

1. **Fresh grass:** these are harvested by hand using a cutlass or sickle and

by a machine callmower. Mowers are of two types:

- Cutterbar mower and
- Rotary mower

2. **Dried Grass or Hay:** this is harvested by a machine callcutd Hay baller

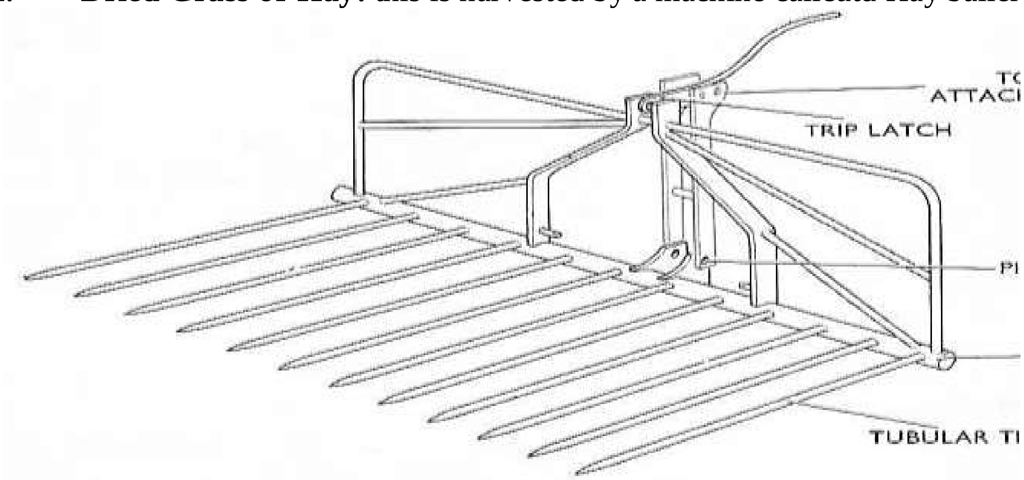
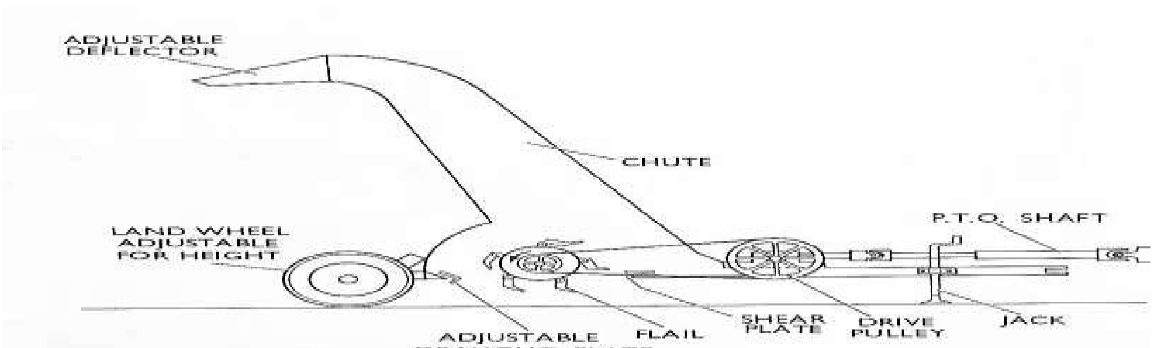


Fig. 145. A tractor buckrake.



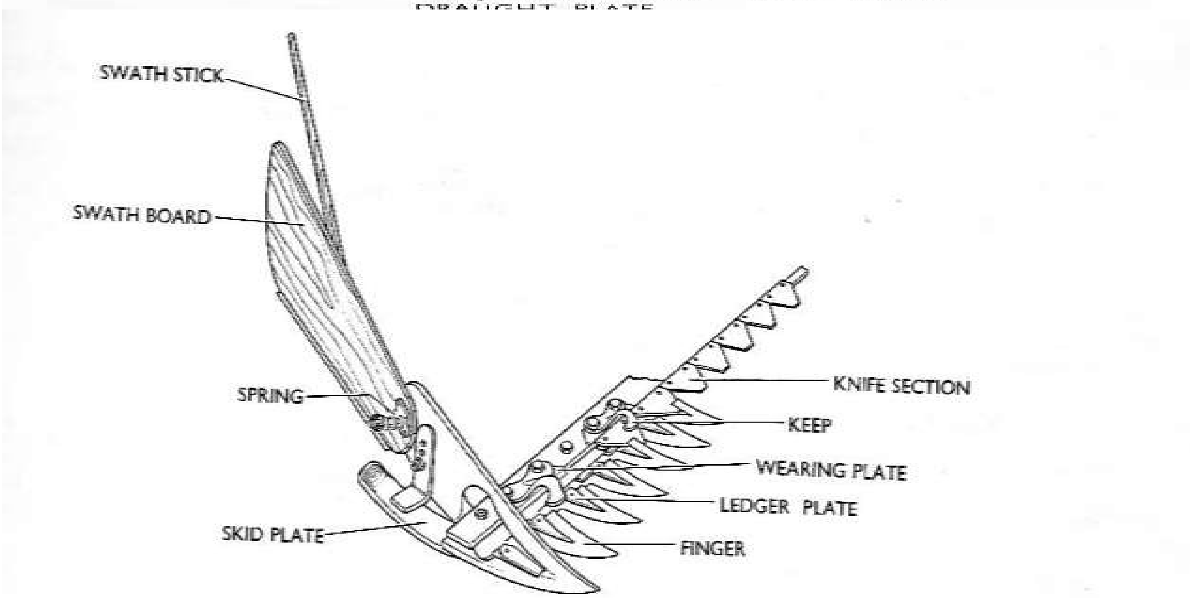


Fig. 122. Cutting mechanism of a mower cutter-bar.

5. OTHER CROP HARVESTING MACHINES

These are harvesting machines made for all the kinds of crop produced in the farm. The most talked about is the one called the combine harvester. The combine harvester does the following jobs all atthe same time in the farm during operation.

1. Cuts the crop
2. Feeds the crop to the cylinder
3. Threshes the seed from the seed head
4. Separates the seed from the straw.
5. Cleans the seed
6. Handles the clean seed or grain until it is taken by the truck or trailer for safe storage.

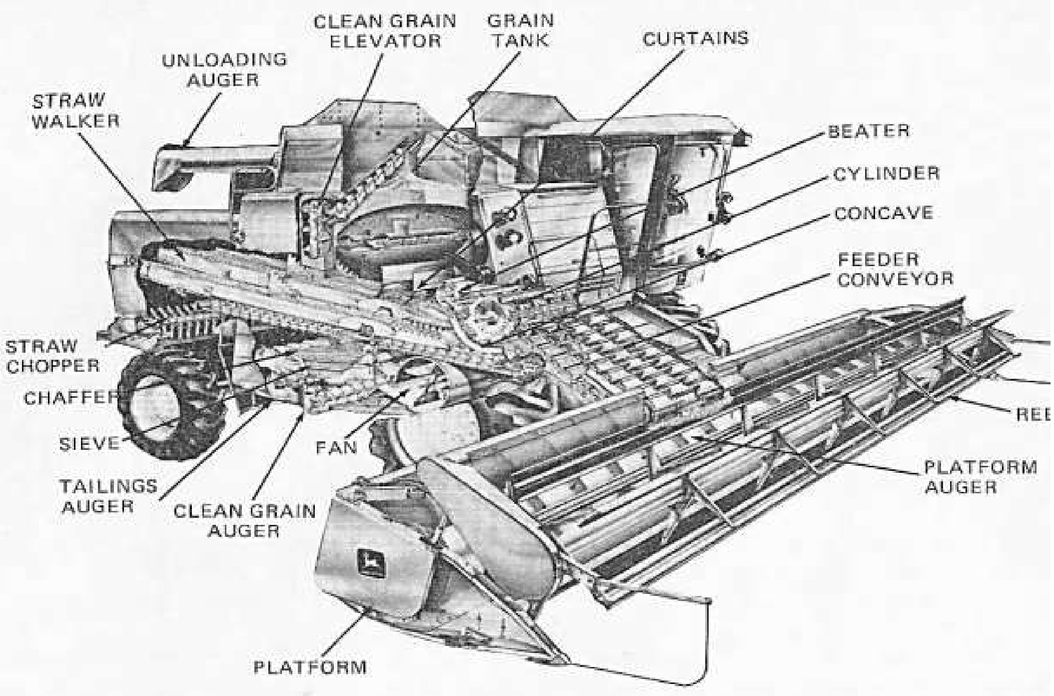


Fig. 23-9. A cutaway view of a self-propelled combine. (*Deere & Co.*)

1. Types of Combine Harvester

Several types of combines are available to meet the various needs of agriculture producers. Selection of these machines will depend on the crop grown the terrain of the farm, number of hectares of farm to be harvested and capital available. These combines are classified as:

1. Self-propelled combined
2. Hillside combined
3. Pull-type combined
4. Special combined

6. *PRACTICAL ASSIGNMENT*

1. Students should visit a modern agricultural and /or a major market or dealer of agricultural machines to enable. They see these types of harvesting machines.
2. If possible the farmer can demonstrates the use of any of the combined AVAILABLE.

7. *SUMMARY*

Most crops are harvested by either a simple locally made harvesting machines or by a more sophisticated harvester or combine harvester. A combine harvester performs five major functions.

1. Cutting the crop and feeding it to the cylinder
2. Threshing the crop
3. Separating the crop from the straw
4. Cleaning the crop
5. Handling the crop

8. *PROCESSING MACHINES*

When crops are process after harvesting they may take various forms or shape. The machines or equipment to do these changes into forms and shapes are available. They range from locally made to more complex modern one. These complex ones are mostly found in industries. The local ones are usually hand mills or hand sieves using such local equipments as pestle and morta, grinding stones, and the local sieve
Processing involves:

1. Size reduction
2. Threshing
3. Milling
4. Preparing feeds for animals.

9. PRACTICAL ASSINGMENT

Students are to visit any farm where they can see these machines. Students may request for the demonstration of these machines

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DEPARTMENT OF
AGRICULTURAL ECONOMICS AND EXTENSION

FPY/SIWES PRACTICAL GUIDE

AEA 403:
FARM APPRAISAL AND EVALUATION

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FARM APPRAISAL AND EVALUATION

1. Unit 1 PROJECT IDENTIFICATION

1. Introduction

The first step to take when you are venturing into agribusiness is the identification of the project you are to embark upon. In the identification of project, usually many ideas about different kinds of projects will occupy your mind. However your ability to select one project from the pool of ideas before you is called project identification. This task is not easy to undertake since it involves a lot of risk and uncertainties that has to be checked before selection in order to avoid project failure. The purpose of project identification is to help develop a preliminary proposal for the most appropriate set of intervention and course of action within time and budget frame (Food and Agricultural Organization – FA0-2018).

2. Objectives

At the end of the lesson, students should be able to:

- Define a project
- Explain how to identify a project
- State the characteristics of a project

3. Definition of a Project

Project is a specific activity with a starting point and a specific ending point intended to accomplish specific objectives.

Project can also be said to be an activity for which money will be spent in expectation of returns which logically seems to lend itself to planning, financing and implementation as a unit. It is the smallest operational element prepared and implemented as a separate entity.

Agricultural project on the other hand is investment activity in agriculture in which financial resources are expended to create capital assets that produce benefits over an extended period of time.

4. Project Identification

An important question that often comes up in project analysis or management is how you will arrive at the decision to start a project. In other words what are the forces that will stimulate you to venture into a project? Most often you are moved by the impulse of challenge. You feel challenged on a situation and various ideas begin to flow and run through your mind. These ideas are usually called business idea. Ability to select one of these ideas is called project identification.

There are many sources from which ideas may come to you for selection, these include:

- Hobbies and interest,
- Personal skills and experience,
- Analysis of government policy statements, budget, plans, especially in respect of areas of change and future priority,
- Research findings,
- Natural resources, local raw materials and investment priority of state and local government,
- Agriculture and industrial trade fairs,
- Analysis of companies annual reports,
- Analysis of the trend and patterns of imports and exports,
- Mentors,
- Mass media such as newspapers, magazines, television and internets,
- Exhibitions,
- Survey,
- Complaints and
- Brainstorming

Your selection must always be based on costs and returns. This can often be measured through valuation at the market prices of the selected project. This is also a part of project appraisal. We shall discuss about appraisal later in the course.

Some example of agricultural areas from where you can select a project include crops (arable and tree crops, livestock, credits, irrigation, agricultural machinery, agricultural education, fishery, marketing, land settlement, product processing and preservation, rural development among others.

There are so many sub sets of the ideas listed above which you can also select from. For example in livestock there are projects like poultry, ruminants and non–ruminants, grass cutter or cane farming, snailry and so on

5. Characteristics of a Project

Project share the following characteristics:

- Unique in nature.
- Have definite objectives (goals) to achieve.
- Require set of resources.
- Have a specific time frame for completion with a definite start and finish.
- Involves risk and uncertainty.

6. Summary

* We have learnt that project is an activity in which money is spent with expectation for a return.

* When you want to start a project, many ideas come to your mind from different sources. Your ability to identify the project to be embarked upon is the first step in project appraisal.

* Usually there are many agribusiness ideas that can be converted to projects. It is your responsibility to make the best choice.

* Your selection will be based on the valuation of the cost and return of the idea.

7.Practical Assignment

* Define an agribusiness project?

* Yusuf Dalhatu has just passed out from National Youth Service Corps and had some money saved during the service. He wants to go into agribusiness venture. Advise him on how he can identify a viable agribusiness project.

8. References

Food and Agricultural Organisation – FAO – (2018). “Project Identification

Investment Learning Platform (ILP), Food and Agricultural Organisation of the United Nation.

2. Unit 2. FEASIBIBLITY STUDY

1. Introduction

As we learnt in Unit 1, the first step towards venturing into agribusiness is identification of the project or business idea you want to embark upon. It is advisable to select at least 2 or 3 projects even though you will eventually end up choosing one of them. This is because when you do the arithmetic of cost and return of each project putting into consideration the resources within your reach, you may end up selecting the alternative project for execution. The next step after project identification is the preparation of a feasibility study of the project selected.

2. Objectives

At the end of the lesson, students should be able to:

1. Define feasibility study
2. State the need for a feasibility study
3. Discuss the contents of a feasibility study
4. Write a feasibility study

3. What is a Feasibility Study?

As the name implies, a feasibility study is an analysis of the viability of an idea. It is putting ideas and information you collected for a business venture together. The feasibility study focuses on helping answer the important question of ‘’should you proceed with the proposed project idea?’’ All activities of the study are directed toward helping answer this question. It is expected that you should conduct a feasibility study to determine the viability of your idea before proceeding with the development of the agribusiness you have chosen. Finding out early that a business idea will not work saves your time, money and heartache later. The feasibility study is a critical step in your agribusiness assessment process. If properly conducted, it may be the best investment you ever made. (Hofstrand, and Hoiz – Clause (2009).

4. Reasons why you do a Feasibility Study

A feasibility study helps you to:

1. Decide if you should start your agribusiness or not.
2. Organise your ideas so that you will start and run your agribusiness in the best way.
3. Present your agribusiness idea to a lending institution such as a bank to secure loan for your agribusiness.
4. Guide for implementation of your agribusiness idea.
5. Gives focus to your agribusiness and outline alternative.
6. Identifies reasons not to proceed.
7. Provides quality information for decision making.
8. Provides documentation that the agribusiness venture was thoroughly investigated.
9. Helps to attract equity investment.

5. Content of a feasibility Study Report

These are the main parts of the feasibility study.

- ***Executive Summary***

  It contains the important information from the rest of the feasibility study. It is important that the summary is clearly worked out and that it looks tidy, because it is the first impression anyone who reads the feasibility study will get of your business. Executive summary should contain brief information on the:

  - Business name,
  -philosophies and goals for setting up the business,
  -need the business will satisfy in the society,
  -the form of business,
  -why that forms of business was chosen,
  -staffing,
  -legal issues,
  -marketing plan,
  -financial issues and
  -viability of the business.
- The executive summary is usually the last part of the feasibility study to be written but the first to be read. We shall now take each of this content of a feasibility study and try to explain them in detail.

3. Business Name

A little description of how you come about the business name.

- ***Goals Setting***

  The goals and objectives of the business must fit into the national goals on such sectors of the economy.

- ***Business Idea***

  This is the short and precise description of the basic operations of the business.

  - What product or services you will produce,
  - Whom you will produce for or sell to,
  - How you will produce the products and
  - Which need your business will fulfill for the customer.

- ***Form of Business***

  There are different forms of business. These are sole proprietorship, partnership, Limited Liability Company and cooperative.

  - Which form of business will you engage in?
  - Why did you choose that form of business?
  - Number of people that will manage the business if the form is not sole proprietorship.

- ***Legal Responsibilities and Insurance***

  Every business has legal responsibilities and insurance. The **legal** responsibilities that must be specified include:

  - Registration of the business
  - Licenses and permits
  - Taxes, this include:
    - ❖ VAT
    - ❖ Employees income tax
    - ❖ Profit tax
    - ❖ Local council levies
    - ❖ Union

Levies Employees

- ❖ Minimum wage
- ❖ Working hours
- ❖ Holiday
- ❖ Occupation safety

- Annual leave, sick leave, etc.

- Credit lease and other contractual agreements. Most agribusiness requires **insurance** coverage to give financial security against different kinds of risks.
- Specify properties like machines, vehicles, stock, etc that must be insured against theft, damage, fire accident or natural disaster.
- Specify also about how to insure yourself and employees against accidents and medical expenses.

- ***Staffing***

  Personnel you require for your agribusiness in terms of skills, experience and number.
  - List the task that needs to be performed in the business.
  - Decide which task you will not have time and skills to perform yourself.
  - Determine skills, experience and other requirements needed in the staff for their tasks.
  - Decide how many employees are needed for each task depending on the nature of the business. It may be.

- Skilled
- Semi skilled
- Unskilled
- Seasonal
- Permanent
- Casual
- Gender

Specify their remunerations which can be categorized as high (consultant), average (salaries) and low (wages).

- ***Costing***

Costing is a very important aspect of your business. You need to be able to do the following under costing:

- cost the fixed assets
- Cost the variable inputs which include:

- Direct material costs and spare parts
- Direct labour cost
- Indirect cost like transport, electricity, rent and interests.

Costing should be detailed and every item of the business must be valued. Costing also include fixing of prices for your products.

4. *Marketing Plan*

You must specify how you want to market your product which includes the 4Ps product, Price, place and promotion.

5. *Product*

- Quality
- Availability
- Packaging

6. *Price*

- Affordability
- Flexibility

Place

- Target customers
- Storage

7. *Promotion*

- Personal contact
- Fliers/posters
- Mass media
- Bill boards
- Town criers
- Internets

Financial Responsibilities

8. *Required Start-Up Capital and Sources*

This is usually estimated from the costing of the business. They should also include your operating cost and personal expenses.

Having determined the amount of money required to start, it then becomes necessary to ascertain where to get the money. These sources must be specified.

Example -owner's equity
-friends and relatives
-Banks
-cooperative societies
-stock exchange, etc

9. *Financial Planning*

There must be plan for cash flow and profit. Financial planning must specify cash flows and cash inflows usually on annual basis.

The worth and viability of the business is determined here. This is done using cost and revenue figures within the projected life span of the business. The viability is determined by using the traditional methods and discounted cash flow (DCF) methods.

The traditional methods include:

-payback period
-accounting rate return

The discounted cash flow methods include:

- Net present value (NPV)

-internal rate of return (IRR)

-profitability index (PI) / Benefit Cost Ratio (BCR)

These tools must be used to assess the worth of the project and its viability or profitability using the prevailing interest rate (Nwandu, 2009).

6. Summary

You have studied that feasibility study tells you to go ahead and implement the business idea that you have or not. It reveals to you the viability or worth of the agribusiness. Feasibility study also gives you an early warning, saves your time and money against an agribusiness venture among others.

You have also learnt about the various items you will gather and study under feasibility study that will give you insight into the agribusiness environment. This will help you, take your take decision. Such areas include looking into the aims and objectives of setting up such an agribusiness venture, the legal responsibilities, costing of the agribusiness, staffing, marketing and finance among others.

It is advisable that you do not go into an agribusiness venture without carrying out a feasibility study.

7. Practical Assignment

- Adamu Ibrahim wants to establish a poultry farm. As his son that participated in a workshop on writing of feasibility studies, give him reasons why it is necessary to carry out a feasibility study before the establishment of the poultry farm.
- Explain to Chukwuemeka an illiterate farmer the meaning of a feasibility study.
- Following the guidelines, write a feasibility study for Oma Farms Limited on their establishment of their new fish pond project with a capital outlay of ₦5,000,000.

8. References

Hofstrand, D. and Hoiz – Clause, M. (2009). “What is a Feasibility Study?” Extension and Outreach, IOWA State University, USA.

Nwandu, P. I. (2009). *“Entrepreneurship in Agribusiness”*. Onitsha: Jo-Gene Publishers.

10. UNIT 3. AGRIBUSINESS PROJECT APPRAISAL

1. Introduction

When you have conducted a successful feasibility study and selected the agribusiness project you want to implement, the next step is to construct an agribusiness project plan. This is easy to achieve since it is just adopting the feasibility study of the agribusiness project selected into a working document called agribusiness plan or agribusiness ‘’blue print.’’

Agribusiness project plan is then appraised before implementation. For better understanding you should note that appraisal of agribusiness project starts from feasibility study where you questioned the viability of the agribusiness project. Unit 3 will elaborate more on agribusiness project plan and agribusiness project appraisals.

2. Objectives

At the end of the lesson students should be able to:

1. Explain the difference between feasibility study and agribusiness project plan
2. Explain agribusiness project appraisals
3. Mention tools used for agribusiness appraisals or analysis

3. Feasibility Study versus Agribusiness Plan

It is necessary that you know the difference between a feasibility study and agribusiness plan. The feasibility study provides an investigating function. It addresses the question "Is this a viable agribusiness venture?'' On the other hand an agribusiness plan provides a planning function. Agribusiness plan outlines the actions needed to take the proposal from idea to reality. In feasibility study you are considering many alternatives but the agribusiness project plan deals with only one alternative. That is the selection of the best idea from the pool of ideas as the project to implement.

The feasibility study is conducted before the agribusiness plan. An agribusiness plan is prepared only after the agribusiness venture has been deemed to be feasible. If a proposed agribusiness venture is considered to be feasible, an agribusiness plan is usually constructed as the next step that provides a roadmap of how the agribusiness will be created and developed. The agribusiness plan provides the blue print for project implementation [Hofstrand and Hoiz-Clause, 2009].In other words an agribusiness plan is a feasibility study that is selected for implementation.

4. Explanation of Agribusiness Project Appraisals

Agribusiness project appraisal refers to the process of assessing and questioning the contents of a feasibility study before resources are committed to a project. It is the discipline that concern itself with calculating agribusiness project viability. Agribusiness project appraisal is an important decision making tool that lays the foundations for better delivery and justification for spending money on a project. The typical areas of investigation include economic, environmental, financial, social and technical aspects of the project. This is done to determine if a project will meet its objectives. Most often it involves comparing alternative options**.** Appraisals are done before the take-off of the project. From the foregoing you can also infer that project appraisal assesses the viability of a feasibility study or agribusiness plan.

5. Tools Used for Agribusiness Project Analysis [Appraisals]

The most widely accepted methods or criteria in use for project analysis are:

1. Traditional Criteria
2. Discounted Cash Flows [DCF]

11. Traditional Methods

Here we have the: *Payback Period and

* Accounting Rate of Return [ARR]

12. Discounted Cash Flow

Under the DCF we have:

*Net Present Value

*Benefit Cost Ratio [BCR] [Also called Profitability Index]

*Internal Rate of Return [IRR]

6. Summary

You have learnt that all the assessments that is done before taking the decision to go on and establish an agribusiness is an appraisal. This also tells you that feasibility study and agribusiness plan are all parts of appraisal of an agribusiness. Appraisal is also used to assess the viability of an agribusiness. Some appraisal tools include Payback period, Accounting rate of return, Net present value, Benefit cost ratio and Internal rate of return.

7. Practical Assignment

***** As Farm Manager of Praise God Farms, how will you convince Chief Delight Dalu the owner, that there is difference between Feasibility study and Agribusiness project plan.

* Explain to young Agribusiness Entrepreneurs, agribusiness project appraisal.

* Appraising an agribusiness project requires some tools used for arithmetic calculations to find out if an agribusiness project is viable. Mention these tools.

13. 8 Reference

Hofstrand, D. and Hoiz – Clause, M. (2009). “What is a Feasibility Study?” Extension and Outreach, IOWA State University, USA.

14. Unit 4. ARITHMETIC OF PROJECT APPRAISALS

1. Introduction

In Unit 3 we mentioned some tools that are used for project analysis or appraisals. These tools are used to appraise the viability of a project. You can use more than one method to value your project. This will help you take the best decisions on your projects.

2. Objectives

At the end of the lesson students should be able to:

1. Explain the different methods of appraising agribusiness projects
2. Discuss the advantages and disadvantages of the different methods of appraising agribusiness project
3. Solve some arithmetic problems on the different methods of appraising agribusiness projects
4. Appraise an agribusiness project
5. Take decision on the viability of an agribusiness project

15. 3. Traditional Methods for Appraising Agribusiness Projects 3.1.Payback Period Method

This is defined as the number of years required to recover the original cash outlay invested in the project. If the project generates constant annual cash inflows, the payback period can be computed by dividing cash outlay by the annual cash inflow.

$$\text{Payback Period} = \frac{\text{Cash Outlay}}{\text{Annual Cash Inflow}}$$

Example:
A project requires an outlay of ₦50, 000.00 and yields an annual Cash inflow of₦12, 500.00 for 7 years calculate the payback period.

Solution:

$$\frac{\text{Cash Outlay}}{\text{Annual Cash Inflow}} = \frac{₦50{,}000.00}{}$$

₦12,500.00

=4 Years

In the case of unequal cash inflows, the payback period can be found out by adding up the cash inflows until the total is equal to the final cash outlay.

Example:

Calculate the payback period of a project which requires a cash outlay of ₦20,000.00 and generates cash inflows of ₦8,000.00; ₦7, 000.00; ₦4, 000.00 and ₦3,000.00.

Solution:

When you add up the cash inflows, you will find that in the first 3 years, ₦19, 000.00 of your original outlay has been recovered. In the 4^{th} year, the cash inflow generated is ₦3,000.00 and only ₦1,000.00 of your original outlay remains to be recovered. Assuming that the cash inflows occur evenly during the 4^{th} year, the time required to recover ₦1, 000.00 will be:

$$\frac{1,000 \times 12}{3,000} = 4 \text{ months}$$

Thus, the payback period becomes 3 years and 4 months

3.1.1. Acceptance Rule

The payback period can be used as an accepted or rejected criterion as well as ranking projects.

If the payback calculated for a project is less than the maximum payback period set up by management, it will be accepted and if not it will be rejected

In ranking, payback period gives the highest rankings to the projects which has shortest payback period and lowest ranking to projects with longest payback period. Thus if you are to chose between two mutually exclusive projects, the project with the shorter payback period should be selected [ranked first].

Example: Calculate the payback period [PBP] of the following projects, each requiring a cash outlay of ₦10,000.00. Suggest which projects are acceptable, if the standard payback period is 5 years.

16. Solution:

Cash Inflows Year	Project X	Project Y	Project Z
	₦	₦	₦
1	2,500.00	4,000.00	1,000.00
2	2,500.00	3,000.00	2,000.00
3	2,500.00	2,000.00	3,000.00
4	2,500.00	1,000.00	4,000.00
5	2,500.00	0.00	0.00

Payback Period

For Project X is: $\frac{₦10,000}{₦2,500}$

= 4 years

For Project Y

₦4,000.00 + ₦ 3,000.00 + ₦2,000.00 + ₦1,000.00 = ₦10,000.00

₦10,000.00 is received in 4 years For

Project Z

₦1,000.00 + ₦2,000.00 + ₦3,000.00 + ₦4,000.00 = ₦10,000.00

₦10,000.00 is also received in 4 years

The payback period in each case is 4 years. That is at the end of the 4th year, the initial cash outlay of each project is received. This means that all the projects are acceptable because the standard payback period [5years] is higher than the actual payback period in all the projects.

3.1.2. Advantages of Payback Period

1. Payback period is simple to understand and easy to calculate.
2. It cost less than most of the sophisticated techniques which requires most of your time and use of computer.

3.1.3. Disadvantages

1. It fails to take account of cash inflows earned after the payback period. For example in the above illustration Project X is considered to be at par with Y and Z as these have the same payback period but Project X is more desirable than Y and Z as X yields cash inflows after the payback period.
2. It is not an appropriate method of measuring the profitability of an investment project as it does not consider the entire cash inflows yielded by the project.
3. It fails to consider the pattern of cash inflows. That is the magnitude and timing of cash inflows. In other words it gives equal weight to returns of equal amount even though they occur in different periods. For example compare projects Y and Z in the above illustration where the 2 projects involve equal cash outflows and yield equal total cash inflows over equal time periods [that is N10, 000 in 4 years]. Using payback period both are equally desirable, but Project Y should be preferable as large cash inflows come earlier in Project Ys life as in contrast with Project Z which generates greater cash inflows later in its life.
4. There are administrative difficulties in determining the maximum acceptable payback periods. There is no basis for setting a maximum payback period. It is generally a subjective decision.

3.2. Accounting Rate of Return Method

The Accounting Rate of Return [ARR] method uses accounting information as revealed by the financial statement to measure profitability of an investment proposals. ARR is found out by dividing the average income after taxes by the average investment.

The average investment will be equal to original investment with the salvage value if any divided by 2.

The formula is:

$$ARR = \frac{\text{Average Income}}{\text{Average Investment}}$$

This can be gotten from the balance sheet.

17. Example:

A project cost ₦50,000.00 and has a scrap value of ₦10,000.00. Its stream of income before depreciation and taxes during 1st year through 5years is ₦10,000.00;

₦12,000.00; ₦14,000.00; ₦18,000.00 and ₦20,000.00. Assume a 50% tax rate and depreciation on straight line basis of ₦ 8,000.00. Calculate the ARR for the project.

18. Solution:

Period	1	2	3	4	5	Average
Average earning before depreciation &taxes(₦)	10,000.00	12,000.00	14,000.00	16,000.00	20,000.00	14,000.00
Depreciation(₦)	8,000.00	8,000.00	8,000.00	8,000.00	8,000.00	8,000.00
Net earnings before taxes(₦)	2,000.00	4,000.00	6,000.00	8,000.00	12,000.00	6,400.00
Taxes at 50%(₦)	1,000.00	2,000.00	3,000.00	4,000.00	6,000.00	3,200.00
Book value of Investment						
Beginning(₦)	50,000.00	42,000.00	34,000.00	26,000.00	18,000.00	
Ending(₦)	42,000.00	34,000.00	26,000.00	18,000.00	10,000.00	
Average(₦)	46,000.00	38,000.00	30,000.00	22,000.00	14,000.00	30,000.00

$$ARR = \frac{3,200 \times 100}{30,000}$$

$$= 10.67\%$$

3.2.1. Acceptance Rule:

As an accept or reject criterion, ARR method will accept all projects where ARR is higher than the minimum established by the management and reject projects which have ARR lesser than the minimum rate.

ARR method ranks project with the highest ARR as number 1 and the lowest rank is assigned to the project with the lowest ARR.

3.2.2. Advantages of ARR

1. ARR is simple to understand and use.
2. It can be readily calculated using accounting data.
3. It uses the entire stream of income in calculating the accounting rate.

19. 3.2.2. Disadvantages

1. ARR ignores the time value of money.
2. It uses accounting profit not cash inflows in appraising projects.

3.3. Discounted Cash Flow

In order to determine the worth of your project, [that is whether it is viable or not] it is necessary to discount the cash flow using the appropriate rate of discount. After discounting the cash flow, the viability of your project can be determined using any of the following indices or criteria:

1. NPV – Net Present Value
2. BCR – Benefit Cost Ratio
3. IRR – Internal Rate of Return

Before you go into the application of these discounted cash flow indices, it is necessary that you understand the principles of discounting which is key to discounted cash flow methods.

3.3.1. Principles of Discounting

Discounting is the process of finding the present value of a series of future cash flows. Discounting is the reverse of compounding. This means that a present sum is compounded to find its future value and a future sum is discounted to back to the present to find its current or present value. We shall concentrate on only discounting since we are only concerned about the viability of a project using the discounted cash flow method.

Discounting is done because a sum to be received in the future is worth somewhat less now because of the time difference assuming a positive interest rate. Discounting is premised on the concept of time value of money. A present value can be interpreted as the sum of money which would have to be invested now at a given rate of interest to equal the future sum on the same rate.

Suppose you are offered the alternative of either ₦5,000.00 today or ₦6,085.00 at the end of 5 years, which option will you choose? A correct choice must be based on the concept of time value of money. To make the choice you should find the present value of ₦6,085.00 at the prevailing interest rate. Suppose the prevailing interest rate in the economy is 4% then the present value of ₦6,085.00 is ₦5,000.00 This means that you should be indifferent about the choice since ₦5,000.00 today is the same as ₦6,085.00 at the end of the next 5 years.

The formula for finding the present value is given as follows: Present

Value,

$$PV = FV \frac{1}{[1 + r]^{n}}$$

Where; PV = present value

n = number of years

FV = sum at the end of n years or future value r=

discount rate or interest rate

The above figures may now be substituted to show that the present value of ₦6,085.00 is ₦5,000.00

PV = present value n

= 4

FV = ₦6,085

r = 4%

Substituting

$$PV = 6,085 \frac{1}{[1 + 0.04]^{4}}$$

PV = 6,085 x 0.8219

PV = ₦5,000.00

Consider another illustration. Find the present value of ₦3,600.00 at 20% interest rate calculated annually.

20. Solution:

PV = present value n

-

= 5 years

FV = ₦3,600.00 r

= 20%

Substituting

$$PV = 3,600 \frac{1}{[1 + 0.2]^5}$$

PV = 3,600 x 0.4019 PV

= ₦1,446.84

3.3.2. Discount Factor Table

In order to simplify calculations involving present value and other related factors, you can use the **interest factor table** also called the **discount factor table.** You can download the discount factor table from the internet especially Google. The table can also be obtained from reputable bookshops. The arithmetic of project appraisals or project analysis is hinged on this discount factor table. For the remaining part of this course, we shall not go into the rigorous exercise of calculating the discount factor with the formula but will use the discount table where applicable. However this does not mean you should not know how to calculate the discount factor since your knowledge of this could be tested.

Let us use the discount factor table to solve the following problem.

21. Problem

Use the interest factor table to find the present value of ₦121.67at the discount rate [interest rate] of 4% for 5 years.

22. Solution

First step is to open the page of the discount factor table where you have the Present value interest factor [PVIF].

The tables are arranged in such a way that on top of the page at the right hand side is the Interest rate while at the left hand side vertically arranged are the years. The second step in our problem is to obtain the discount factor by tracing where 4% [0.04] intercepts 5 years [periods]. This is at 0.8219.

The 3rd and final step is to obtain the Present Value by multiplying the future value [N121.67] with the discount factor [0.8219]. The formula is given by:

PV = FV [PVIF or DF]

Where:

PV = Present value.

PVIF = Present value interest factor or Discount factor] = [0.8219]

PV = ₦121.67 [0.8219]

PV = ₦121.67 x 0.8219

PV = ₦100.00

The interpretation is that ₦121.67 in 5 years time at an interest rate of 4% has a Present value of ₦100.00.

3.3.3. Role of Discount Rate in Investment Decision

1. The discount rate is used to convert future value into their present value. Investment can only be properly evaluated if cost and benefits occurring at different time periods are brought to their present value.
2. The discount rate is a means of testing the profitability of a project.

23. ***Project***	***IRR%***
A	26
B	20
C	16
D	10
E	6
F	1

Application of the rule of project acceptance tells us that if sufficient resources are available and the discount rate is between 8% and 9%, projects A, B, C and D are acceptable while E and F will be rejected.

If discount rate is raised to 12%, only A, B and C will be acceptable. If discount rate is raised to 18% only A and B will be accepted. The discount rate in this case is being used as a profitable test measure of projects.

3. The discount rate is a means of allocating available capital resources to more lucrative businesses. Given the objective of profit maximization as a goal and given the fact that capital is a scarce resource; the available capital should be allocated to those projects which make the best use of them. In other words, the discount rate is a means of ensuring that capital resources are allocated to those projects which yields returns higher than the opportunity cost of the capital.
4. Discounting rate is a means of choosing appropriate (or determining the best alternative) technology of production especially concerning whether to adopt labour or capital intensive technology.

Recall that we suspended discussions on how to use the discounted cash flow methods to determine the viability of a project. We believe that by now you must have known the meaning of discounting. That is bringing the future cash inflows of a project to its present value using the prevailing interest rate [discount factor] and time [periods]. This is done to allow for better comparisons to be made on the projects.

We can now resume our discussions on the discounted cash flow methods of assessing the viability of a project. Remember that we mentioned 3 of them which include: Net Present Value [NPV]; Benefit Cost Ratio [BCR]; and Internal Rate of Return [IRR]. We can now take the methods individually and analyse them.

3.4. Net Present Value (NPV)

This involves finding the present value of the expected net flow of a project, discounted at a cost of capital [interest rate] and then subtracting from it the initial cost outlay of the project. If the present value is positive the project should be accepted but if it is negative, the project should be rejected. The formula for finding NPV is given by

NPV sum of the discounted value of the PV of Revenue

- Sum of the discounted value of cost or

$= \sum DV \text{ of Rev} - \sum DV \text{ of cost}$

Example

Give the following information about a project calculate the NPV at 8%

Example

Years	Total cost(₦)	Total Revenue(₦)
0	10,000.00	-
1	4,500.00	12,000.00
2	5,000.00	13,000.00
3	6,000.00	14,000.00

Solution

Discount factor for year 0 = 1

Year	DF at 8%	TC (₦)	PV of TC (₦)	TR (₦)	PV of TR (₦)
0	1	10,000.00	10,000.00	-	-
1	0.926	4,500.00	4,167.00	12,000.00	11,112.00
2	0.857	5,000.00	4,285.00	13,000.00	11,141.00
3	0.794	6,000.00	4,764.00	14,000.00	11,116.00
		₦ 25,500	₦ 23,216	₦ 39,000	₦ 33,369

NPV = PV of Revenue - PV of Cost

NPV = ₦33,369 - ₦23,216 = ₦ 10,153

The project has a positive NPV and as such it is viable

3.5. *Benefit Cost Ratio*

Benefit cost ratio evaluate cost with benefit that will be derived from the project. In evaluation, externalities of the project are included. In calculation the BCR the NPV of cost and revenues accruing to the project is calculated. For a project to be accepted as being viable it must have a BCR that is greater than or equal to one (1)

The BCR is calculated with the following formula BCR =

$$\frac{\text{PV or Revenue}}{\text{PV or Cost}}$$

24. *Illustration*

Using the figures from the NPV calculated above. Calculate the BCR PV or

cost = ₦ 23,216.00

PV of Revenue = ₦ 33,369.00 BCR =

$$\frac{33,369.00}{23,216.00} = 1.437$$

The BCR is greater than 1 and the project is therefore accepted as being viable.

3.6. *Internal Rate of Return*

IRR is defined as the interest rate that equates the present value or the expected future cash flow, or receipts, to the initial cost outlay.

Mathematically IRR is defined as the rate of discount which will make NPV = 0 or nearly equal to 0, or the rate of discount which makes PV of revenue equal to PV of cost.

i.e. = PVR = PVC

Or the rate of discount which will make the BCR = 1

i.e. $\frac{PVR}{PVC} = 1$

In actual or practical terms the IRR measures the efficiency of capital resources invested in the project. This is why lending agencies prefer the IRR to other indices

If in measuring the earning capacity of capital resources invested in the project, the calculated IRR is higher than the banks lending rate, the bank would be willing to lend out money and vice versa.

3.6.1. Computation of IRR

IRR is usually computed by method of trial and error/arithmetic method.

This requires trying a number or discount rates on the cash flow until one is obtained to make the NPV = 0. This is done by method of interpolation.

25. Example

Calculate the IRR of the following cash flow from a project assuming that discount rate is 8%

Year	TC (₦)	TR(₦)
0	10,000.00	-
1	4,000.00	8,000.00
2	4,000.00	8,000.00
3	4,000.00	8,000.00

Solution

Year	Df at 8%	TC(₦)	PV of Cost(₦)	TR(₦)	PV of Rev.(₦)
0	1	10,000.00	10,000.00	-	-
1	0.926	4,000.00	3,704.00	8,000.00	7,408.00
2	0.857	4,000.00	3,428.00	8,000.00	6,856.00
3	0.794	4,000.00	3,175.00	8,000.00	3,352.00
			20,308.00		20,616.00

NPV = ₦20,616.00 - 20,308.00 = ₦3O8.00 NPV =

₦3O8.00

Having discounted the cash flow and having obtained a positive NPV, the next thing is to choose a discount rate with which to discount the same cash flow to obtain a negative NPV. This is by trial and error. Use a rate close to 8%.

Year	Df 10%	TC(₦)	PVC(₦)	TR(₦)	PV of TR(₦)
0	1	10,000.00	10,000.00	_	_
1	0.909	4,000.00	3,636.00	8,000.00	7,272.00
2	0.826	4,000.00	3,304.00	8,000.00	6,608.00
3	0.751	4,000.00	3,004.00	8,000.00	6,008.00
			19,944.00		19,888.00

NPV = ₦19,888.00 - ₦19,944.00 = -₦56.00

Having gotten positive NPV of ₦ 308 at 8% DR and a negative NPV of ₦ - 56 at 10% DR,

- DR = Discount Rate

IRR = Lower DR + Difference btw the 2DRS x NPV at lower DR Sum of the absolute value of the 2NPVS

$$IRR = 8 + (10 - 8) \times \left(\frac{308.00}{308.00 + 56.00} \right)$$

$$= 8 + 2 \left(\frac{308}{364} \right)$$

$$= 8 + 1.69$$

$$= 9.7$$

NB

forget any fraction during approximation

IRR = 9%

The 9% DR is compared with the bank of financial institution lending rates. If the IRR is higher the project is viable and it profitable to invest and vice versa.

- DR = Discount Rate

Exercises

The Agro feed Ltd has two investment proposal, project A & B which have initial outlay of ₦10,000 respectively and a life of 6 years each. The discount rate or cost of capital is 15%. The expected income streams are shown below.

Years	Project A	Project B
1	₦ 5,000.00	₦1,000.00
2	₦4,000.00	₦2,000.00
3	₦3,000.00	₦3,000.00
4	₦1,000.00	₦4,000.00
5	₦100.00	₦5,000.00
6	₦100.00	₦6,000.00

(a) Calculate the payback period, NPV, BCR and IRR of project A and B;

(b) Advise the farmer on the project to select if:

(i) The projects are independent

(ii) The projects are mutually exclusive.

(c) State the advantages and the disadvantages of these methods.

26. Summary of the Analysis of Result

The summary of the results you will obtain from the above exercises are: (a). Payback period, NPV,BCR and IRR of project A and B:

	Method	Project	Result
1	Payback period	A	2$\frac{1}{2}$ years
		B	4 years
2	Net Present Value	A	₦ 10.00
		B	₦ 1,172
3	Internal Rate of Return	A	15%
		B	20%
4	Benefit cost Ratio	A	1.0

(b).Selection

The selection of projects depends on whether they are independent projects or mutually exclusive project. For the above illustration, we shall select from projects A and B (i) when they are independent and (ii) when they are mutually exclusive.

i. Independent Projects

Independent projects are projects that could be executed separately without their execution affecting each other.

If projects A and B are independent, we shall select as follows:

Method	Project	Remark
P.B.P	A	May be accepted
	B	May be accepted
NPV	A	Acceptable
	B	Acceptable
IRR	A	Not Acceptable
	B	Acceptable
BCR	A	Acceptable
	B	Acceptable

ii. Mutually Exclusive Projects

They are those projects that the implementation of one of them makes it technically, or commercially infeasible to implement the other.

If projects A and B are mutually exclusive, we shall select as follows:

Method	Project	Remark
P.B.P	A	Acceptable
	B	Not acceptable
N.P.V	A	Not acceptable
	B	Acceptable
I.R.R	A	Not acceptable
	B	Acceptable

Whenever there is a conflict among the methods, we rest our judgement on the result of NPV. This is because the NPV represents the value added by the agribusiness if the project is executed. But IRR measures only rate and not value added. Note that the IRR is the rate of return that comes to agribusiness beyond the project's cost of capital. The IRR should be greater than the cost of capital for the project to be profitable.

So if projects A and B are independent then both are accepted. But if they are mutually exclusive then only B is accepted.

In the above illustration, the expected cash flow from projects A and B varied over the years. But for some proposals, the expected annual cash flows are same throughout the life of the projects.

(c).Advantages and Disadvantages of each method:

Advantages of Net Present Value [NPV]

1. It recognises the time value of money
2. It considers all cash flows over the entire life of the project in its calculation.
3. It is claimed (for this method) that the ranking of projects is independent of discount rates chosen for the analysis.

27. Disadvantages

1. It is difficult to use.
2. It assumes that the cost of capital is known. This may not always be true.
3. It may not get satisfactory answers when the projects being compared involves different amount of investments (because they will give different net benefit amount. The benefit being bigger is no guarantee that it will be better depending on the Internal Rate of Return).

28. Advantages of Internal Rate of Return [IRR]

1. It recognises time value of money
2. It considers cash flows over the entire life of the project,
3. It has a psychological appeal to the users. The percentage figure calculated under this method is more meaningful and acceptable to users because it satisfied them in terms of the rate of return of capital.
4. It's also compactable with the firms' objectives of maximizing owners' welfare.

29. *Disadvantages*

1. It's difficult to understand and use in practice as it involves complicated computations;
2. It implies that the intermediate cash inflows generated by the project are reinvested at the internal rate of returns of the project; whereas the Net present value (NPV) method implies that cash flows are reinvested at the firms cost of capital, the letters assumption seems to be more appropriate;
3. It may yield results inconsistent with the Net present value (NPV) method, if the project differ in their: expected life and timing of cash flows.
4. It may not give unique answers in all situations.

30. *Advantages of Benefit Cost Ratio [BCR]*

1. Ranking.
2. Time value of money is considered.

31. *Disadvantages*

1. More computation.
2. The meaning of interest rate depends on the context.

32. *Practical Assignment*

1. Calculate the followings:

   (a). present value of ₦10.00 accruing after 10 years at 6% (b). Present value of ₦10.00 accruing after 5 years at 7% (c). Present value of ₦50.00 accruing after 15 years at 8%

   (d). Present value of ₦10.00 accruing after 10 annual instalment for 10 years at 5% [paid at the and each year).
2. A project capital cost is estimated at ₦1000.00 spread over 3 years. It is expected that ₦600.00 will be spent in year 0 and ₦200.00 in each of the following 2 years. What is the total cost discounted to the starting year. Discount rate of 8%.

3. (a). The benefits of a project are expected to be N100,000 annually for 10 years starting from year 1 what is the present value of this benefit stream at 10% discount rate.

   (a) . What difference will it make if the benefit starts to accrue in year 3 instead of year 1 and continue in the same regular bases of ₦100,000.00 and continue to year 8 after which year 9 has no benefit and year 10 has ₦28,000.00 from terminal scrap value of the plant.

4. A project with a 12 years operative life is expected to yield the following streams of net benefits.

Year		Amount (₦)
Y_0	-	1,000,000.00
Y_1	-	100,000.00
Y_2	-	100,000.00
Y_3	-	200,000.00
Y_4	-	300,000.00
Y_5	-	400,000.00
Y_6		400,000.00
Y_7		400,000.00
Y_8		400,000.00
Y_9		400,000.00
Y_{10}		400,000.00
Y_{11}		400,000.00
Y_{12}		400,000.00

What is the present value of these net benefits streams assuming a discount rate of 10%.

5. An agribusiness proposal has a cost outlay of N 360,000 and the cash inflow of revenue is as follows:

   Year 1: ₦60,000.00

   Year 2: ₦75,000.00

   Year 3: ₦90,000.00

   Year 4: ₦125,000.00

If the prevailing interest rate is 10%, using (a) payback period, (b) NPV and (c) BCR, evaluate the: (i) Worth of the agribusiness (ii) Viability of the agribusiness.

6. The estimated cost and cash inflows for two agribusiness projects are given below:

Year	Cost of Project A(₦)	Revenue of Project A(₦)	Cost of Project B(₦)	Revenue of Project B(₦)
0	32,892.00	0.00	37,414.00	0.00
1		14,000.00		4,000.00
2		12,000.00		10,000.00
3		10,000.00		12,000.00
4		8,000.00		14,000.00
5		6,000.00		16,000.00

The cost of capital or discount rate is 8%

Calculate the (i) Net present value (NPV)

(ii) Benefit cost ratio (BCR)

(iii) Payback Period (PBP)

(iv) Which of the project is more viable?

33. Unit 5. EVALUATION OF AGRIBUSINESS PROJECTS

1. Introduction

When the agribusiness project has been established and it is up and running, there is need to intermittently find out if the objectives of setting up the agribusiness project are being achieved. The process of carrying out this function is called evaluation. However it is important to note that there have been some arguments on appraisals and evaluation of projects. To some according to (Abdullah, 2018) believe that evaluation starts from the appraisal stage. While others argue that evaluation starts when the project is ongoing and until the end of the project. For the purpose of this course, we shall regard evaluation as assessments of ongoing projects and until the end of the project**.**

2. *Objectives*

At the end of the lesson students should be able to:

- Define project evaluation
- State the purpose of project evaluation
- Outline the importance of project evaluation
- List and explain types of evaluation
- Describe what to be evaluated
- Explain the problems of project evaluation in developing countries
- Discuss evaluation of an ongoing project

3. *What is Project Evaluation?*

Project evaluation is a systematic and objective assessment of an ongoing or completed project (International Labour Organisation –ILO- , 2018). Evaluation is a process that critically examines a project. It involves collecting and analysing information about activities, characteristics and outcomes of a project.

4. *Purpose of Project Evaluation*

- The purpose of project evaluation is to determine the relevance and level of achievement of project objectives, development, effectiveness, efficiency, impact and sustainability (ILO, 2018).
- To make judgements about a project and improve decisions.

5. *Importance of Project Evaluation*

Evaluation is instrumental in:

- Providing you with information needed to guide your project strategy towards achieving set goals and objectives.
- Providing early warning of activities and processes that need corrective action.
- Helping empower project partners if any by creating opportunities for them to reflect critically on the projects direction and decide on improvements.
- Building understanding, motivation and capacity amongst those involved in the project.

- Assessing progress to enable reporting requirements to be met.

6. *Types of Evaluation*

The following are types of evaluation made in an agribusiness project:

- Self evaluation: This is managed and conducted by the members of staff.
- Internal Evaluation: This is managed by independent officials of the agribusiness project. The evaluation is conducted and led by external evaluator who has no previous link to the project
- External Evaluation: This is managed from outside the agribusiness organisation and conducted by evaluators who have no previous links to the project being evaluated.

7. *What to Evaluate*

- Relevance and Strategic Fit of the Project: Here you evaluate the extent to which the objectives of the project are being met.
- Validity of the Project Design: Here you evaluate the extent to which the project is logical and coherent.
- Project Progress and Effectiveness: Your evaluation should be on the extent to which the immediate objectives were achieved, or are expected to be achieved taking into account their relative importance.
- Efficiency of Resource Use: Here evaluation is a measure of how economically; resources or inputs (funds, expertise, time, etc) are converted into results.
- Comparison: Here you should compare the planned and actual performance.
- Effectiveness of Management Arrangements: This evaluates the extent which management capacities and arrangements put in place supports in the achievements of results.
- Impact of Orientation and Sustainability of the Project: Here you evaluate the strategy put in place to achieve sustainability of the project.
- Corrective Action: There should be evaluation of the corrective action required to get the project on track if the project is derailing.

8. *Evaluation of Ongoing Project*

An ongoing project evaluation must continuously seek feedback on how project is progressing. One effective way is to have the project team actively seek information on the status of the project by seeking answers to such questions as:

- What is going right on the project?

- What is going wrong on the project?
- What problems are emerging?
- What opportunities are emerging?
- Where is the project with respect to schedule, cost and technical performance objectives?
- Does the project continue to have a strategic fit with enterprises mission?
- Is there anything that should be done that is not done?
- Are you comfortable with the results of the project?
- Is the customer happy with the way things are going?

Questions of this type can be used during regularly scheduled project review meetings to motivate discussions among the project team members and to encourage them to think retrospectively about the project. Such thinking will prompt the team members to evaluate the project.

9. Writing Project Evaluation Report

Writing a project evaluation report is a very important aspect of project analysis that you must carry out. This is because the report will tell you if the project was a success or failure. It also helps you to know if you can continue with the project or terminate the project. The report will show all aspects of the agribusiness plan that is being implemented. It should be written in simple language that will be easy to read and understand. The evaluation report done internally should be separated from the external evaluation. These two reports are compared to get a better over view of the project.

10. Practical Problems of Project Evaluation in Developing Countries

a. Project planning and preparations are largely ineffective. Most often projects are hurriedly put together and ready for execution.
b. Appraisal and selection of projects in developing countries are usually faulty.
c. There are also problems in start-up and activation of projects. There are bureaucratic delays in obtaining license and in the disbursement of funds for the project.
d. The execution, operation and supervision of projects are inadequate. Most often due to delays, the cost of executing the project over- runs the estimated cost. Sometimes there is insufficient capacity or incompetence on the part of contractors handling the projects. The projects very often are not properly supervised.
e. There may be defective design of project. This results to either the resources going to be used for the project being short or surplus. There may be lack of contingency

planning to meet emergencies and unanticipated delays. Sometimes the resources of other projects that that are on-going are tampered in order execute the project.

f. External coordination of project activities may be inadequate or ineffective and sometimes lacking. Sometimes one agency or department required to carryout a part of the execution of the project for example training needs may decide not to perform the function because they are not the executors of the main project.

g. There may also be deficiencies in evaluation of project results follow-up action. These may include:

- Inadequate or inappropriate utilization of complete projects

- Faulty supervision and control on the part of international lending agencies

- Poor internal reporting and monitoring procedures

- Inadequate monitoring and control by central government ministries responsible for project implementation

- Failure to adapt appropriate project outputs and techniques to other developmental activities

- Failure to train and retain personnel following project completion and the transfer of project operations to routine production activities

- Failure to anticipate, plan for or adjust to the political and social impact of projects on local populations

- Long delays in submitting project completion reports

- Failure to terminate projects at appropriate time or to transfer project activities to established governmental organizations

- Inadequate or ineffective project post-evaluation methods and procedures

(Rondinelli, 1976)

11. Summary

We have learnt that evaluation and appraisal are tools used for the assessment of an agribusiness project. While appraisal is used to assess an agribusiness before establishment, evaluation is used to assess an ongoing or completed agribusiness project. However both assessments work towards the success of an agribusiness project.

12. Practical Assignment

- Ofuobi Foodstuff Traders Union obtained loan from Greenalf Micro Finance Institution to establish their businesses. Their businesses have been up and running. Greenalf MFI has a policy of carrying out an oversight function of helping their customers to evaluate their businesses. As a Greenalf MFI staff, you were sent to evaluate Ofuobi Foodstuff Traders Union businesses. How will you carry out the following evaluation to the understanding of the traders?
    - meaning of evaluation;
    - purpose of you carrying out the evaluation;
    - what you want to evaluate; and
    - report of your evaluation.
- Evaluating projects in developing countries is always fraught with problems. Discuss some these problems.

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NATIONAL OPEN UNIVERSITY OF NIGERIA

FACULTY OF AGRICULTURAL SCIENCES

DEPARTMENT OF CROP
AND SOIL SCIENCES

FPY/SIWES PRACTICAL GUIDE MANUAL

SLM 405: AGRICULTURAL METEOROLOGY

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AGRICULTURAL METEOROLOGY - ELEMENTS AND THEIR OBSERVATIONS

1.0 INTRODUCTION

Observations of the physical and biological elements in the environment are essential in agricultural meteorology. Meteorological considerations are indispensable in assessing the performance of plants or animals because their growth is a result of the combined effect of genetic characteristics and their response to environment (nature). Without quantitative data, agro meteorological planning, forecasting, research and services by agro meteorologists cannot properly assist agricultural producers to survive and to meet the ever-increasing demands for food and agricultural by-products. Such data are also needed to assess the impacts of agricultural activities and processes on the environment and climate.

The physical elements of climate are observed in order to assist in the evaluation of actual and future land use potentials and of such constraints in agriculture as are caused by the environment. To meet these requirements, agricultural meteorology needs reliable, quantitative data on the relevant climatic elements.

Indispensable climatic elements in agricultural meteorology include those pertaining to geographical climatology and especially those permitting interpretation of physical processes in the lower layers of the atmosphere and the upper soil layers. These include Temperature, Sunshine and Radiation, Wind, Clods, Humidity, Rainfall, Soil temperature and soil moisture. Others include Dews, Fogs, Open water evaporation and Plant transpiration.

2.0 OBJECTIVES

1) To identify the physical elements of climate.
2) To identify the importance of these weather elements in relation to agriculture.
3) To recognize the calibrations of these elements.

3.0 PROCEDURE

a) Temperature, sunshine and radiation

Temperature is the condition of a body which determines its ability to communicate heat to other bodies or to receive heat from them. For meteorological purposes, temperature is referred to the Celsius scale (degree centigrade). 0 degrees centigrade is the normal ice point; 100 degrees centigrade is the normal boiling point of water. The relationship to the absolute thermodynamic Kelvin scale is given by: T degrees Celsius + 273.15= degrees Kelvin.

In agriculture, the spectral distribution of solar radiation especially in photosynthesis assessments is of great interest. Radiation fluxes to and from the earth's surface are most important meteorological elements for heat and energy balance assessments. Energy conversion from solar radiation mainly takes place on the surface of the soil and of plants. This phenomenon is of special interest in agricultural meteorology. The duration of sunshine (units: hr per day) allows for estimates of the energy available for physical and biological processes.

b) Rainfall, dews

The amount of precipitation, rain, snow, ice and dew which reaches the ground in a stated period is expressed as the depth to which it would cover a horizontal surface if there were no loss by evaporation, run-off or infiltration, or if any part of the precipitation falling as snow or ice were melted (liquid equivalent). As precipitation measurements should as much as possible, be representative for a larger area, the choice of site, the form and exposure of the gauge, the prevention against loss by evaporation as well as the effects of wind and splashing are important points which have to be observed.

The amount of precipitation is measured in millimeters, the readings being made to the nearest 0.2 mm; 10 mm should read to 2% of the total. Depth of snow is given in centimeters.

Ordinary rain gauges usually have the form of a collector above a funnel leading into a receiver.

Measurement of dew

Dew, being essentially a nocturnal phenomenon, and relatively small in amount, is nevertheless of much interest in arid zones. The amount of dew deposited on a given surface in a stated period is usually expressed in the same units as rainfall: mm depth of dew.

A direct method of measuring dew is to expose a weighted plate of hygrosopic material (gypsum, blotting paper) at sunset and re-weight it after sunrise. This method requires accurate weighing and protection at sunrise to prevent evaporation. Qualitative assessment of dew is obtained by exposing filter paper "sensors" with dew spots. When wetted by dew, the spots will spread to an extent which depends on both the duration and intensity of dewfall. Dew duration recorders operate to a far extent in the same way as the above mentioned wetness recorders.

c) Wind

In agricultural meteorology, the effects of the kinetic energy transfer of wind to the plant/soil system as well the effects of its mass transfer on the energy and water balance are of interest.

By its physical nature two magnitudes are required when describing wind: its **velocity** and the **direction** from which it blows.

- Windspeed is usually indicated in: m/sec, km/h, or knots (= 1 nautical mile/h), but occasionally the non-linear Beaufort scale is used, which refers "forces" from 0 to 12 to the effects of wind on smoke, trees or water surfaces.

- The direction from which the wind blows is either given in accordance with the geographical directions (e.g. N,E,S,W) or in degrees: 1 to 360 (90 degrees = East, 180 degrees - South, 27 degrees = West, 360 degrees = North; 0 frequently stands for Calms).

The Wind Vane (Direction) is a common instrument used in most weather stations

An assembly of a vane plate (which can have many shapes) and a needle is mounted on a vertical axis, which allows it to revolve freely. As a result of the mechanical action of the wind on the vane, the needle will be turned in the direction from which the wind blows. As the direction indicated by the vane, oscillates around the equilibrium point of the airflow (which can change direction rapidly over time), big efforts have been undertaken to minimize this drawback by different designs. The axis of the wind vane can be connected to a mechanical or electrical (contacts, potentiometer) device, which provide recording facilities and/or remote reading of the wind direction.

ADVANTAGES

a) To assist the management of agricultural activities - determining the time, extent and manner of cultivation and other agricultural operations (sowing, harvesting, planting, application of biocides and herbicides, ploughing, harrowing, rolling, irrigation, suppression of evaporation, design, construction and repair of buildings for storage, animal husbandry etc.) and different methods of conservation, industrial use and transportation of agricultural products.

b) To assess the performance of plants and animals in relation to climatic elements.

c) To assess the impact of agricultural activities and processes on the environment and climate.

DISADVANTAGES

a) Specialized and precision equipment are required for accuracy.

b) Trained specialists are conditions for the management of a good weather station which is costly

c) Interpretation of results may not necessarily follow the course of nature and so may be misleading

RECOMMENDATIONS

1) It is recommended that research institutes and study centres (schools and colleges) should have functional weather stations to serve their immediate community.

2) National annual weather forecasts should be taken seriously, while efforts should be made to have clientele weather forecasts and services.

3) Weather stations and their component parts should be periodically maintained to ensure accuracy and precision.

4.0 CONCLUSION

Weather elements and their observations are essential to agriculture and the environment. Our behaviour as humans is driven by the changing weather elements especially our farming operations. The physical elements of climate are observed in order to assist in the evaluation of actual and future land use potentials and of such constraints in agriculture as are caused by the environment. It is in light of the above that each community and educational establishments should have a functional weather station.

WORK ASSIGNMENT

1) If your thermometer reads 25°C, what is its equivalent in Kelvin?
2) What is the unit of measurement of sunshine?
3) What is the unit of measurement of rainfall?
4) List other sources of precipitation apart from rainfall.
5) Wind speed of zero signifies what.

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CROP PHENOLOGY AND CLIMATE EFFECTS ON THE OBJECTS OF AGRICULTURE

INTRODUCTION

The key atmospheric variables that impact crops are solar radiation, air temperature, humidity, and precipitation. The day-to-day variability of these across the landscape can be described as weather. Weather extremes at critical periods of a crop's development can have dramatic influences on productivity and yields. The long-term average temperature and humidity and the total solar radiation and precipitation over a crop's growing season can be described as the climate. It is the climate that, in the absence of any weather extremes, determines the realized yields for a given region.

Phenology is the study of periodic plant and animal life cycle events and how these are influenced by seasonal and annual variations in climate, as well as habitat factors (such as elevation).

Understanding crop phenology is fundamental to crop management, where timing of management practices is increasingly based on stages of crop development. This will facilitateplanning of operations, such as irrigation, the application of fertilizers and pesticides.

The response of crops to the different weather variables is quite complex and difficult to describe. Predicting the exact response of crops to the weather is, as a result, an inexact science, and one that contains great uncertainty. If one of the variables is limiting (for example, temperatures that are too hot or too cold), then the effects of solar radiation or precipitation do not greatly affect the crop. When none of the variables is limiting, the crop will respond to the variable that is farthest from the optimum for that variable.

OBJECTIVES

1) To identify the effects of temperature changes on crop growth and development
2) To identify moisture regimes for major crops
3) To identify the effects of winds on crops and the need for cover crops development

PROCEDURE

1) Temperature

Other than planting, temperature is the main variable that determines when a crop will grow. It also determines, along with precipitation and solar radiation, how well a crop will grow and how fast it will develop. There are four temperature thresholds, called the cardinal temperatures, that define the growth of a crop: the absolute minimum, the optimum minimum, the optimum maximum, and the absolute maximum. The absolute minimum and maximum temperatures define the coldest and hottest temperatures at which a crop will grow. Temperatures between the optimum minimum and maximum define the range of temperature where the crop performs the best. For example, maize (Zea maysL.), for example, has an absolute minimum temperature of 50 °F (10 °C), an optimum minimum of 64 °F (18 °C), an optimum maximum of 91 °F (33 °C), and an absolute maximum of
117 °F (47 °C).

Heat stress affects plants because as temperature increases, respiratory reaction rates speed up, using more of the photosynthetic compounds manufactured in a day. Also, with elevated maximum temperature, especially temperatures that exceed 100 °F (38 °C), plants require more water to maintain optimum water content in their tissues.

If the soil cannot meet the additional water requirement, heat stress is compounded by an added water stress.

2) Precipitation

The type, timing, and amount of precipitation (rain, dew) received during the year play critical roles in crop productivity. Rain is generally more efficient in recharging the soil pro-file and thus is more available for crops. The efficiency of rain in recharging the soil depends on the rate or intensity with which the rain falls. Rain showers or storms that fall at rates greater than 0.5 inches an hour (12.7 cm/hr) are less efficient than lighter showers because the water forms ponds on the surface and runs off the fields into ditches and rivers, carrying along precious topsoil.

The timing of rainfall while crops are growing is critical. During seed germination and stand establishment, either too much or too little rain can influence yields. Too much rain, especially with cool temperatures, can result in seed diseases, causing poor stands, or can saturate the soil, causing poor soil aeration and poor germination and stands. Dry soils during germination and stand establishment can result in either poor seed germination or weak and small plants that may not withstand dry weather during the early growth of the crop, causing smaller plant leaf area. For corn, the critical time during the early growth lasts for approximately 30 days, from planting to tassel initiation, when the corn leaves are being initiated and beginning to grow.

Because the soybean crop continues to flower and fill pods from the start of flowering to almost the beginning of maturity, soybean requires adequate rainfall throughout the period of flowering to maturity. Failure to receive adequate rainfall during flowering and pod fill will result in fewer flowers and pods on the plants.

Wet soils during rainy season play an important role in determining how many days are suitable for field work. When soil moisture is normal or wetter than normal, even small rains will result in field work delays on all but the sandiest soils. Over saturated soils delays planting and seed emergence in addition to poor aeration. This underscores the importance of weather elements in crop production, thus crop phenology.

3) Solar Radiation

Plants use the solar energy from the sun to fix carbon dioxide from the atmosphere, in combination with water from the soil, into carbohydrates that cause plants to grow, reproduce, and provide the grain and vegetation used as food by humans and animals. The solar energy available to plants is a function of sunshine intensity and duration.

When the crop has a full canopy, leaf area index greater than 2.7 the rate of carbon fixation by maize results in an accumulation of approximately 0.14 bushels of grain per acre per megajoule-bu/A/MJ (8.8 kg/ha/MJ). An average heavily overcast day between May and August receives about 8.2 MJ of solar energy. Thus, if all the carbon fixed by photosynthesis were to go into the grain, the yield gain on a heavily overcast day would be 1.2 bu/A/day (75.5 kg/ha/day).

ADVANTAGES

1) Understanding crop phenology in relation to weather is fundamental to crop management, where timing of management practices is increasingly based on stages of crop development and occurrences of the elements of weather.
2) It facilitates planning of operations, such as irrigation, the application of fertilizers and pesticides.

3) Harvesting of crops, especially grains are synchronized to periods of highly reduced precipitation and humidity in order to hasten drying and storage.

DISADVANTAGES

1) Weather forecasts are seldom accurate as the vulgaries of nature are unpredictable
2) Most weather forecasts are for regions and hardly could be applied to small geographical areas. A regional forecast cannot suffice for all farming areas.
3) Expertise is required to read and interpret data at weather stations

RECOMMENDATIONS

1) It is recommended that there should be proper study of the climate and weather components of your region/location before sitting your agricultural enterprise
2) Crop phenology studies of a region/location should be conducted before the commencement of commercial farming activities. These studies are necessary for appropriate crop type selection and management.

CONCLUSION

The response of crops to the different weather variables is quite complex and difficult to describe. Predicting the exact response of crops to the weather is, as a result, an inexact science, and one that contains great uncertainty. This notwithstanding, understanding crop phenology is fundamental to crop management.

PRACTICAL EXERCISES

a) What are the effects of water logging on farming operations and activities?

b) What are the likely consequences of prolonged cloud cover during the day time of our cropping season.

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SIMPLE LAY OUT OF AGRO-METEOLOGICAL STATION

1.0INTRODUCTION

An agro-meteorological station (weather station) is a facility, either on land or sea, with instruments and equipment for measuring atmospheric conditions to provide information for weather forecasts and to study the weather and climate. Weather stations range from simple analogue technology to digital technology

The measurements frequently taken include temperature, atmospheric pressure, humidity, wind speed, wind direction, and precipitation amounts. Weather stations sensors are used to take readings of the various weather elements, so the data collected can be analyzed using weather station software.

2.0OBJECTIVES

a) To identify areas suitable for sitting weather stations
b) To identify sensors for weather elements
c) To take readings of the sensors and interpret same.

3.0PROCEDURE

Installation Guide

In order to report accurate weather information you must take care in deciding where to place your weather station. The process of deciding how and where to install your weather station is called "Siting". Siting is the single most important factor in ensuring accurate readings. In fact, sitting influences the accuracy of weather readings much more than the quality of the weather instruments themselves.

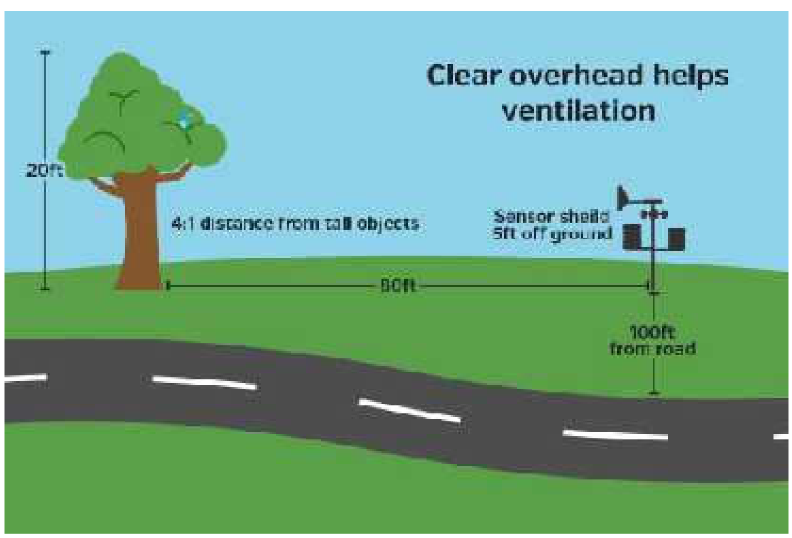
Temperature

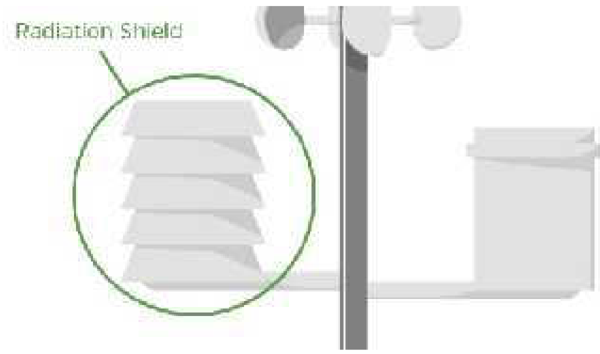
The most common error in installing a weather station is associated with misplacing the thermometer sensor. Meteorologists define temperature as the temperature in shade with plenty of ventilation.

When placing your weather station, make sure:

- The thermometer sensor never receives direct sunlight.
- The thermometer receives plenty of ventilation and is not blocked from the wind.
- If the thermometer is placed on a roof-top, make sure it is at least 5 feet above the roof-top.
- If the thermometer is placed above grass, again, it should be at least 5 feet above the grass surface.
- The thermometer is at least 50 feet from the nearest paved surface.

Suggestion - use a radiation shield for your thermometer. This way, your weather station can be placed in direct sunlight, with the thermometer located inside the radiation shield.





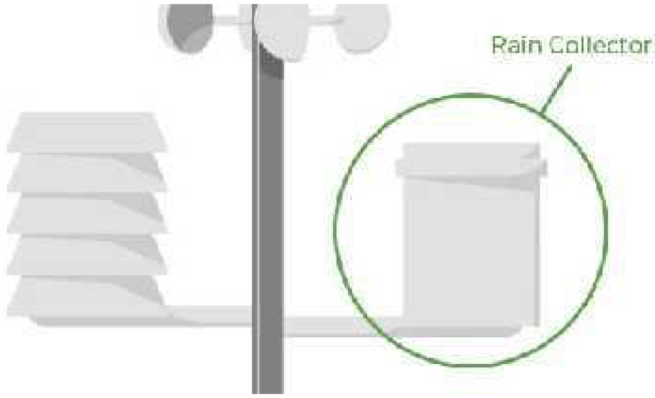
Humidity

Humidity measurements should reflect the humidity of the general atmosphere in your location. Plants and bodies of water influence humidity measurements. Hence, make sure the humidity sensor is at least 50 feet away from the nearest tree or body of water.

Rain Collector

You want the Rain Collector (or, Rain Gauge) to receive rainfall as if it were in the middle of a large field. Nearby buildings create "shadows". Imagine if there's a building nearby to the west, and it is raining with a west wind. In such an event, your station's rain collector is bound to miss a lot of falling rain because of the "shadow" cast by the building. As a rule of thumb:

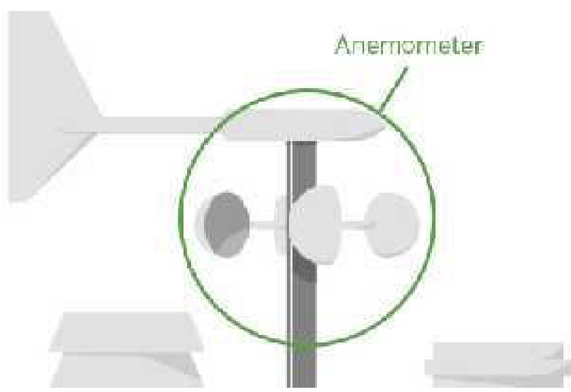
- The rain collector should be placed with at least 5 feet horizontal clearance from the nearest obstruction.
- If a nearby obstruction is just over 5 feet away, that obstruction should be no more than 10 feet tall.



Wind Speed and Direction

Similar to a rain collector, the anemometer should reflect the wind patterns as if the instrument was placed in a large field.

- The standard wind measurement should be taken at 10 meters (33 feet) above the ground. A roof-top works the best. Try to place the anemometer as high as is convenient.
- Try to make the anemometer the highest object around 7 feet or more above the surrounding obstructions is best.



Types of weather element sensors and their setting

1) **Thermometer** - A thermometer measures **temperature**. Some weather stations measure both the temperature indoors and outdoors, record highs and lows, show trends to indicate

temperature rising or falling, and even predict short-term future temperature ranges.

Ordinary spirit-in-glass thermometer. This simple louvred thermometer screen is available as a kit

2) **Hygrometer** - A hygrometer measures **relative humidity**. Relative humidity is the quantity or percentage of water vapor (water in gas form) in the air. Humidity influences environmental factors and calculations like precipitation, fog, dew point and heat index.

Humidity is measured most accurately with a wet- and dry- bulb thermometer

3) **Barometer -** A barometer measures **atmospheric pressure**. A barometer can help to forecast upcoming weather based on the changes it measures in the atmospheric pressure. Some weather stations feature a barometric pressure history chart or pressure trend arrow so you can easily track changes, like a pressure drop.

A simple, clearly-marked, barometer

4) **Anemometer -** An anemometer measures how fast the wind is blowing, or **wind speed**. Some weather stations can display wind speed in MPH, KPH or knots, and record current, peak and average wind speed readings.

A simple home-made weather-vane   The ventimeter can measure wind speed and indicate wind direction

5) **Wind Vane -** A wind vane, or weather vane, is an instrument that determines which direction the wind is blowing**.**

6) **Rain Gauge -** A rain gauge measures **rainfall or liquid precipitation.** Some weather stations include rainfall alerts to notify you when a rain event has begun, or to alert you of potential flood conditions. The opening of the collector should have a receiving area of 200 to 500 cm2. (The most common standards are: 200 cm2, 324 cm2 (diam: 8 inch) and 400 cm2. However, in many countries 126 cm2 (diam: 5 inch), are still used. The rim of the collector should have a sharp edge and should fall away vertically inside and be steeply leveled outside. It should be designed to prevent rain from splashing in and out. The receiving water container should have a narrow neck and be protected from radiation to prevent loss of water by evaporation.

   The rain measures, measuring glass or dip rod, have to be graduated to correspond to the relative areas of cross section of the gauge orifice. A measuring cylinder should be made of a clear material (glass or moulded plastic), have a low coefficient of expansion, and its diameter should not exceed 3 times of the gauge diameter. Graduation should be in units of rainfall and at least every 0.2 mm should be marked. Dip rods are mainly used to measure rainfall in monthly or seasonal gauges. However, these measurements should be checked using cylinders as well.

A cheap plastic rain-gauge with funnel and measuring cylinder

CONCLUSION

The measurements and observations outlined in this chapter can form the basis of many interesting constructional and experimental instruments in the study of weather for agriculture. These simple sensors form the background to the understanding and use of the advanced versions.

PRACTICAL EXERCISES

1) Talk a walk to a weather station nearest to you and identify the available weather sensors
2) Where is the direction of the wind now. State date and time
3) List the damages that might be caused by excessive wind speed
4) What preventive measures are necessary to avert the damages listed in (3) above.

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1) Geoff Jenkins (1999). Simple weather measurements. Royal Meteorological Society, Berkshire, England.
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AFS 401 FISHERIES PRACTICAL MANUAL

CONTENT **PAGE**

5. FISH BIOLOGY

1.0 INTRODUCTION

The biology of fishes is the biology of active living organisms in water. It introduces learners to the basics of fish biology, which entails: Anatomy, Physiology, Embryology and Endocrinology of bony and cartilaginous fish. Fishes are cold blooded or poikilothermic animals i.e. their body temperature varying passively in accordance with the ambient temperature (surrounding water temperature). Although, fishes as a group can tolerate wide range of temperature just below 0^0C to 45^0C, individual species generally have a preferred or optimum as well as a more restricted temperature range.

2.0 OBJECTIVES

At the end of this unit, you should be able to acquire practical knowledge of:

- The structure and physiology of fish
- Identify the basic diagnostic features of fish
- Explain the structural implication of fish to an aquatic existence
- Draw and label the internal organs and skeletal system of fish
- Differentiate between exocrine and endocrine glands.

3.0 PROCEDURE

Fish dissection to reveal the internal anatomical features of fish in the three living groups of fishes (cyclostomes, chondrichthyes and the osteichthyes. Demonstration of respiration, circulation or skeletal system in fish using plastic models

1. Procedure: External Anatomy

1. At your lab stations, you will have a dissection kit. Please be careful with the scalpel as they are very sharp.
2. Bring the pan to the front bench and get a fish.
3. Back at your station, and using the descriptions below, identify the external structures of your fish writing the answers to any questions that are posed.
   Eyes - Fish eyes serve a variety of purposes - to seek out food, to avoid predators and other dangers, and, perhaps even to navigate in the ocean. Fish do not have eyelids. They are constantly bathed in water and do not need tears.
4. Using your finger, gently move the eye in its socket. Is there an eyelid present?_______________________________________

Nostrils – Some fish have a well developed sense of smell and use this ability to seek out their home streams for spawning. In some cases, this scent is also helpful in avoiding predators.Fish breathe through their gills, not their nostrils.

Lateral Line - Fish do not have ears, as such. In part, low frequency sounds are detected in the water through asystem of small holes along each side of a fish called the lateral line, which is connected to a delicate system of nerves. They also react to medium frequencies suggesting they detect these as well(this reaction is not well understood at this time).

Mouth - Fish use their mouth to catch and hold food of various types, but their food is not chewed before swallowing, it is swallowed whole. The mouth is the beginning of the fish's alimentary canal (digestive tract). In addition, it is a very important part of the breathing process. Water is constantly taken in through the mouth and forced out over the gills where oxygen is extracted.

5. Inside the mouth for teeth. Open and close the mouth. Describe how the upper and lower jaw articulates during this movement.

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6. Examine the upper and lower jaw. Does the lower jaw stick out further? This would mean the fish eats by attacking its prey from below. Or does the upper jaw stick out further? This would mean the fish eats by attacking its prey from above. Do both jaws meet at one common point? This fish eats by attacking fromabove or below. What direction do you think your fish attacks its prey from and why?

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Vent - The external opening of the alimentary canal. Urine, feces, eggs and milt exit here.

Gills - Fish gills are composed of two basic parts, the gill covers and the gill filaments. The gill cover, a bony structure called the **operculum**, protects delicate filaments and, together with the mouth, forces water containing oxygen over the gills. The gills are probably one of the most important organs in the body of a fish. They are delicate but very effective breathing mechanisms. Gills are far more efficient than human lungs, because theyextract 80% of the oxygen dissolved in water, while human lungsonly extract 25% of the oxygen in the air.

7. Grasp the operculum to feel the bony structure. What is the benefit of having an operculum?

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Gills are thin walled structures, filled with blood vessels. Their structure is arranged so that they are constantly bathed in water. The fish takes in the water through its mouth. The oxygen dissolved in the water is absorbed through the thin membranes into the fish's blood. Carbon dioxide issimultaneously released from the blood into the water acrossthe same membranes.

8. Open the operculum and look inside at the gills. Describe them, using three different adjectives.

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Fins – Fish have two sets of paired fins (pelvic and pectoral) andfour single fins (dorsal, caudal and anal). Fish can contract their muscles and move the pelvic and pectoral fins for movement in all directions. The caudal fin is used for forward momentum. Thedorsal and anal fins aid in stabilizing the fish in the water and preventing it from rolling. All fish fins are made of bony fin rays that are connected to each other with a thin membranoustissue.

9. i) On the fish diagram below, label it with the name of the structures as well as determining the anterior, posterior, dorsal and ventral sides of the fish. List the parts of the fish numbered 1-15.

ii) What is the function of the part numbered 14 in the above fish?

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iii) What is the difference between the parts numbered 12 and 13?

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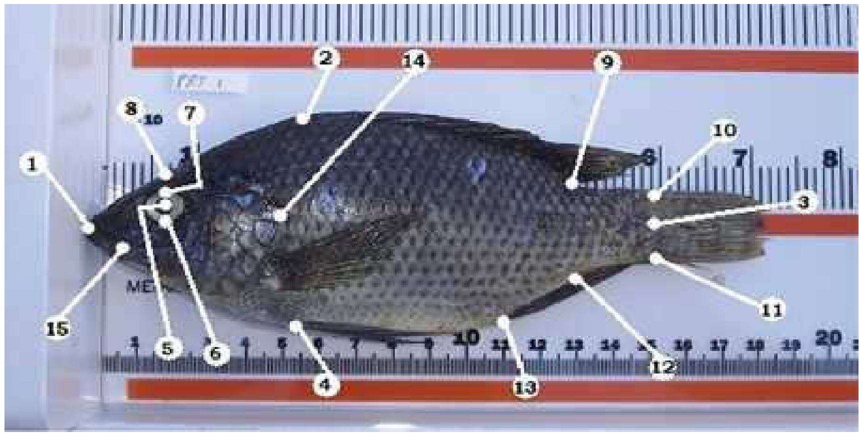

Scales - The bodies of fish are protected by scales which grow in regular concentric patterns and can be used to determine the age and life history of the fish. Over the scales is a layer of mucous (slime) which further protects the fish from disease organisms and helps it slide through the water more easily.

10. Use the sharp edge of your scissors to take off one of the scales. Use a hand lens to look at the rings. By counting the larger rings, researchers can tell the approximate age of a fish. How old is your fish?

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2. Procedure: Internal Anatomy

1. Place the fish on its side in the dissection pan, belly towards you, head pointing to your right. Insert a pair of sharp dissection scissors into the vent and make a shallow cut up to and betweenthe pectoral fins all the way to where the opercula meet.
2. Locate the **heart**. It will be in the cavity anterior to the pectoral fins. Use the scissors to snip the aorta (large, white tube on top of the heart) and remove the heart.
3. The large, brownish organ in the body cavity posterior to the pectoral fins is the **liver**. It is used to synthesize and secrete the essential nutrients that were contained in the food. It plays a part in maintaining the proper levels of blood chemicals and sugars. The **gall bladder**, which is attached to the liver, contains green bile which in part is used to help digest fats.
4. Locate and remove the **alimentary canal**. It starts at theesophagus which is connected to the mouth and ends at the

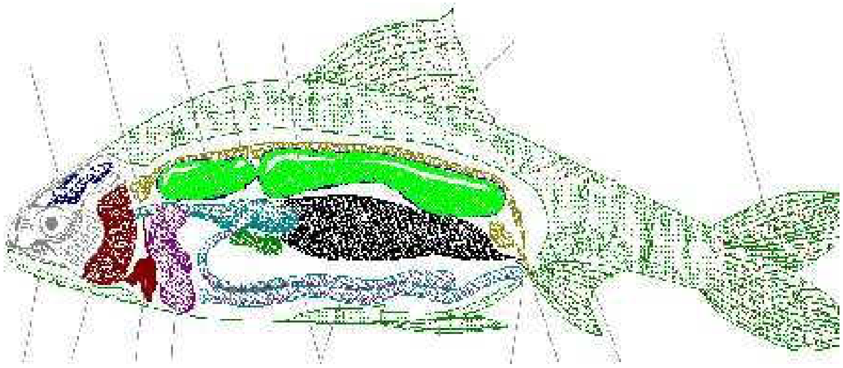
intestines at the vent. Once removed, locate the following: **Esophagus**: muscular tube that moves food from the mouth tothe stomach_______

Stomach: a saclike organ that receives the food from the esophagus; mechanical digestion occurs here.
Intestines: tube running from the vent to the stomach; chemical digestion and nutrient absorption occurs here.

5. The **air bladder** is the only remaining organ in the body cavity. It is a whitish organ and the fish use it to control their buoyancy.They can inflate or deflate it with gas. Remove the air bladder.
6. The dark red line along the backbone is the **kidney**. The forward part of the kidney of a fish functions to replace red blood cells, the rearward part filters waste out of the blood. The kidney can be removed by slicing through the membrane along each side, and then scraping with a spoon.
7. What is left is the body cavity, or **coelom**, that houses major organs. If your fish is female, you should find the **ovaries** near the vent—they are an orange mass of eggs. Fish lay thousands of eggs and only a small percentage ever makes it to adulthood. If your fish is male, you should find a bladder of **milt**, or fish sperm, near the vent. Reproduction is carried out when the female deposits her eggs into the water and the male quickly fertilizes them with his sperm—this is called **external fertilization**. Any resulting fertilized eggs will develop in the water column without aid from the parents.
8. Is your fish male or female?
   ____
9. Clean up by disposing of the fish, cleaning the dissection materials and wiping down your lab area.

3. Post Lab Questions

1. Identify the structures in the diagram below.
2. What external features (3) separate bony fish from sharks?
   ____
3. What internal features (2) separate bony fish from sharks?
   ____



4. How is swimming accomplished in bony fish as compared to sharks?

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5. What sensory organs do sharks and bony fish both have? What sensory structures are unique to sharks?

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4. Endocrine System

The endocrine system is made up of specialized cells, glands and hormones. Acting like a communication network, it responds to stimuli by releasing hormones, the chemical messengers that carry instructions to target cells throughout the body, from endocrine glands.

5. Practical Assignment

Highlight the functions of endocrine system labeled in the diagram above____

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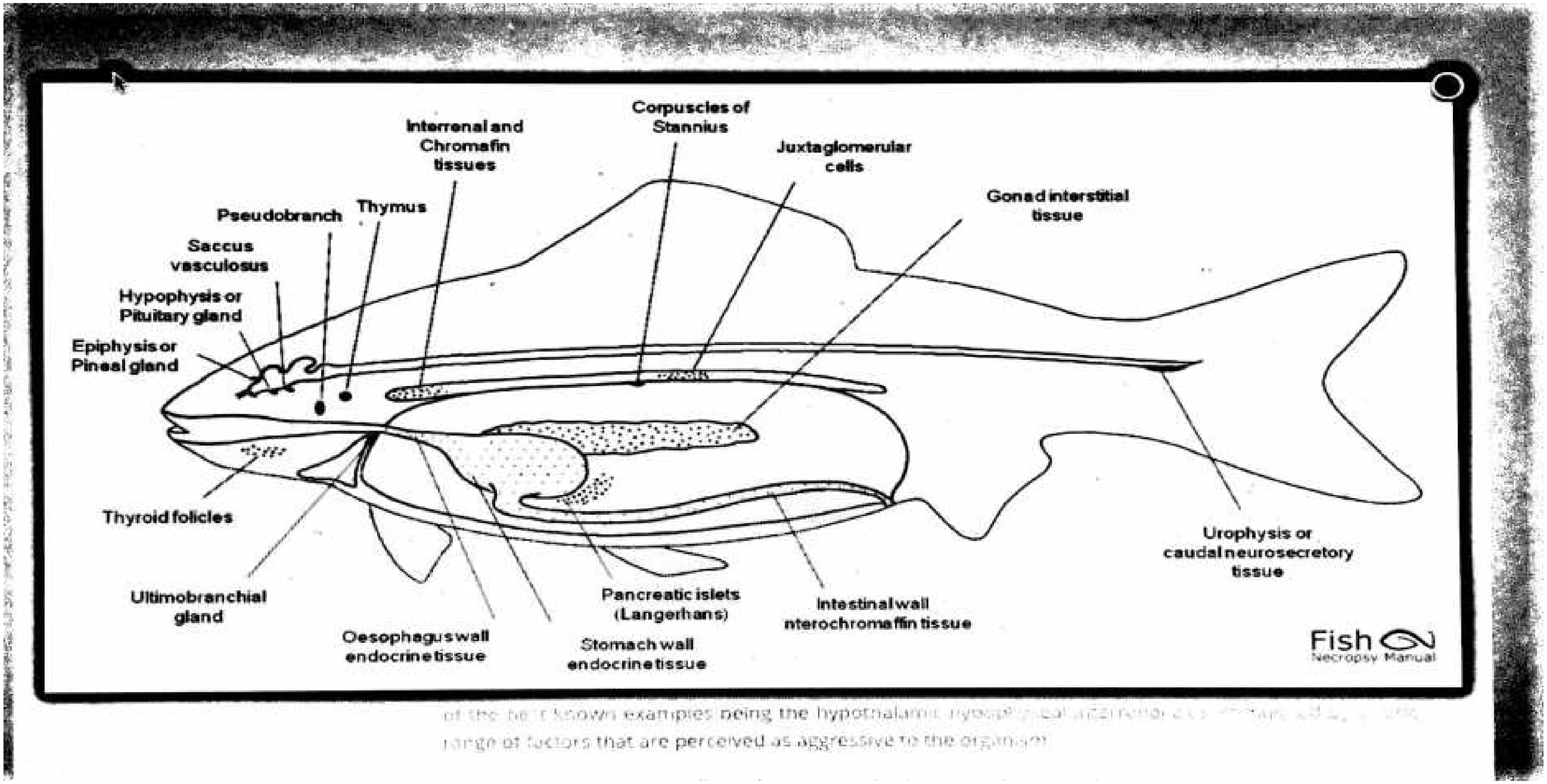
Corpuscles of Stannius
Interrenal and Chromafin tissues
Juxtaglomerular cells
Gonad interstitial tissue
Pseudobranch
Thymus
Saccus vasculosus
Hypophysis or Pituitary gland
Epiphysis or Pineal gland
Thyroid folicles
Ultimobranchial gland
Oesophagus wall endocrine tissue
Stomach wall endocrine tissue
Pancreatic islets (Langerhans)
Intestinal wall nterochromaffin tissue
Urophysis or caudal neurosecretory tissue
Fish
Necropsy Manual

4.0 CONCLUSION

The gross external anatomy allows an individual especially the fisheries scientist to identify most species with a fair degree of accuracy. All vertebrate animals (fish, amphibians, reptiles, birds and mammals, including humans) have the same general endocrine glands and release similar hormones to control development, growth, reproduction and other responses.

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6. ICHTHYOLOGY

1.0 INTRODUCTION

Ichthyology is the branch of zoology devoted to the study of fishes.This includes skeletal fish (Osteichthyes), cartilaginous fish (Chondrichthyes), and jawless fish (Agnatha). While a majority of species have probably been discovered and described, approximately 250 new species are officially described by science each year. Accordingto Fish Base, 31,500 species of fish had been described by January 2010. There are more fish species than the combined total of all othervertebrates: mammals, amphibians, reptiles and birds.

The practice of ichthyology is associated with marine biology, limnologyand fisheries science.

Ichthyology, a subset of zoology, is the study of fishes. Zoology is a branch of biology, and ichthyology incorporates many elements ofbiology in its studies. When people refer to the study of fishes, grammarians might note this as incorrect. It is correct because multiplespecies of fish are referred to as fishes.

Modern fish are divided into three classes.

i. AGNATHA- primitive jawless fish. Lampreys and Hagfish
ii. CHONDRICHTHYES- the jawed fish with cartilaginousskeletons. Sharks, Rays, Rat- Fishes
iii. OSTEICHTHYES- fish with bony skeletons; Lungfish, Trout, Bass, Salmon, Perch, Parrot Fish.

2.0 OBJECTIVES

At the end of this section you will be expected to:

- Define and understand what is ichthyology
- Understand the general characteristics of fishes
- Learn about Fish Classification
- Learn how to use dichotomous keys to identify different fish.

3.0 PROCEDURE

Visit a nearby river survey the fish composition. Use the existing fish identification keys in identifying freshwater and marine species. Observe the countable traits such as gill rakers or number of dorsal fin spine to analysis the meristic analysis of fish and examine the size and shape using a measurable trait, such as standard length or wet weight, which can be gauged as a length, mass, angle or ratio of other measurements to determine the morphometric of different fish. Prepare of different stock solution of formaldehyde for the preservation of different specimens (whole, fish, tissues, organs).

When you follow a dichotomous key, your task becomes simpler if youuse a few simple rules of thumb:

i. Read both choices in a couplet carefully. Although the first description may seem to fit your sample, the second may apply even better.
ii. Keep rough notes telling what sequence of identification steps you took. This will allow you to double-check your work later and indicate sources of mistakes, if they have been made.
iii. If you are unsure of which choice to make in a couplet, follow both forks (one at a time). After working through a couple of more couplets, it may become apparent that one fork does not fit your sample at all.
iv. Work with more than one sample if at all possible. This will allow you to tell whether the one you are looking at is typical or atypical. This is especially true when working with plants – examine more than one leaf, branch, cone, seed, flower, etc.
v. When you have keyed out an organism, do not take your effort as the final result. Double-check your identification scheme,using your notes.
vi. When reading a couplet, make sure you understand all of the terms used. The best keys will have a glossary of technical termsused in the key. If a glossary is unavailable, find a good reference work for the field (textbook, biological dictionary, etc.) to help you understand the term. A key has been provided with this activity.
vii. When a measurement is indicated, make sure that you take the measurement using a calibrated scale. Do not "eyeball" it or takea guess.

4.0 CONCLUSION

Ichthyology is the study of fishes. It's pronounced ick-thee-O-lo-gee. Scientists who study ichthyology are called ichthyologists. Can you guess how many kinds of fishes have ever been discovered? The answeris around 27,000 ... so far! But new species of fish are found all the time. For example, in 2016, ichthyologists found a whole new kind of fish in the Amazon River. That's one reason why ichthyologists study fishes: we're not even done counting them yet. You should be able at least identify and count the fish species in your surrounding rivers,lakes, streams and marine environment.

5.0 Practical Assignment

i. Visit local streams in your area for the purpose of sampling and identifying the fish community as well as the abiotic characteristics of the habitats in which they occur. Record you findings:

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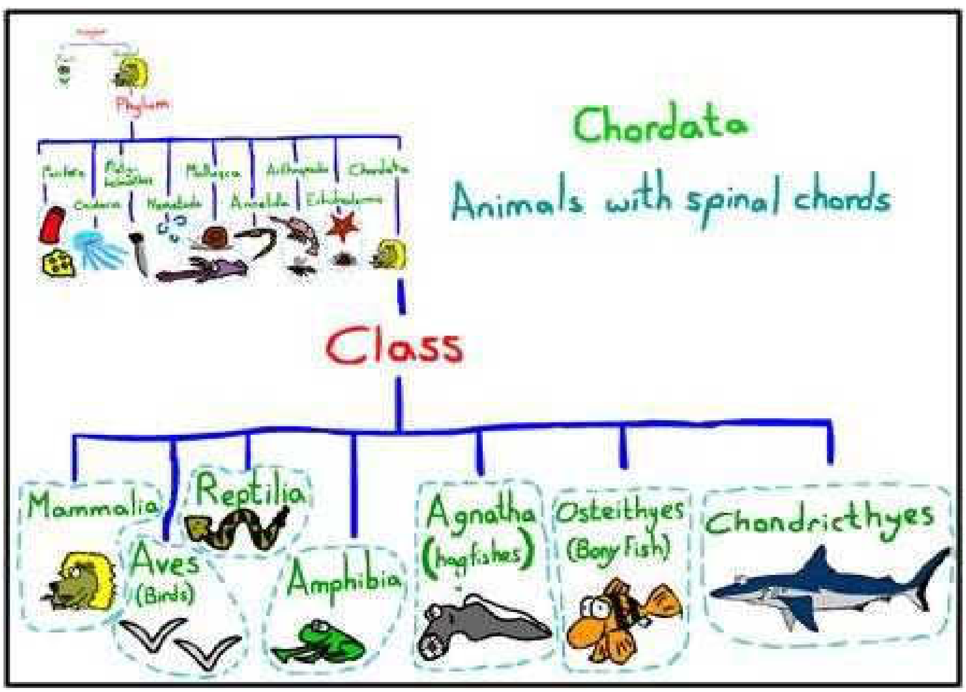
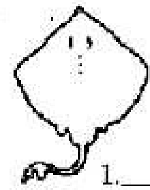


ii. List the characteristics and the fishes under the class **agnatha, Chondrichthyes and osteichthyes** https://sharkresearch.rsmas.miami.edu/assets/pdfs/learning-tools/high-school /MODULE%202%20Ichthyology%20%20SECTION%20% 201%20Introduction%20to%20Ichthyology%20and%20Classificati on.pdf

Use Key to Families to help you identify the family of each shark orbatoid below:



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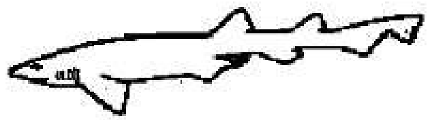

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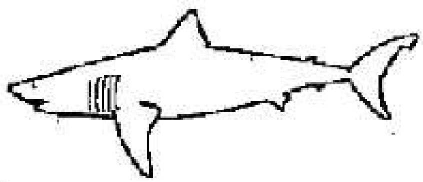

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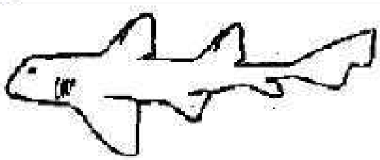

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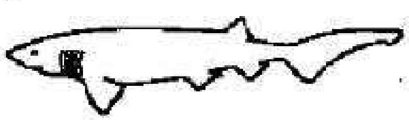

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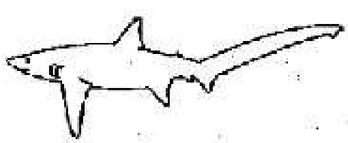

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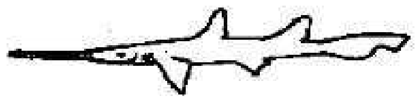

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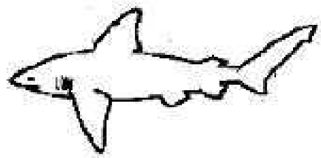

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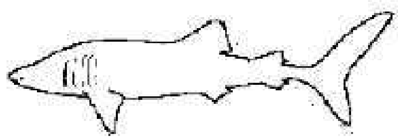

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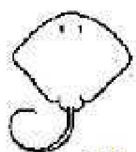

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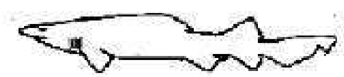

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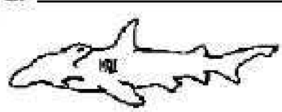

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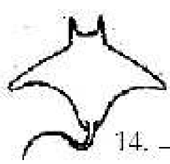

14. ________________

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7. LIMNOLOGY

1.0 INTRODUCTION

All organisms depend on water for their survival. Limnology evolved into a distinct science only in the past century, integrating physical, chemical and biological disciplines in order to describe and manage freshwaters ecosystems. Although inland water bodies are well below the oceans size, they are complex systems and they can't be fully understood if studied without taking into account the complex interrelations between physical, chemical and biological aspects. The study is vital because productivity and production are both dependent on the relative interaction of physical, biological, and chemical features operating within a given system.

2.0 OBJECTIVES

At the end of this section, you should be able to determine thephysical, chemical properties of fresh water as well as biological factors. That is; Laboratory and field determination of:

- Physical (Temp, turbidity, current, light etc) of properties of fresh water
- Chemical (PH, DO, Co_2, Nitrite, Nitrate, ammonia BOD of properties of fresh water
- Biological factors of fresh water (primary productivity, energy flow, plankton sampling/analysis).

3.0 PROCEDURE

Keep all field equipment clean, dry, and fully charged. An importantnote to remember is that battery power is dependent on temperature because an instrument runs well a t20 C does not mean it will function properly at 0 C. Calibrations should be conducted at each sampling station to insure the accuracy of the measurements. Label all bottles and complete the inventory forms prior to sending them to the laboratory.

1. Field Measurements

Temperature: Before taking temperature measurements, calibrate the thermometer by placing the probe in a mixture of ice and water. The ice-water mixture is 0C. Record the temperature to the nearest
0.5 C at 1 meter intervals when the lake is stratified by lowering a 50-m

cabled probe through the water column, and at every other meter when the lake is isothermal.

Dissolved Oxygen: Calibrate the meter lower the probe while agitating if the probe is not equipped with an automatic stirrer, and record D.O. concentrations (mg-1L) and temperatures.

Salinity: 1) Prepare a salinity standard by dissolving 31.77 g of reagent grade NaCl in 1000 ml of DI water. This solution has a chlorinity of 19.4%% and a salinity of 35%%. 2) Measure the conductivity of the standard and the sample. Rinse the probe with DI water following the standard measurement before continuing to the sample. Solutions should be 15 C, and the meter's temperature compensator turned off.

Alkalinity: Calibrate the pH meter, Pour 100 ml of sample into a beaker and place on a magnetic stirrer. Immerse the pH probe in the sample. Using the buret slowly add titrant (0.02 N H2S04) to a pH of4.5. Record the volume (ml) of titrant. Rinse the probe with DI waterbefore continuing to the next sample.

Turbidity: Calibrate the turbidimeter with a reference standard according to the manufacturer's instructions. Invert an unfiltered sample several times and pour into a cuvette. After all air bubbles have dissipated, record the NTU reading from the appropriate scale.

2. Dissolved Gases:

i. Collect the sample in a 300-ml BOD bottle without trapping air bubbles in the bottle
ii. Add in order 2 ml each of solutions I and 11. Invert several times to mix.
iii. Allow the floc or precipitate to settle, mix again, and allow to re-settle.
iv. Add 2 ml of sulfuric acid and mix until the floc is completely dissolved. The sample is now fixed and can be analyzed later (< 8 hr) if kept in the dark.
v. Pour 101 ml of the fixed sample into a 250-ml erlenmeyer flask,
vi. Using an automatic buret, titrate the sample with 0.025 N sodium thiosulfate to a pale straw color.
vii. Add 1-2 ml of the starch solution and complete the titration until the blue-black color turns clear. Record the volume (ml) of titrant used.

3. Nitrogen, Ammonium, Nitrate and Nitrite:

i. Pour 50 ml of sample or standard into a 50-ml stoppered cylinder

ii. Add 2 ml and invert to mix.
iii. Add 2 ml of phenol and invert to mix.
iv. Add 2 ml of potassium ferrocyanide and invert to mix
v. Add 5 ml of the hypochlorite solution, invert twice to after 15 minutes invert again.
vi. Allow 2 hours for full color development, and measure the absorbance at 640 nm against a DI water blank.

4.0 CONCLUSION

Limnology is a subject that should interest anybody who is concerned about the quality of life the freshwater environment either in Nigeria orany Third world Country of Africa and Asia. The practical application has therefore, been designed to help you understand the most complexproblems of managing both the lotic and lentic water systems. You must apply concepts to understand limnology.

5.0 PRACTICAL ASSIGNMENT

Visit a fishery laboratory in your area and carry out the various experimental procedures to determine the physical, chemical properties of fresh water, lagoon and marine waters. Record your observations.

a. Temperature

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b. Dissolved Oxygen

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c. Salinity

d. Alkalinity

e. Turbidity

c. Dissolved Gasses

Nitrogen, Ammonium, Nitrate and Nitrite

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6.0 REFERENCES

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Strickland, 3. D. H. and T. R. Parsons. 1972. A Practical Handbook ofSeawater Analysis. Bull. Fish. Res. Bd. of Canada167. 311p.

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8. FISHERIES ECOLOGY

1.0 INTRODUCTION

Ecology is often referred to as the "study of distribution and abundance”. One of the first things a field ecologist will want to know about an animal or plant species is: How **dense** is the population [units of density are number of individuals {or colonies etc.} per unit area {or volume}]. Another important question is: How are the organisms **dispersed** [The pattern of distribution in space] within the habitat? In most cases it is impossible to count every individual or plot their location on a map [This would be a **census**] because of the time, effortor money involved. So it would be useful if there were some way that we could get an accurate representation of some spatial characteristics of the population without having to map every organism.

By **sampling** the population we can do this, BUT the sampling must bedone properly if we want our representation to be valid. To insure an adequate representation, some guidelines must be followed.

2.0 OBJECTIVES

At the end of this section, you should be able to:

- Basic knowledge of sampling methods
- Apply different sampling techniques in different ecosystem
- Assess fish biomass within an aquatic ecosystem.

1. 3.0 Procedure

General Procedure: To obtain an unbiased estimate of the population, sampling should be done at **random** –or more specifically *the sampling should be conducted in such a way that the probability of each individual being selected in the sample is the same*. There are several ways of insuring this criterion is met – or at least approximated. **Random numbers** are series of numbers such that the chance of selecting, for example, any digit (0 – 9) is equal at any point in the sampling procedure. If the random numbers can be assigned to organisms or to locations in the habitat, they can be used to select the sample from the population. One way to generate a series of random numbers is to write the numerals 0 through 9 on slips of paper, mix them in a hat, draw the slips out, write the number down, then replace the slip in the hat, remix, and draw again, etc. etc. etc.

A faster and less cumbersome method is to use a **random number table**. You worked with ways of getting random numbers in the previous lab. You can use the numbers in the table to select sampling positions (e.g. paces along a trail, GIS coordinates, termite holes in a wall that you have numbered etc.). Most calculators and spreadsheet applications also have random number generating functions,

2. Procedure for Sampling Zooplankton

Three common methods for sampling zooplankton (shown in the photographs below) are net, trap, and tube. Nets are used most often, yet they have serious limitations in regard to obtaining good quantitative data, especially in nutrient and algae-rich waters. Nets are conical devices made of fine nylon mesh that are pulled through the water either vertically or horizontally for a known distance. Animalsare captured in a vial or mesh-walled bucket at the bottom of the net and then can be rinsed into a storage bottle for counting.

The amount of water from which zooplankton are removed is estimated as length of tow times mouth diameter of the net. However, nets may not actually filter this volume of water. The main advantage tousing a net is that samples of large volumes of lake water can be collected quickly. Nets can be obtained with various mesh sizes, depending on whether one wants to collect only the largestzooplankton or the entire size range that occurs in the water.

Integrated sampler	Schindler-Patalas trap	Plankton net
		

Photos of integrated sampler, Schindler-Patalas trap and plankton net

The most common trap sampler is the Schindler-Patalas trap, obviously named after the two scientists who invented the device. This is a clear plastic box that is lowered to a desired depth in the water column and then quickly closed (upper and lower doors) by pulling upward on the line by which the device is lowered and raised in the water. This traps zooplankton inside the box. When lifted into the boat, the water is allowed to exit a small mesh net that is attached to the lower wall of the box, and zooplankton is collected inside a sampling bucket at the end of that net. This device provides a high degree of certainty regarding the actual volume of water sampled, but if the water columnis deep, it may take many samples to collect animals from all depths from surface to bottom.

The third method is a tube, made of common PVC or Tygon. A tube is lowered into the water column, and when the bottom reaches the desired depth (near the sediments), a line is pulled to close the bottom with a rubber stopper or other device. The tube is raised into the boat and the collected water poured through a net to collect the zooplankton. This device also provides a high degree of certainty about volume of water sampled, but it may not be an effective way to sample large animals that occur at a low density, or animals that can detect and escape from a narrow sampling device.

Nets, traps, and tubes will be used to collect representative during the Zooplankton Ecology course, and students will participate in a critical analysis of these three common sampling techniques.

3. Counting and Biomass Estimation

Simple counts of zooplankton can be done with a light microscope. For large zooplankton such as Daphnia, which occur at relatively low densities (1 to 100 per liter), the entire sample may be scanned at alow magnification, counting all observed individuals. For small zooplankton, such as rotifers and copepod nauplii, which occur at high densities (>1000 per liter), it is standard practice to count a known percentage of the sample volume at high magnification, and then multiply by total volume / counted volume to obtain the total numberof animals in the sample. Once you know the number of animals ofeach species in a sample, density in the lake is estimated as counts divided by volume of water filtered with the net or collected by the trap or tube.

Quantitative Analysis of Plankton: Generally, The counting procedure involves recording the taxa observed and the number ofalgal units (objects) for each taxon in a known area of the counting chamber. As the volume of sample added and area of the whole chamber observed is recorded, the concentration of each individual taxon can then be calculated.

4. Counting Procedure

The count should be carried out in the following manner: A lowmagnification (e.g. x 40 or x100), whole chamber count to pick up largetaxa, followed by transect counts at an intermediate magnification (x250), which are helpful to enumerate "intermediate-sized" taxa that are too small for the low-magnification count but too large to be reasonably counted using fields of view at high magnification, followed by a high magnification count (x400 or greater) using fields of view. Thispicks up the small taxa. Aim to count 100 fields of view (i.e. about 400 units assuming the recommended sample concentration).

Qualitative and quantitative evaluation of plankton: Replicate plankton samples, each of 50 L, collected from various spots around a chosen river or lake by means of a bucket and filtered through bolting silk plankton net of 50 p,. The filtrate should be transferred to other bottle and preserved immediately in 1:100 Lugol's solution. Qualitative and quantitative analysis of both phyto-and zooplankton should be done following drop count method (APHA 1995). Identification of planktonis often made by following Ward and Whipple (1959) and Presecot (1962).

The inundation or saturation of wetland soils by water leads to the formation of anaerobic conditions as oxygen is depleted faster than it can be replaced by diffusion. The rate of oxygen loss in flooded soils can vary depending on other soil conditions, such as temperature and rates of microbial respiration. In most wetlands, small, oxidized layersof soils may persist on the surface or around the roots of vascular plants, but generally, anaerobic, or reduced, conditions prevail.

5. 4.0 Conclusion

Freshwater Fisheries Ecology defines what we have globally, what we are going to lose and mitigate for, and what, given the right tools, we can save. To estimate potential production, the dynamics of freshwater ecosystems (rivers, lakes and estuaries) need to be understood. These dynamics are diverse, as are the earth? freshwater fisheries resources (from boreal to tropical regions), and these influence how fisheries are both utilized and abused.

6. 5.0 Practical Assignment

Take a visit to a near dam or state fisheries departments' ecosystem within your area and carry out the following activities:

i. Identify and list different sampling techniques in ecosystem

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ii. Collect a named zooplankton from the ecosystem and counts the number of zooplankton with aid of a light microscope. Record your personal procedure and your findings:

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iii. Use plankton net to collect a sample of zooplankton in different sides of the rivers. Analysis the qualitative and quantitative analysis of plankton. Record your personal procedure and your findings:

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iv. Enumerate the techniques for assessment of fish biomass of a given ecosystem in your area.

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v. With aid of the figure below what is the relationship between D.O. and temperature using forested wetland and river throughbarren land. (https://www.nap.edu/read/4766/chapter/4#41)

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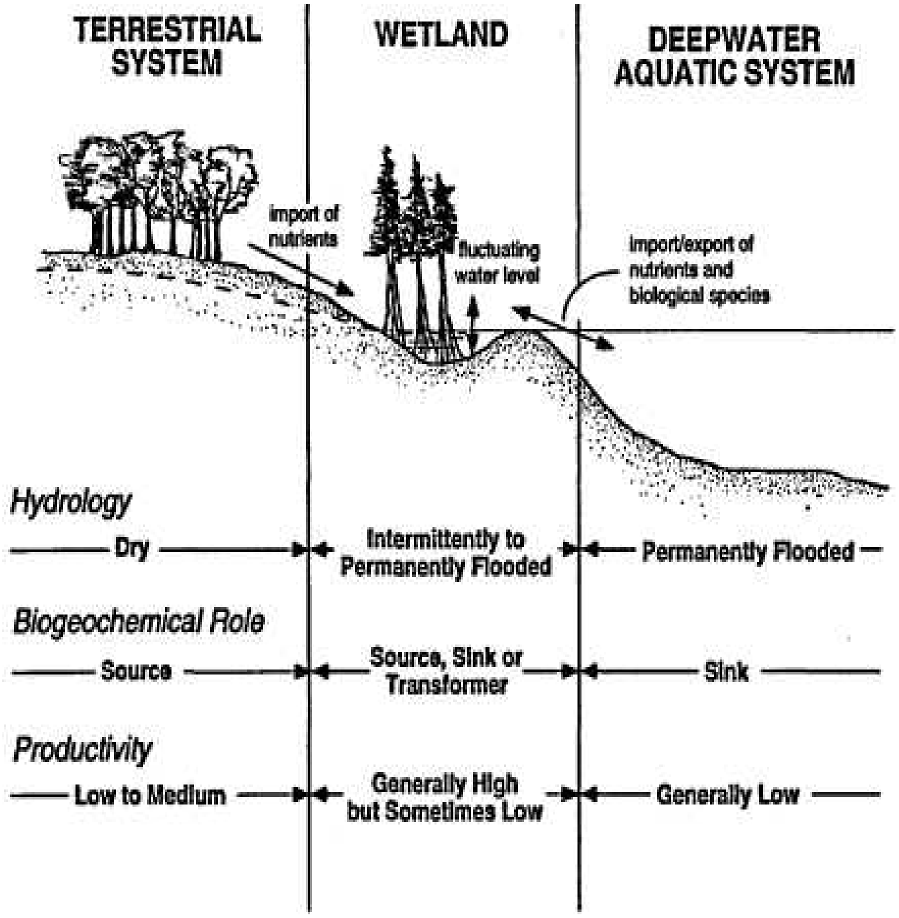

Figure 2.1: A Wetlands can be part of a continuum between terrestrial and deepwater aquatic systems. Source: Mitsch and Gosselink, 1993.

7. 6.0 References

https://www.researchgate.net/publication/237633265_Guidance_on_th eQuantitative_Analysis_of_Phytoplankton_in_Freshwater_Samples

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Ward, H.B. and Whipple, G.C. 1959. Freshwater Biology {?d ed), John Wiley and Sons, Incorporated, New York, 1248p.

9. AQUATIC FLORA AND FAUNA

1. 1.0 Introduction

Aquatic plants grow in and around the rock pools and slow channels of the river. Some are rooted in mud or cracks in the rocks; others float on, or near, the water surface. They tend to be soft, fleshy, and easily torn. The first step toward correct identification of an aquatic plant is to observe how it is growing in the water. Understanding the growth habit will also help determine the best method and timing for control, if necessary. Some species may exhibit different growth forms in response to their environment. Furthermore, a plant's growth form may change during its life cycle. Invertebrates fauna are a vital part of the freshwater ecosystem. They include grazers, plant shredders, filterers, and predators. Many of them feed on plant matter (algae, leaf litter and aquatic "weeds") and in turn they provide the most importantfood source to almost all of the freshwater fish.

2. 2.0 Objectives

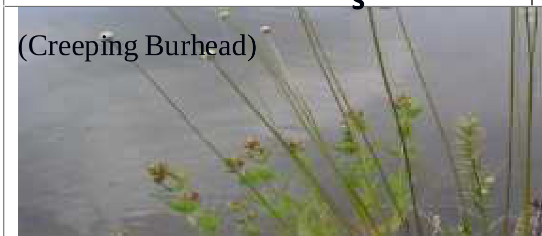
At the end of this section, you should be able to:

- Identify different zooplankton present in water bodies and wetlands
- Collection of water samples from different sources for screening and identification
- Drawing and Classification of zooplankton
- Collection of aquatic animals
- Drawing and classification of collected animals


Collection of Various plant species

Different Flora in the fisheries ecosystem	Distinguishing Characteristics
1.  **Canna spp.**	•**Ornamental growing tall with showy flower.** •**Large oval leaves pointing upward.** •**Usually growing in small clusters limited to the shoreline.**
2.  **Cephalanthus occidentalis (Buttonbush)**	Distinguishing Characteristics •**Woody, aquatic shrub with oval leaves coming to a point.** •**Loose clusters of round seed heads approximately 3⁄4-inch in diameter.** •**Grows in shallow water,often out from the shoreline.**
3.  *Colocasia esculenta* (Wild Taro)	•**Arrowhead-shaped terminal leaf up to 2 feet long.** •**3 primary leaf veins stretching to each lobe. Several secondary veins along the primary veins that are nearly opposite.** •**To separate amongst other plants with arrowhead-shaped leaves, *Colocasia esculenta* leaves are peltate.**
4.  *Cuscuta spp*. (Dodder)	•**Parasitic, aquatic vine found growing on other emergent plants.** •**Stems yellow to orange.** •**Occasional tiny white flower along stem.**
5. 	•**Leaves spade-shaped, with shallow cleft at petiole;petioles are grooved; leaves have 3 to 5**

primary veins.
•**Flowers on short stalks whorled around leafless stalk;**

1. Echinodorus cordifolius	
(Creeping Burhead) 	**1. Hygrophila costata**
 ***Eriocaulon spp.***(Hatpins) **2. Hydrocotyle spp.**	
6. (Water Pennywort) 	
 ***Hydrolea quadrivalvis*** (Waterpod)	

7. w h or ls ar e in te r m itt e nt al o n g a lo n g ar ch in g st al k.

•Usually restricted to shoreline.

•Thin rush with small terminal inflorescence resembling small cotton ball. •Rush loosely fanning in all directions.

•Moist soil or very shallow water.

•Each stem has a single terminal leaf that is nearly round with shallow cleft; about the size of a half-dollar; similar to terrestrial dollarweed.

•Stem attaches to center ofleaf.

•Usually found growing along shoreline in moist soil or very shallow water; can also form floating mat of tangled stems that are erect on terminal end similar to *Myriophyllum aquaticum*.

•Leaves alternate with rough margins.

•Stiff thorns and blue flowers in leaf axis.

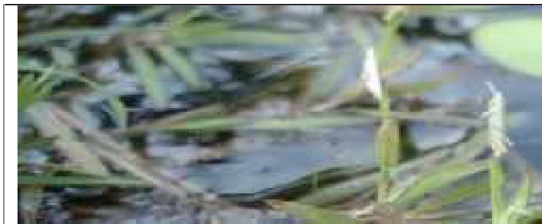
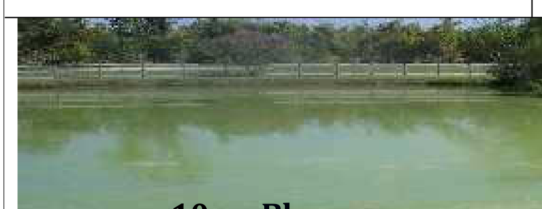
•Stems have fine hairs.

•Usually grows in isolated clumps along shoreline, but can eventually surround shoreline. Appearance and growth habit very similar to *Polygonum spp*.

•Leaves arranged oppositely around stem; leaves have rough margins; primary and secondary leaf veins very distinct.

•Small, white to pink flower in leaf axis; tiny leaves may also be present in leaf axis. •Stems

(Lake Hygrophila) 8.	**and sometimes primary leaf vein dark red.** **•Usually grows in isolated clumps along shoreline, but can eventually surround shoreline.**
 ***Hymenocallis spp.***(Spider Lily)	**•Basal leaves appearing like grass blades; leaves up to 3 feet long and 1.5-inch wide.** **•Showy, white flowers in groups at end of thick, leafless stem. •Grows in moist soil to shallow water.**
 ***Justicia americana* (Waterwillow)**	**•Long, very narrow leaves arranged oppositely along stem.** **•Stems always erect and more narrow than alligator weed or water primrose. •Faint purple, irregular flower.** **•Spreads by rhizomes and can grow out from shoreline in deeper water.**
 ***Limnobium spongia*** (Frog's Bit)	**•Leaves spade-shaped and often curled upward on sides; leaves point upward; leaf stalks not bulbous at base but rather firm with ridges; leaf veins webbed.** **•Also has small floating leaves that are heart-shaped. •Plant has feathery white roots.** **•Forms thick mats growing out from shoreline.**
9.  ***Ludwigia peploides*** (Water Primrose)	**Leaves arranged alternately around thick, hollow stem that is green to red; leaves can have many different shapes, but often oval or club-shaped.** **•Flowers yellow.** **•Rooted along shoreline, but forms floating mat.**

 **1. Luziola fluitans** (Southern Water Grass)	**•Leaf blades 3 to 5 inches long; lying flat on surface or raised a few inches high. •Leaf blades feel rough on top. •Rooted at shoreline, butforms floating mat that creeps out from shore. Has the appearance of terrestrial crabgrass.**
 ***Marsilea spp.* (Water Clover)**	**•Delicate plant resembling 4-leaf clover. •2 growth forms: can grow erect on long, think stalk; or can grow in slightly deeper water with leaves floating on surface. Usually found in moist soil or very shallowwater.**
 ***Various spp.* (Green algae)**	**•Green algae free-floating in the water column; the water itself appears green. •Directly related to water fertility and fish productivity.**
 ***Euglena spp.* (Euglena)**	**•Unicellular organism that has characteristics of both plant and animal. •Forms a rusty brown or green skim on surface depending on sunlight absorption. •Often associated with pond with high organicnutrient input.**
 **10. Blue-green algae**	**•Algae that forms a skim on the surface that can be light green, dark green, blue or even white. •Usually found in fertile ponds. •Often has a foul, sulfurodor.**

11. Fauna in the fisheries ecosystem

Freshwater invertebrates (insects, crustaceans, snails, worms and other small critters) are often used as indicators of the state of streams, rivers, lakes and ponds.

12. 3.0 Procedure

Protozoans are unicellular organisms living independently or in colonies of similar cells. Most of them are microscopic organisms. They can be found in aquatic habitats such as streams, ponds, oceans and in moist soil. However, others live as parasites on animals and plants. Examples of protozoans include Amoeba, Paramecium etc.

Preparation of slides or fresh specimens of pond water:

- Place one drop of pond water in the center of the clean slide using the pipette.
- Cover the drop by lowering the cover slip gently down unto it ina slanting position. Ensure no air bubbles are trapped (those air bubbles are frequently mistaken for organisms).
- Use the coarse focusing knob and the lower power objective to ensure the sample is properly focused.
- Observe your preparation under the microscope using both lowand high power objectives to identify any of the protozoans.
- Drawing under high power and label fully at least two protozoans you identify.

13. Where to Look and How to Sample Invertebrates

A single site can be used for a spot check, although most biological surveys involve a series of sites along a particular water body. Select sites with easy and safe access, and always seek permission to cross property. The widest range of stream invertebrates can be found in shallow (but permanently submerged), fast-flowing, stony-bedded reaches known as “riffles”. Larger, more stable rocks usually support the most invertebrate types, although the rocks need to be small enough to be lifted or turned over.

Invertebrates can be picked or scraped off rocks and placed into a tray or transparent container. The more invertebrate types found, the more useful information you will gain relating to the “state of health” of the site. Be sure to look for the smaller species as well as the moreobvious, larger species.

 Ameletopsis	Ameletopsis is a six-le ged larvae generally a rare mayfly which is difficult to collect intact, but it is a good indicator of "clean" water.
 Zelandoperla	Zelandoperla is a six-le ged larvae recognised by the very long antennae, tails and hairy legs. Like all of the large stoneflies they prefer high quality waters.
	Freshwater (Paratya) and estuarine shrimps are eight or more legged crustacean that prefer slow-flowing weedy streams, estuariesand lakes. They often tolerate nutrient enriched, or otherwise degraded waters.
	Helice mud crabs are eight or more legged Crustacea abundant in muddy river estuaries.
	*Potamopyrgus* is the widespread "pond snail" found in most freshwaters especially amongst weedbeds and streambed algae. This snail can tolerate various water quality conditions.

	Oligochaete worms are found everywhere, from pristine streams, to the most polluted waterways. Their ability to thrive in many heavily polluted habitats gives them the sensitivity score of 1(4).

Field identification of the different aquatic flora (emergence and sub- mergence weeds, by names/botanical classification. Identification of the different aquatic fauna in a typical fresh water ecosystem (invertebrates,vertebrates, benthos), a practical note on the economic importance of each.

14. 4.0 Conclusion

Invertebrates can tell us a great deal about the “state of health” of ourwater bodies. The presence of many invertebrate species usually indicates clean water, cool temperatures and generally natural conditions. A stream which lacks any invertebrate life has a major

habitat problem, possibly because of recent pollution, or low flowconditions.

15. 5.0 Practical Assignment

I. Look out from the following fauna in your area, take a photograph of them, state their distinguishing characteristicsand highlight the economic importance of each.

i. *Spirogyra spp.* - Silk Algae
ii. *Pithophora spp.* - Cotton Algae
iii. *Lyngbya spp.* - Lyngbya
iv. *Hydrodictyon spp.* - Water Net Algae
v. *Wolffia spp* - .Watermeal
vi. *Spirodela polyrhiza* - Giant Duckweed
vii. *Pistia stratiotes* - Water Lettuce
viii. *Eichhornia crassipes* - Water Hyacinth
ix. *Azolla caroliniana* - Mosquito Fern
x. *Nymphaea odorata* - Fragrant Water Lily
xi. *Nelumbo spp.* - American Lotus
xii. *Brasenia schreberi* - Watershield
xiii. *Ruppia spp.* - Widgeon Grass
xiv. *Potamogeton nodosus* - Long-leaf Pondweed
xv. *Najas guadalupensis* - Southern Naiad

2. Use the following steps to identify, photograph and state their distinguishing characteristics and highlight the economic importance.
   i. Choose a "riffle" habitat in streams, or a shallow "weedy" habitat in stagnant or slow flowing waters.
   ii. If you are sampling a series of sites, ensure that the habitat types are as similar as possible.
   iii. Collect as many invertebrate groups as possible, from the under sides of stones, or grab samples of vegetation.
   iv. Use this guide (https://www.trc.govt.nz/assets/Documents/Research-reviews/Freshwater/Photographic-Guide-sm.pdf) to identify these groups as accurately as possible.

6.0 References

http://www.aces.edu/dept/fisheries/rec_fishing/documents/plantguide.pdf

https://www.trc.govt.nz/assets/Documents/Research- reviews/Freshwater /Photographic-Guide-sm.pdf

10. FISH FARMING TECHNIQUE AND HATCHERYMANAGEMENT

1. 1.0 Introduction

Fish farming systems can be classified into different categories most especially based on the exposure to natural climates and influence of vagaries of weather. The three main classifications are: Open System, Semi-closed systems and Closed Systems. Culture techniques areeither monoculture (culturing of a species of fish in a culture environment at a particular time) or Polyculture (rearing of more than one species of fish in a culture environment at a particular time). Hatchery is a place where process of producing young fish (Fingerlings) is taken place. Hatchery is important to the growth and development offish farming in order to ensure availability of quality fish seeds that can meet up with the required quantity all the time of the year. Hatchery can be indoor or outdoor.

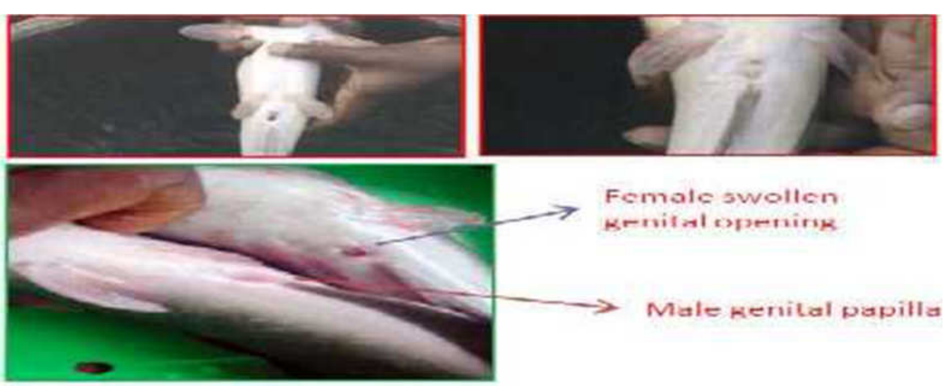
2. 2.0 Objectives

At the end of this section, you should be able to:

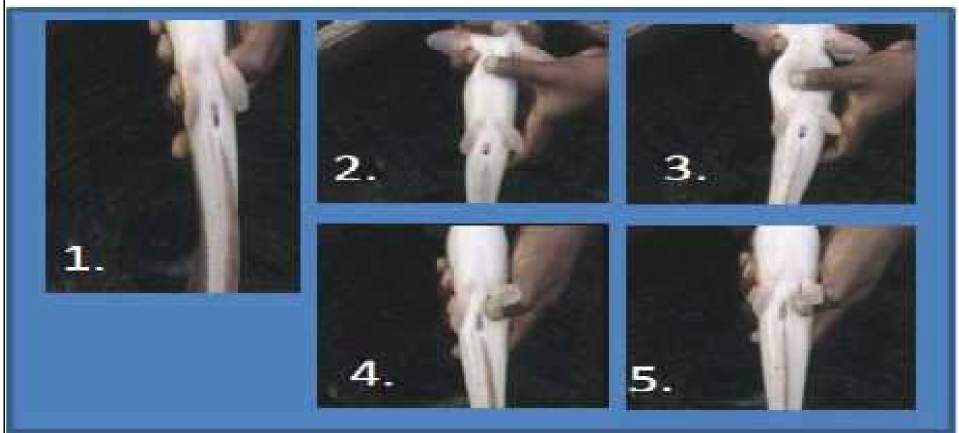
- Induced breeding of fish (Clarias or Heterobranchus) using crude pituitary extract (CPE) or synthetic hormone (Ovaprim).
- Dissect fish to extract hormone, preparation and injection of the fish
- Incubation fish at different temperatures and also with and without oxygenation. Students to determine the results under the different stages of gonadal maturity.

3. 3.0 Procedure

Below are 18 steps procedure to efficient African Catfish Breeding:

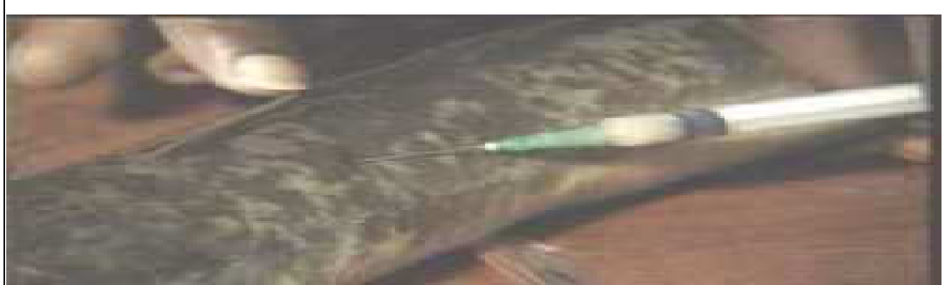


Step 1: Identify and separate the sexes



Step 2: Select and check for a gravid female ((i.e. female with ripe eggs)

Step 3: Weigh the Female Fish Dried African Catfish Pituitary Gland, Grind the pituitary using a pestle until it becomes powder, Add 1ml saline solution. Collect the solution and Inject the female fish using an hypodermic Syringe.



Step 4: Prepare the female Catfish for injection. The fish should also be injected above the lateral line with the needle at 45 degrees to body ofthe fish.

Step 5: Isolate the Injected fish in a Comfortable, big bowl and wait for 10 to 12 hours.

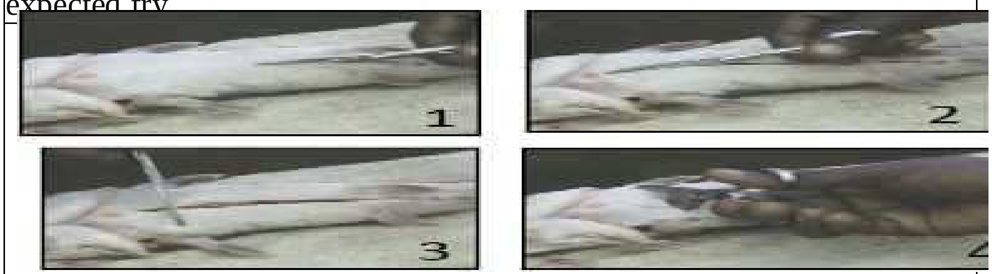
Step 6: Prepare to strip the fish, Set up your incubator.

Step 7: Bring the Fish out after 10 to 12 hours gently and cover the head with a clean, moist towel.

Step 8: Wipe the body of the fish dry using a dry, soft towel.

Step 9: Strip the fish (i.e. press the eggs out of the fish).

Step 10: Weigh the stripped eggs. This helps to have an idea of the expected fry



Step 11: Bring the Male out, kill it, turn the belly up and cut it open

Step 12: Remove the milt sac

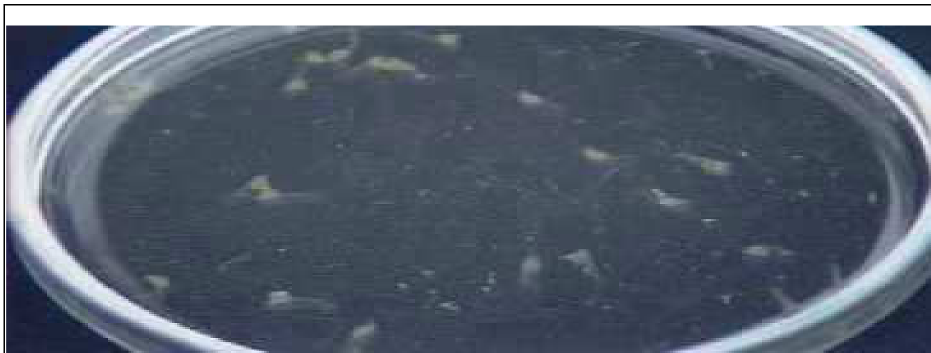
Step 13: Cut the testicles into bits to release the sperm

Step 14: Add saline solution to the milt

Step 15: Pour the mixture of saline solution and milt to the stripped eggs in the bowl and mix thoroughly and add fresh, clean, water. Continue

Step 16: Spread the eggs inside the incubator on the Spawning sponge. The spawning sponge is completely immersed in water. It however sits on the spawning net which keeps it suspended in the water. The net is held in place by pegs.

Step 17: Wait 20 to 36 hours. After 20 to 36 hours, remove the sponge and spawning net. By now the fry would have emerged from the hatched eggs and would have gone to the bottom of the net.



Step 18: Observe the newly hatched eggs, with yolk still visible and attached to the fry

4. 4.0 Conclusion

The major practicable means of providing enough quality seed forrearing in confined fish enclosure waters such a fish ponds, reservoirs and lakes is through artificial propagation methods. This is because there is steady growing importance of fish farming which has compelled improvements in the technologies necessary for securing the initial and basic requirements for productive aquaculture.

5. 5.0 Practical Assignment

I. Visit a fish-breeding laboratory, observe carry out the following:

- i. List various equipment used in the hatchery
- ii. Following the process stated above attempt to breed, incubating the fish at different temperatures and also with and without oxygenation.
- iii. Enumerate the different stages of gonadal maturity of African Catfish.

6.0 Reference

https://thefishsite.com/articles/19-steps-to-efficient-african-catfish- breeding

11. FISH NUTRITION

1. 1.0 Introduction

Fish Nutrition is the science that interprets the interaction of protein,lipids, energy, vitamins and minerals and other substances in food in relation for growth, reproduction, health, disease of fish and other normal physiological functions.

Proximate Analysis is a partitioning of compounds in a feed into six categories based on the chemical properties of the compounds. It is important to remember that proximate analysis is not a nutrient analysis, rather it is a partitioning of both nutrients and non-nutrients into categori s based on common chemical properties.

2. 2.0 Objective

At the end of this section, you should be able to:

- Analyzeor measure the amount of each individual component in the feedstuff.

3. 3.0 Procedure

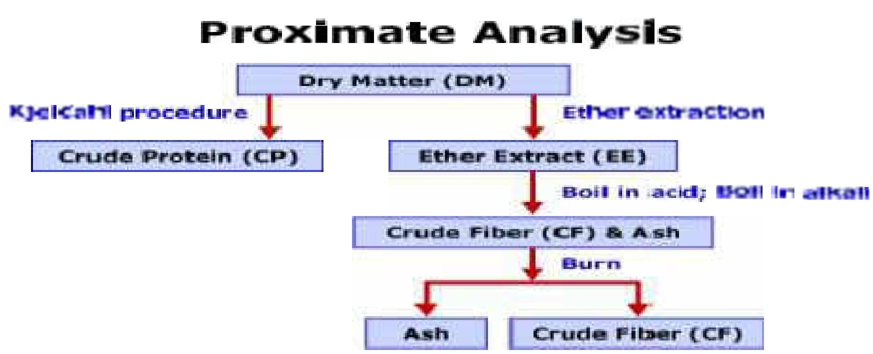


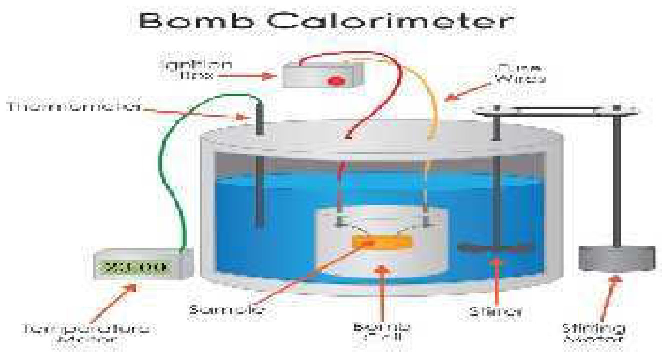
Diagram of the proximate analysis system

This system of analysis divides the food into six fractions: moisture, ash,crude protein, ether extract, crude fibre and nitrogen-free extractives.

1) The moisture content is determined as the loss in weight that results from drying a known weight of food to constant weightat 100^{0}C.
2) The ash content is determined by ignition of a known weight of the food at 550^{0}C until all carbon has been removed.

3) The crude protein (CP) content is calculated from the nitrogen content of the food, determined by a modification of a technique originally devised by Kjeldahl over 100 years ago.
4) The ether extract (EE) fraction is determined by subjecting the food to a continuous extraction with petroleum ether for a defined period.
5) The carbohydrate of the food is contained in two fractions, the crude fibre (CF) and the nitrogen-free extractives (NFE).

4. Determination of calorific value of fish feed



(bomb calorimetry)

5. Bomb Calorimeter

A bomb calorimeter is used to measure the heat created by a sample burned under an oxygen atmosphere in a closed vessel (bomb), whichis surrounded by water, under controlled conditions.

About 1g of solid or liquid matter (food) is weighed in a crucible and placed inside a stainless-steel container (the "decomposition vessel") filled with 30 bar (435psi) of oxygen. Next, the sample is ignited through a cotton thread connected to an ignition wire inside the decomposition vessel and burned (combusted).

After calibrating the decomposition vessel with a substance of a known heat, we know how much heat is necessary to heat up the water by 1°C. After that, the food will be burned and the unit displays the amount of energy inside the food sample in units of calories, J, or BTUper gram. Some food samples burn better inside the calorimeter than others.This is the physical calorific value.

6. Feed Formation Pearson's Method

You should follow the following guidelines when formulating feed using the Pearson Square method.

To use Pearson's Square:

1. Subtract the nutrient requirement (middle of square) from the nutrient concentration (on left of square) in the feed across the diagonal (top left – middle = bottom right; bottom left – middle = top right). Repeat this for both feeds. Make any negative numbers on the right side of the square positive. The answerson the right side of the square are the parts of each feed to include in the ration.
2. After subtracting across the diagonal, sum the parts of the two feeds to get the total.
3. Then, divide each part by the sum of the parts to calculate the percent of each feed in the ration.

7. 4.0 Conclusion

Foods are defined as natural sources of nutrients produced in the environment, and feeds are natural and manufactured sources of nutrients produced elsewhere and added to the environment. Nutrients for cultured fish may come from various food sources, such as plankton, bacteria, insects and other fish from within theaquacultural ecosystem, and/or from organic matter and processed feeds added to the ecosystem. Feed formulation using the Pearson Square method is one of the simplest feed formulation techniquesavailable. This method focuses on the Digestible Crude Protein (DCP) as the most basic feed nutritional requirement.

8. 5.0 Practical Assignment

1. List all available feedstuff in your locality?

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2. Use the procedure of proximate analysis above to measure the amount of each individual component in the feedstuff

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3. Calculate the portion of a grain needed to make a 15% CP mix. The grain we have available is lupins at 30% protein and barley at 12% protein.

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6.0 Reference

http://www.tankonyvtar.hu/en/tartalom/tamop425/0059_fish_nutrition_and_feeding/ch01.html

2. FISHING GEAR TECHNOLOGY

1. 1.0 Introduction

Fishing gear is the equipment used by fishermen when fishing. Almostany equipment or gear used for fishing can be called fishing tackle.Some examples are hooks, lines, sinkers, floats, rods, reels, baits, lures, spears, nets, gaffs, traps, waders and tackle boxes.

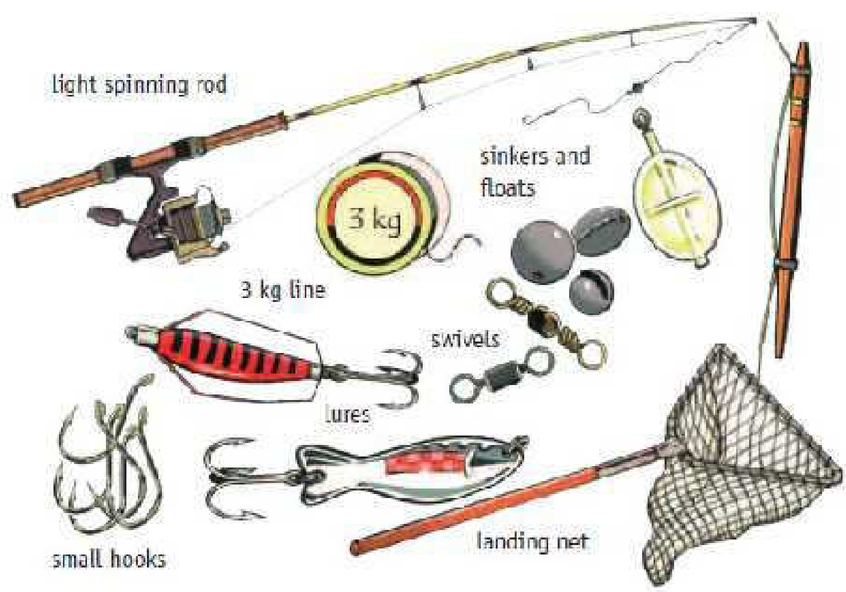
2. 2.0 Objectives

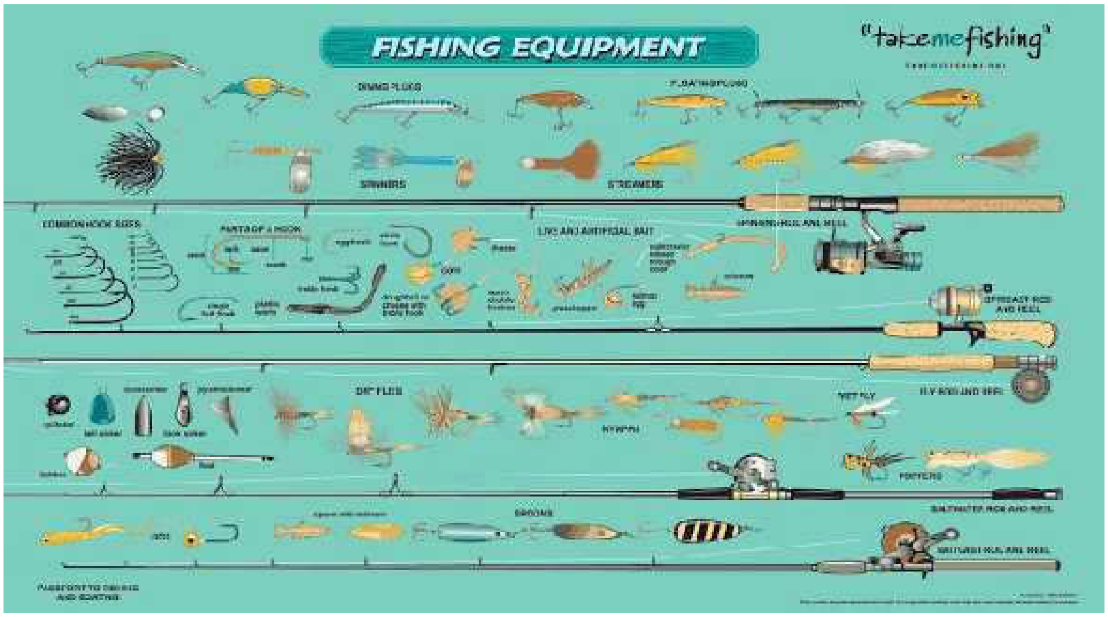
At the end of this section, you should be able to:

- Identify equipment used by fishermen when fishing
- Examine fishing net market and identification of netting, twinesetc.
- understand boat yard and identify the materials for boat building and
- Describe design and construction of different types of fishing gear and their maintenance

3. 3.0 Procedure

4. Basic Fishing Equipment





5. Determination of hanging ratio of nets, buoyancy and sinking

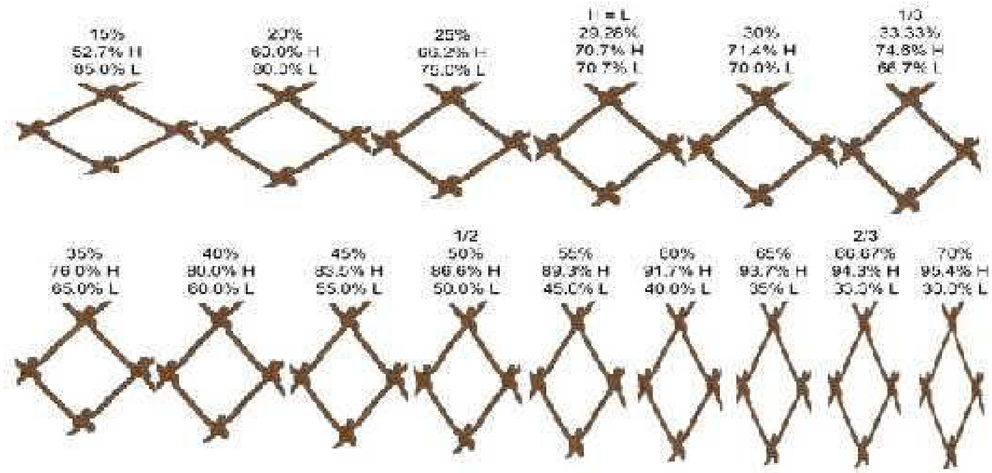
When netting is attached to lines, it should be longer than the lines so as to have a proper looseness. This excess length is expressed as a percentage of the stretched netting. This is the hanging ratio.

The formula for figuring the hanging ratio is stretched length of netting minus length of netting, divided by length of netting. Ratio % = (str length of netting less rope length)/str length of netting).

The shape of mesh is greatly influenced by the hanging ratio. Multiply the stretch mesh size times the number of mesh deep times the % height to get the total height of net.

Multiply the stretch mesh size times the number of mesh long times the % length to get the total length of net.

The following shows the heights and lengths of the mesh for different hanging ratios.



Transformation of net designs to fishing nets from a given netting bundle.

6. 4.0 Conclusion

Fishing gear in fishing cannot be over-emphasized; as without it fish cannot be obtained. This is because fishery management requires a good knowledge of fishing gear. You must be able to identify the best fishing gear for the correct environment and target fish. The method and hanging ration used to catch fish affects the condition in which the product is landed.

7. 5.0 Practical Assignment

I. Visit to fishing net market and identification of netting, twines, netting bundles, specifications and designations. Record the different netting and twines and state the characteristics of each.

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2. A visit to a boat yard and identify the materials for boat building, parts of the boat and engines employed. Record your findings:

3. Take an excursion to riverine States/fishing companies and observe the application of marine fishing gear (gillnets, longlines, trawlnets, boat seines etc.). Record your observations.

4. Describe floats, sinkers and their characteristics and properties.

5. Describe design and construction of different types of fishing gear and their maintenance.

8. 6.0 References

Binyotubo, T. E. 2011. A Guide to Fishing Gear Technology. 60p

FAO. 1985. Definition and classification of fishery vessels types.FAOFisheries Technical Paper No. 267. 63p.

FAO. 1990. Definition and classification of fishing gear categories. FAOFisheries Technical Paper No. 222. 92p.

https://netsandmore.com/component/tags/tag/178

http://www.fao.org/docrep/008/t0367t/t0367t00.htm

12. FISH PARASITES AND DISEASES

1. 1.0 Introduction

Parasitic diseases of fishes are usually encountered more often than microbial diseases. From 30 to 50 percent of the cases received at several fish disease diagnostic laboratories involve parasites. Host reaction to parasitic invasion is highly variable. The severity of a parasite epizootic may be related to environmental factors; host condition, age, and size; and population density. Bacteria pathogens associated with fish into two: the non- indigenous bacteria pathogenand the indigenous bacteria pathogens. The non-indigenous pathogen contaminate fish or fish's habitat in one way or the other and the pathogens include Clostridium botulinum, Listeria monocytogenes, Staphylococcus aureus, Salmonella species, Shigalla species, Escherichia coli, etc. The indigenous bacteria pathogens are those naturally living in the fish's habitat.

2. 2.0 Objectives

At the end of this section, you should be able to:

- Identify methods for application of antibacterial to fish
- Examine and identification of associated pathogenic organism
- Understand how parasitic diseases of fishes are usuallyencountered.

3. 3.0 Procedure

4. Microscopic inspection of smeared slides (e.g. slime or wound)

Microscopic Examination Bacteriological examination is completed by a microscopic search for bacteria, in spoiled cans directly upon sampling orafter incubation. Usually a wet preparation of smeared contents examined under phase contrast microscope is sufficient to detect microorganisms.

5. Identification of associated pathogenic organism (bacteria,fungus, protozoa)

i. Collect the infected parts of the fish aseptically by using sterile forceps and scissors.
ii. Homogenized collected sample in sterile mortar and pestle using phosphate buffer as solvent.
iii. Serially diluted homogenized samples up to 10-6.

iv. Poured One millilitre of diluted sample from each dilution into sterile petri dishes followed by sterilized molten agar medium
v. After solidification, were inverted all the plates and incubated in a thermostat incubator to allow the growth of bacteria.
vi. After incubation, the colonies appeared on the respective agar plates
vii. Finally, the cultures were stored in respective agar slants for further use and identification using microscope.

Methods for application of antibacterials to fish (Haya et al., 2005)

Method of application	**Comments**
Oral route (on food)	Needs palatable components; minimal risk of environmental pollution
Bioencapsulation	Needs palatable compounds; minimal risk of environmental pollution
Bath	Need for a fairly lengthy exposure to the compound, which must be soluble or capable of being adequately dispersed; problem of the disposalof spent drug
Dip	Brief immersion in a compound, which must be soluble or capable of being adequately dispersed; problem of disposal of the dilute compound
Flush	Compound added to a fish holding facility for brief exposure to fish; must be soluble or capable of being adequately dispersed; poses a problem of environmental pollution
Injection	Feasible for only large and/or valuable fish; usually requires prior anaesthesia; slow; negligible risk of environmental pollution
Topical applicatio n	Feasible for the treatment of ulcers on valuable/pet fish

6. 4.0 Conclusion

Diseases and parasitic problems could constitute significant economic losses in fish production if not controlled, thus the need to continue monitoring its prevalence. Ability to identify associated pathogenic organism in the ecosystem and apply antibacterial of methods is critical to sustainable fisheries management.

7. 5.0 Practical Assignment

i. How can you identify diseased fish in the pond?

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What are the methods of identifying and extracting the endo-parasites of fish?

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ii. How do fish farmer in your area prepare treatment “ dips”, “baths” for the treatment of fungal diseases?

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iii. How is oral drugs (food additives /antibiotics) against bacteria diseases calculated in the farm you visited?

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iv. What kind of protozoa infections are you likely to see on a fish?

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v. Mention only five that you know.

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vi. What are the signs of a fungal disease on a fish?

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vii. How can you recognize them on fish?

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viii. What are the general preventive methods of keeping healthy fish?

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8. 6.0 References

Haya, K., Burridge, L., Davies, I. & Ervik, A. (2005). A Review and Assessment of Environmental Risk of Chemicals Used for the Treatment of Sea Lice Infestations of Cultured Salmon. In Environmental Effects of Marine Finfish Aquaculture, edited by Barry Hargrave, 305-340. Springer Berlin / Heidelberg.

http://articles.extension.org/pages/58704/fish-disease

https://www.microscopemaster.com/microscope-slides.html

Kvenberg EJ (1991). Non-indigenous Bacterial Pathogens, In: Microbiology of Marine Food Products. (Eds). Donn, R. W. and Cameron, H. Van Nostrand Reinhold, New York, pp. 263-291.

13. OCEANOGRAPHY

1. 1.0 Introduction

Oceanology is the study of the physical and the biological aspects of theocean. Scientists study the ocean in many ways. Seagoing oceanographers have historically conducted observations from research vessels. However, examining the physical, chemical, and biological properties of the ocean in that manner can be very expensive. Today, thanks in part to new technologies, scientists employmultiple tools to monitorour oceans.

2.0 Objectives

At the end of this section, you should be able to:

i. Identify instrument for oceanic data collection
ii. Illustrate the uses of basic oceanic instrument in maritime environment.

2. 3.0 Procedure

Visit to maritime environment, oceanography institutions, boat yards and fishing terminals in maritime states and exposure to the sea voyage,marine organisms, tidal rhythms, wave and oceanic vessels.

3. 4.0 Conclusion

One of the main pieces of equipment that oceanographers use for the study of the ocean is a platform or research ship. A research ship is equipped with a variety of instruments to measure temperature, water current, turbidity, salinity, tides, waves, Oxygen, pH, and for collecting water samples and sea floor sediments. Other instruments, such as submersibles, remote controlled vehicles and autonomous robots equipped with photographic equipment help oceanographers study the oceans.

4. 5.0 Practical Assignment

1. During your visit to maritime environment, oceanography institutions, boat yards and fishing terminals, what are instrument for oceanic data that you observed?

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2. What are the uses of current metre, echo sounder, sediment samplers, under – water cameras?

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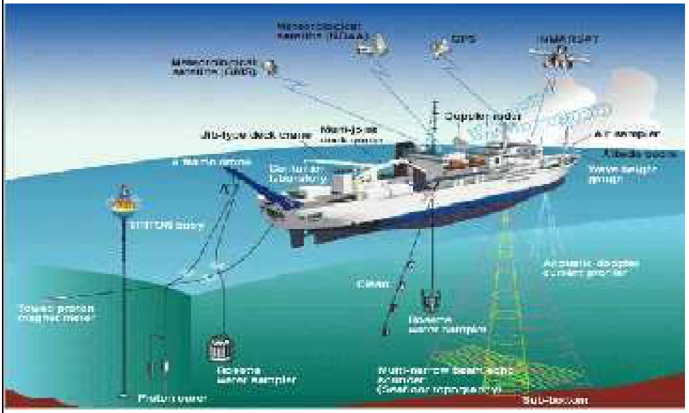
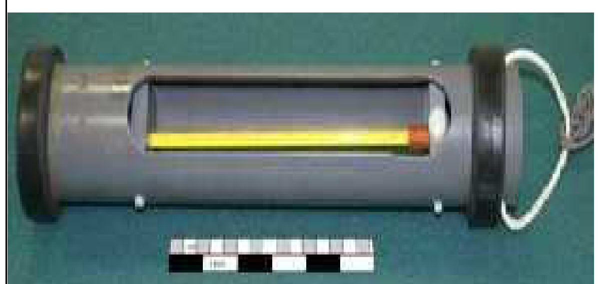
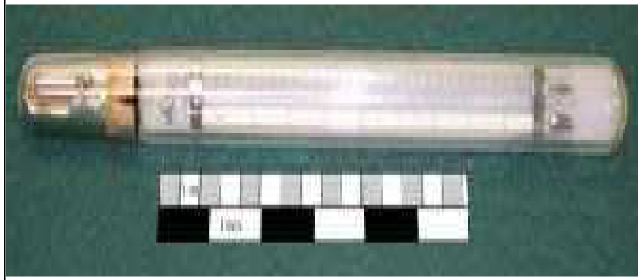
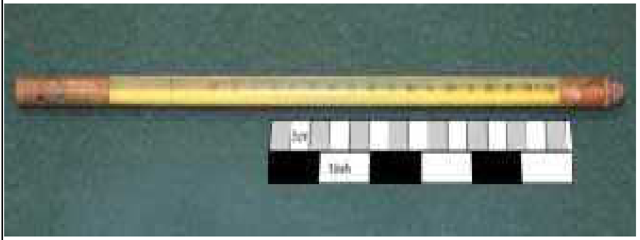
3. What are the uses of the following oceanic data collection?

 Pressure Compressor	

 Linear Actuators	 Rotary Actuators
 Laser Camera	 **Bucket Thermometer**

 Deep Sea Light	 **Reversing Thermometer (for Nansen Bottle)**
 **Standard Thermometer**	 **Bathythermograph (BT)**

Salinity: Hydrometer (quick test type for aquariums)	**Hydrometer Set** (cylinder, hydrometer, thermometer, TSD graph)
 **Chemical Test Kit** (Knudsen Titration modification) for Salinity	 Salinometer

 Chemical Test Kit (Winkler Titration) for Oxygen	 Current Meters

 Fathometer	 Sounder (lead line)
 Secchi Disk	 pH meter

Chemical Test Kit for Saltwater pH


Dissolved Oxygen Probe

5. 6.0 References

Davis R.A. 1987. Oceanography: An Introduction to the Marine Environment. Dubuque: Wm. C. Brown Publishers.

Pickard G.L., and W.J. Emery. 1990. Descriptive Physical Oceanography: An Introduction. 5th enlarged ed. Oxford: Pergamon Press.

SUN Working Group on Symbols, Units and Nomenclature in Physical Oceanography. 1985. The International System of units (SI)in oceanography. iapso Paris: Unesco Techni- cal Papers in Marine Science 45: 124.

http://www.marinebio.net/marinescience/01intro/tomeas.htm

http://www.actforlibraries.org/oceanographic-instruments/

14. ORNAMENTAL FISHERIES AND AQUARIADESIGN

1. 1.0 Introduction

Ornamental fishes can be defined as attractive colorful fishes of peaceful nature that are kept as pets in confined spaces of an aquarium or a garden pool with the purpose of enjoying their beauty for fun and fancy. An aquarium is a container, which displays the aquatic organisms in a simulated natural environment by introducing aquatic plants, rocks, gravels, artificial decorative and maintaining physic-chemical andbiological parameters there in with the aid of equipment controlling aeration, water movement, temperature, suspended organic matter,and illumination besides feeding.

2. 2.0 Objectives

At the end of this section, you should be able to:

- Identify freshwater and marine aquarium fishes suitable for home aquarium;
- Understand the various types of aquaria and their construction techniques;
- Construct a fish aquarium
- Manage and maintain the constructed aquarium

3. 3.0 Procedure

Demonstration of the step – by – step construction of an aquarium;

i. Put the Growth Substrate.(2cm)
ii. Put the Gravel. (3-4cm)
iii. Place the decorating such as the Granite Cave and Moss Wall I will show you the next steps.
iv. Pour water up to the middle of the Aquarium.
v. Plant the Plants.
vi. Place the Heater in the corner on the back of the Aquarium (some Aquariums included along Heaters on the market) and a Thermometer.
vii. Place the Aquarium Filter (in the next step I will show how to build the Aquarium Filter).
viii. Bring the remaining water to fill the tank.

ix. Place the Aquarium Lamp and AC adapter (some Aquariums included along Aquarium Lamps on the market).
x. Put into operation the Lighting, Filter and Thermostat, and leave the Aquarium to work for at least 2-3 days

Implement utilized in the construction of an aquarium

i. Single edged razor blades.
ii. Acetone.
iii. A non-toxic 100% silicone sealant
iv. A roll of paper towels.
v. A washable felt tip marker.
vi. A roll of duct tape.
vii. Some emery cloth or silicone carbide sandpaper.

Identification of different kinds of aquariumFreshwater

Tropical Aquarium

i. This is the “standard” in the hobby.
ii. The water temperature usually ranges from 72- 84 Degrees Fahrenheit.
iii. Freshwater Tropical aquariums are far easier to maintain and keep.
iv. There are no fancy chemical additives (beyond basic water conditioners such as chlorine removers) that must be administered.
v. There is no need for expensive light fixtures or really complicated aquarium equipment.
vi. Tropical fish are generally less expensive when compared to marine fish.

Coldwater Aquariums

i. The temperature is usually below 70 degrees or at least room temperature in most homes.
ii. One of the most common coldwater species kept in a coldwater aquarium is the Goldfish.
iii. Setting up a goldfish aquarium is as simple as adding the proper equipment and in return, dramatically lengthening the lifespan of their little goldfish. Coldwater freshwater fish may be a little more expensive when you start shopping for species other than the standard goldfish. Koi and goldfish ponds are great examples of domesticated coldwater fish habitats.

Marine Aquariums

i. Marine tanks require saltwater for the fish to survive. Salt must be purchased and mixed before adding water to the tank.
ii. Marine tanks offer beautiful fish, colorful corals, and spectacular

invertebrates to admire. These specimens are usually significantlyhigher in price as compared to the tropical freshwater specimens.

iii. Marine aquarium equipment is significantly more expensive due mainly to keeping coral.

Brackish Aquariums

i. Brackish water is a mixture of saltwater and freshwater.

ii. It's like in the middle, not freshwater, but not as strong as marine saltwater.

iii. People generally do not have much success with brackish water fish due to the water conditions are hard to maintain and mostof the fish that are brackish fish have not been housed properly before they end up in your home aquarium.

4. Different kinds of aquarium (ornamented) fishes

5. Aquarium maintenance

Aquariums can be maintained be reduce stress, Cycling the tank, performing periodic partial water changes, managing the filtration system, vacuuming the gravel and feeding the fish appropriately.

4.0 Conclusion

The keeping of fish in an aquarium became a popular hobby and spread quickly. It is the second largest hobby in the world next to photographydue to its tremendous economic opportunities and prospects.

6. 5.0 Practical Assignment

i. Visit aquarium home or farm. Identify and take photograph of different ornamental fish reared?

ii. Highlight the step by step techniques of fish aquarium construction?

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iii. Manage and maintain the constructed aquarium?

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iv. What are the characteristics of aquarium in your area?

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v. How would you know the type of ornamental fish to be rearedin it?

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7. 6.0 Reference

George F. H and Jack H: A guide to freshwater aquarium fishes. Published by the Hamlyn group Ltd, London. 176p.