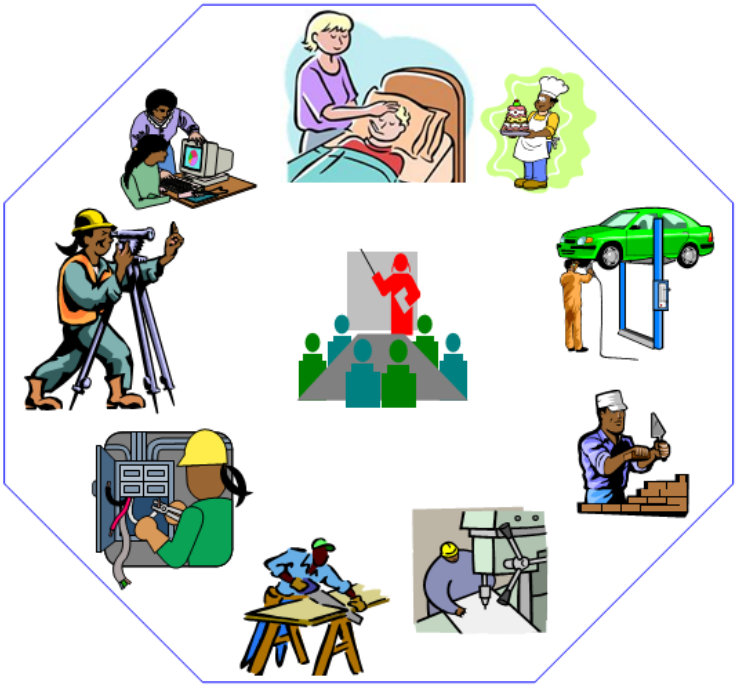
የሥራና ክህሎት ሚኒስቴር
Ministry of Labor and Skills

Crop Production

Level -II

Based on March 2022, Version 4, Occupational standard



Module Title: **Collecting and Compiling Crop Production Data**

LG Code: **AGR CRP2 M06** LO (1-4) LG (28-31)

TTLM Code: AGR CRP2 TTLM 0922v1

September, 2022

Addis Ababa, Ethiopia

Table of Contents

Introduction to the Module 3

LO #1-Connect computer hardware peripherals 4
Instruction sheet 4
Information Sheet 1 5
Self-check 1 31
Operation Sheet -1 ..... **Error! Bookmark not defined.**
LAP TEST-1 ..... **Error! Bookmark not defined.**

LO #2- Install and administer basic computer applications 48
Instruction sheet 48
Information Sheet 2 49
Self-Check – 2 59
Operation Sheet -2 ..... **Error! Bookmark not defined.**
LAP TEST-2 ..... **Error! Bookmark not defined.**
Reference Materials 60

Introduction to the Module

This module covers the knowledge, skills and attitude required to identify data to be collected and organize production data, compile and interpret data, present and documented production data.

LG #28	LO #1- Identify data to be collected

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Determining specific data requirements to be collected
- Obtaining materials or tools required for data collection and calibration
- Identifying difficulties encounter in collecting the data
- Communicating a dice about proposed data collection
- Selecting, using and maintaining suitable personal protective equipment
- Making checks to determine whether notices related to site quarantine

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Determine specific data requirements to be collected
- Obtain materials or tools required for data collection and calibration
- Identify difficulties encounter in collecting the data
- Communicate a dice about proposed data collection
- Select, using and maintaining suitable personal protective equipment
- Make checks to determine whether notices related to site quarantine

Learning Instructions:

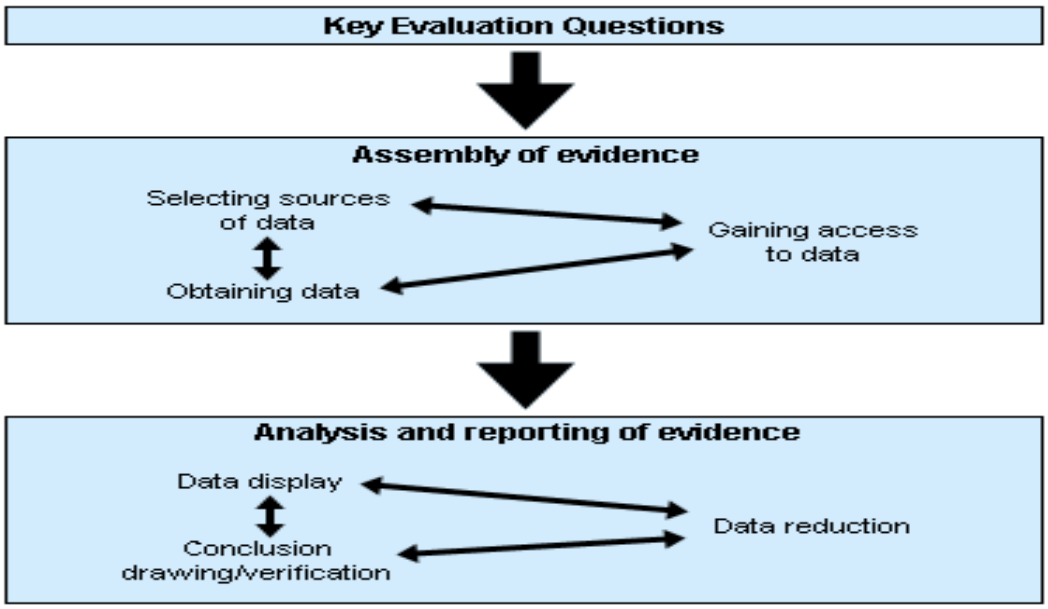
1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks

Information Sheet 1

1.1. Determining specific data requirements to be collected

A. Data versus information

Data are facts which may or may not be processed (edited, summarized or refined) and have no direct effect on the user. By contrast, information causes the user to take an action that he or she otherwise could not have taken. Information is simply defined as ***processed data***. The distinction between data and information has pervasive implications for the study of information systems. If output from the information system fails to cause users to act, the system serves no purpose and has failed in its primary objectives. The process of data collection and analysis in evaluation can be termed 'data management' as described in the following diagram. Figure 1. Data Management Framework



Adapted from Owen, 2006, p.99.

The starting point for this process is the set of key evaluation questions identified in Section. The data in an evaluation is collected primarily to address these questions. The data assembly process comes next and involves identifying the data sources, gaining access to the necessary data and obtaining the data in a useful form. Each of these elements of the process has a number of steps - too many to list here - however, it is useful to address several common questions.

B. Specifying data requirements

Data requirements of the data to be collected should be determined by discussion with the supervisor or by reading work instructions. Data Collection helps you and your team to assess the feasibility of your process. To do so, you must identify the **key quality characteristics** you will measure, how you will measure them, and what you will do with the data you collect. What exactly is a key quality characteristic? It is a characteristic of the product or service produced by a process that customers have determined is important to them. Key quality characteristics are such things as the speed of delivery of a service, the finish on a set of stainless steel shelves, the precision with which an electronic component is calibrated, or the effectiveness of an administrative response to a tasking by higher authority. Data Collection is nothing more than planning for and obtaining useful information on key quality characteristics produced by your process. However, simply collecting data does not ensure that you will obtain relevant or specific enough data to tell you what is occurring in your process. The key issue is not: How do we collect data? Rather, it is: How do we obtain useful data

Every process improvement effort relies on data to provide a factual basis for making decisions. Data Collection enables a team to formulate and test working assumptions about a process and develop information that will lead to the improvement of the key quality characteristics of the product or service. Data Collection improves your decision-making by helping you focus on objective information about what is happening in the process, rather than subjective opinions. In other words, I think the problem is... becomes... The data indicate the problem is...

C. Classification of Data

Data is any information collected as part of a research proposal and expressed as numbers. In practice, most measurements are classified into qualitative or quantitative data. Variables that give rise to non-numerical data are called **qualitative variable**s.

When the variable used to measure an attribute produces numerical observations; the variable is said to be **quantitativ**e.

Example: GPA. Quantitative variables can be further categorized according to the range of numerical values that a measurement can assume.

A continues variable is one that can assume the infinitely many values corresponding to a line interval. Discrete variables can assume only a countable or discrete number of values.

Identify each of the following variables as qualitative or quantitative:

- The door chosen by a mouse in a maize experiment
- The winning time for a horse running in a given match.

The second is continues variable. It could be 121 seconds 121.51 or 121.25, While, the first is a discrete variable. It could take on any number of values 0, 1.2.

D. Qualitative Data

Qualitative data arise when the observations fall into separate distinct categories. Examples are:

- Color of eyes: blue, green, brown etc.
- Exam result: pass or fail
- Socio-economic status: low, middle or high.

Such data are inherently discrete, in that there are a finite number of possible categories into which each observation may fall. Data are classified as nominal if there is no natural order between the categories (e.g. eye color) or ordinal if there is an ordering of the data values (e.g. exam results, socio-economic status).

E.Quantitative Data

Quantitative or numerical data arise when the observations are counts or measurements. The data are said to be discrete if the measurements take separate values, which are often integers (e.g. number of people in a household, number of cigarettes smoked per day) and continuous if the measurements can take on any value, usually within some range (e.g. weight, height).

In discrete data only certain specific values are valid; points between these values are not valid. For example, counts of people (only integer values allowed), the grade assigned in a course (F, D, C-, C, C+, etc), Where as in continuous data all values in a certain range are valid. For example, height, weight, length, etc. Note that some packages label interval or ratio data as continuous. This is not always the case.

Quantities such as sex and weight are called variants because the value of these quantities varies from one observation to another. Numbers calculated to describe important features of the data are called statistics. For example, (I) the proportion of females, and (ii) the average age of unemployed persons, in a sample of residents of a town are statistics.

- **Continuous but discredited**

Continuous data cannot be measured to infinite precision. It must be discredited, and consequently is (technically discrete. For example, a person's height may be measured to the

nearest cm. This can cause problems if the level of discretization is too coarse. For example, what would happen if a person's height was measured to the nearest meter?

As a rule of thumb, if the discretization is less than 5% of the typical value, then a discretized continuous variable can be treated as continuous without problems.

Such data are inherently discrete, in that there are a finite number of possible categories into which each observation may fall. Data are classified as nominal if there is no natural order between the categories (e.g. eye color) or ordinal if there is an ordering of the data values (e.g. exam results, socio-economic status).

F.Source of production data

The sources of data structures and information needed to solve information research problems can be classified as either secondary or primary, determination of which is based on three fundamental dimensions:

- whether the data already exist in some type of recognizable format,
- The degree to which the data have been interpreted by someone, and
- The extent to which the researcher or decision maker understands the reason(s)

Sources of secondary data include:-

- Inside a company,
- At public libraries and universities,
- On Internet Web sites,
- Purchased from firms, specializing in providing secondary information and so on.

A. Primary data represent "firsthand" raw data and data structures that have not had any type of meaningful interpretation. Primary data are the result of conducting some type of exploratory, descriptive, or causal research project that employs either surveys or observation to collect the data. Primary data are collected and assembled specifically for a current information research problem

One of the basic tasks of any research is to obtain information that helps a company's management make the best possible decisions. Focusing on the particular problem to be analyzed, the researcher needs to determine whether useful information already exists, how relevant the information is, and how it should be obtained. Existing sources of information are more widespread than one might expect, as illustrated in the chapter opening example, and should always be considered first in any data collection procedure.

B. Secondary Data

The term **secondary data** refers to data not gathered for the immediate study at hand but for some other purpose.

- There are two types of secondary data:-
  - ✓ Internal and
  - ✓ External.

Internal secondary data are data collected by a company for accounting purposes, marketing activity reports, and customer knowledge. Customer knowledge information is provided by customers for purposes that may be outside the any function of an organization. For example, information may be provided to engineers, logistical support personnel, or information technology departments for issues relating to product improvement, packaging, or Web registration. Nonetheless, data of this type, if properly warehoused and categorized, can be an invaluable form of secondary data for decisions as they relate to customer relationship management (CRM). CRM focuses on customer involvement and interactions throughout many of the processes of an organization.

External secondary data consist of data collected by outside agencies such as the federal government, trade associations, or periodicals. External data may also be available through standardized research services such as NPD Research's food consumption reports, store audits, or consumer purchase panels. Finally, secondary data may be obtained from computerized data sources. Computerized secondary data sources are usual\y designed by specific companies and include internal and external data combined with online information sources. These computerized information sources may include information vendors, private Web sites, mailing lists, or direct marketing clearing and fulfillment services.

1.2.5 Collecting information on crops

Information on income, labor and other costs involved in producing individual crops can be useful in many situations. It can be useful for:

- Scientists in determining suitable topics for research.
- Planners in estimating the probable returns of a project.
- Farmers in making farm management decisions.
- Extension workers and farmers as basis for discussions aimed at finding ways to improve the farm economy.

1.2.3 Data collection

Crop information can be collected in various ways. The method used depends on available local resources, purpose and the degree of accuracy needed.

1.2.3.1. Data collection workshop

Gather farmers (men and women) in the area for a 1-2 day workshop. Small groups of 3 to 5 farmers should discuss a specific crop and fill out the information sheet. Crop data can be presented and discussed among the participants.

- Individual interviews of farmers by extension agents
- This is a time-consuming way to gather information. The data may not be any more accurate than those collected through a workshop or group meeting.
- **Collection by farmers**

Interested individual farmers collect information by themselves as they carry out their farm activities. Initial supervision by the local extensionist is needed to ensure that the data are recorded correctly. Once every 6 or 12 months, the extensionist can gather the information from the farmers for analysis and presentation.

- **Data to collect**

✓ Yields
✓ Fertilizers and pesticides—management, use, quantities and costs
✓ Labor use—days for different activities, cost per day
✓ Other inputs, costs
✓ Income, prices received, quantities sold
✓ Constraints in the cultivation of individual crops
✓ Marketing.

- **How will the information be collected and analyzed?**

✓ What/who are the data sources?
✓ What types of data are most appropriate?
✓ What are the most appropriate methods of data collection?
✓ How will the data be analysed and presented in order to address the key evaluation questions?
✓ What ethical issues are involved in the evaluation and how will they addressed?

1.3. Data collection strategies. You have a number of ways to collect data but there is no one single best way. The decision about which approaches to use depends upon:what you need to know

- where the data reside
- resources and time available
- complexity of the data to be collected
- Frequency of data collection.

1.4. Data collection general rules

The following are general rules to help you with data collection.

- Use available data if you can.
- If using available data be sure to find out how earlier evaluators:
  - ✓ collected the data
  - ✓ defined the variables
  - ✓ Ensured accuracy of the data.
- If you must collect original data:
  - ✓ establish procedures and follow them (protocol)
  - ✓ maintain accurate records of definitions and coding
  - ✓ Pre-test, pre-test, pre-test
  - ✓ verify accuracy of coding, data input

1.2.Obtaining materials or tools required for data collection and calibration

1.2.1 Materials or tools required for data collected are obtained, and where necessary, calibrated

- What/who are the data sources?

In many ALTC projects, students and staff will be the primary data sources but documents and other stakeholders may also be useful sources of information. Due to the small size of many ALTC projects, all students and staff participating may be able to be approached to provide data and sampling therefore will not be an issue. If the population of any data source is too large then sampling will be required. Probability sampling (random or some variation of it) will usually be the best approach for quantitative information and explanatory analysis, whereas qualitative information and descriptive analysis are often served better by non-probability (purposive) sampling (see social science research texts for more detailed guidance on sampling).

The ready availability of existing data may make it generally preferred in evaluation studies, especially if it is accepted as appropriate and of high quality by stakeholders. However, where existing data is of poor quality or not available then new data must be collected, and this is generally more expensive and time consuming. Issues of the quality of any data used in the evaluation should be explicitly addressed in reporting the evaluation.

1.3 Identifying difficulties encounter in collecting the data

1.3.1. Difficulties that may be encountered in collecting the data are identified and advice sought from the supervisor if needed

- **What types of data are most appropriate**?

The data to be collected will depend on the key evaluation questions.

- **Key issues about measures of data collection**

When you collect data, you will need to keep these key issues in mind:

- ✓ Are your measures credible?
- ✓ Are your measures valid?
- ✓ Are your measures measuring what counts?
- ✓ Are your measures reliable?
- ✓ Are your measures precise?

The question that you ask must contain the following;

- ✓ Units in which measurements are to be made
- ✓ A time frame for the measurements
- ✓ A location

- A clear definition of what is to be measured In most evaluations, a combination of qualitative and quantitative information is collected, as required by the different questions being addressed. There is no a priori preference for one type of data over another, and both quantitative and qualitative data have standards of quality.

1.4 Communicating advice about proposed data collection

1.4.1. Advice about proposed data collection is communicated to others as required

- . What are the most appropriate methods of data collection?

The process of actually collecting the data is often the focus of most discussion and controversy but if the process of identification and access is properly addressed, the process of obtaining the data is much less problematic. The objective of the evaluation is to answer each of the key evaluation questions, so a matrix might be developed mapping each question against potential sources of information. The matrix enables identification of overlaps in data collection and the development of more efficient processes.

Figure1. **Sample Data Source Matrix**

Source of Information / Key Evaluation Question	Steering Committee members	Students	Staff	Existing documents	Other stakeholders
1. To what extent has the project been implemented as planned?	✓	✓	✓	✓	✓
2. How well has the project been co-ordinated across different institutions/schools?	✓		✓		✓
3. How appropriate were the project activities in relation to staff capabilities and the institution's ITC structures?	✓		✓	✓	✓
4. How well have the needs of staff been met?			✓		
5. To what extent have students been engaged in the project activities?		✓	✓		
6. To what extent have the intended student learning outcomes been achieved?		✓	✓		

1.4.2. Collect and organize agricultural/production data

- **What is Agricultural / production Data?**

The process of gathering information such as profit margins per crop type and cultivars, pest and disease infestation, weather and climate information, costs, economic conditions etc and analyzing it to be able to find patterns that will help as work more efficiently, sustainably and profitably on a farm.

1.4.3. Agricultural data could be any of these items listed below:

- Occurrence of pest and disease infestations.
- Weather and climatic information
- Rainfall & Soil sample data
- Costs of agricultural inputs
- Prevailing economic conditions in the sector, country
- Yield data
- Production costs per crop.

- Soil and fertilization costs and applications.
- Pest and Weed Control application
- -programs and statistics
- Non-target species data
- Crop quality margins
- Profit margins per cultivar / per crop /per block per orchard / per Hectare
- Agronomic data
- Agricultural photographic data

1.4.4. The reasons why we would collect Agricultural Data

It is always useful to have detailed records and data of patterns of the environment and process of the biophysical environment in order to ensure that we make optimum decisions in order to maximize profits, production and quality, and to reduce risks and problems in production activities. Detailed records of data need to be integrated, compared and correctly and accurately reported on, in order to make data useful and applicable in an agricultural setup.

Patterns of the environment include rainfall, climate, dry cycles, original vegetation, seasons, movement patterns of animals, etc. Processes of the biophysical environment include the interaction and the relationship between food webs, human activities, soil, climate, water, plants, animals and solar energy.

1.4.5. Elementary Methods of Data Collection in Agriculture

A. Interpreting a Gauge

The most commonly read gauge on a farm, are normally a tensiometer, rain gauge etc. Tensiometer is a porous, permeable ceramic cup connected through a tube to a manometer. It is a device for estimating soil moisture levels by measuring the negative hydraulic pressure of water in the soil.

B. Measuring

When applying the basics of collecting Agricultural Data, you will almost constantly be required to measure. But measurement may mean different things to different people. So let's explore a few of the basics to ensure we all agree to the same terminology:

- **The International System of Units (SI):** All systems of weights and measures, metric and non-metric are linked through a network of international agreements supporting the international system of units.
- **There are seven SI base units**:

- The meter for distance,
- The kilogram for mass,
- The second for time,
- The ampere for electric current,
- The kelvin for temperature,
- The mole for amount of substance, and
- The candela for intensity of light.

There are also other units of measure derived from SI – some of these that you might encounter include:

- The newton for force and the pascal for pressure;
- The joule for energy and the watt for power;
- The degree Celsius for everyday measurement of temperature;
- The traditional mathematical units for measuring angles (degree)
- The traditional units of civil time (minute, hour, day, and year);
- Two metric units commonly used in ordinary life: the liter for volume and the ton (Metric ton) for large masses;
- Knot, units traditionally used in meteorology;
- The hectare and the bar, a pressure unit

C. Counting, and Observing,

- **Observing:**

Observation basically means watching something and taking note of anything it does**.**

How and what to observe? Observation is one of the most important aspects of collecting Agricultural Data. It is a skill developed through dedicated action and meticulous methodology. A person doing this unit standard should be able to realize the importance of observation while collecting samples.

- **Counting**

Counting plays a very big role in collecting Agri-data. A farmer may decide to count the number of weeds or pests in a specific area, in order to determine whether or not chemical pest control is necessary.

- **Scouting**

Agricultural scouting is systematic, regular monitoring of a crop. Scouting, or monitoring pest populations, is part of an Integrated Pest Management (IPM) system. IPM prescribes treating the portions of a farm or field that have identified higher than threshold levels of pests, rather than

treating the whole field, resulting in using less applied farm chemicals. The person doing this unit standard should acquaint him/herself with the methods of scouting on different crops, by sourcing training manuals or production manuals of each crop.

- **Monitoring**

Monitoring would imply to count and observe a certain data package or the collection of data over a certain time period.

1.5 Selecting, using and maintaining suitable personal protective equipment.

5.1. Suitable personal protective equipment (PPE) is selected, used and maintained where required

- How will the data be analyzed and presented in order to address the key evaluation questions?

According to Owens's model, the second part of data management is analysis and reporting, which has three components; data reduction, data display and conclusion drawing and verification. The general data analysis process in evaluation is one of reduction- that is, 'the process of simplifying and transforming the raw information according to some logical set of procedures or rules' (Owen 2006: 101). There is a wide range of processes for data reduction for both quantitative and qualitative information. The processes used must be explicitly described when reporting the data analysis results. There are two general purposes for data analysis in evaluation; description and explanation. Both are important because description enables the audience to understand the project, its intended processes and outcomes, and the extent to which these were achieved, whereas explanation provides evidence about the underlying logic of the project and the extent to which it is sustainable, transferable and/or reproducible.

The display of data is a process of organizing the information in ways that lead to the drawing of explicit and defensible conclusions about the key evaluation questions. In many evaluations, conclusions are the endpoint, however in others; the evaluators go further to offer recommendations about the project. The former require placing values on the conclusions such as stating the project is successful or not, whereas, the latter are advice or suggestions for courses of action made to decision makers.

5.2. Preparing materials, tools and PPE

- **Those** Materials and tools for data collection, recording and storage which includes paper, pens, tally forms, flipcharts, computers, data loggers, and bar code scanners should be maintained and prepared
- Suitable personal protective equipment (PPE) like hat, boots, overalls, gloves, apron, waterproof clothing, spray clothing, goggles, respirator or face mask, face guard, hearing protection, sunscreen lotion and hard hat should be selected, used and maintained where required.

1.6 Making checks to determine whether notices related to site quarantine.

1.6.1. Checks are made to determine whether notices relating to site quarantine are in effect and, where required, site quarantine procedures are followed

- What ethical issues are involved in the evaluation and how will they addressed?

Ethical issues often arise in the data management process described above e.g. in the selection of data sources, obtaining the information or reporting results. The main issues which are likely to arise include appropriate methods of collecting, analyzing, storing and reporting data from students to protect their confidentiality and anonymity, ensuring students and staff are not impacted unfairly by the evaluation activities (avoiding interruptions to the learning and teaching processes), and unfairly disadvantaging students who are not receiving the project benefits.

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. Explain Source of production data?
2. List the materials required for collecting data?
3. List the agricultural data should be collected and its purpose?
4. List types of data?
5. List the general rules to help you with data collection**.**
6. What is Agricultural / production Data?

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

LG #29	LO#2-Collecting and organizing production data

Instruction sheet -2

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Collecting and organizing information for interpretation
- Assessing accuracy and relevance information
- Reliable methods of data collection and making efficient use of crop management practice
- Using basic equipment to access, organize and monitor data
- Updating, modifying, maintaining and storing information

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Collected and organize information in a format suitable for compile and interpretation in accordance with sector requirements
- Assesse information held by the production unit for accuracy and relevance in line with requirements
- Methods of collecting data are reliable and make efficient use of crop management practice
- Access, organize and monitor data by using basic equipment in accordance with crop production requirements
- update, modify, maintain and store information in accordance with crop production requirements

Learning Instructions:

5. Read the specific objectives of this Learning Guide.
6. Follow the instructions described below.
7. Read the information written in the information Sheets
8. Accomplish the Self-checks

Information Sheet -2

2.1 .Collecting and organizing information for interpretation

The process of gathering information such as profit margins per crop type and cultivars, pest and disease infestation, weather and climate information, costs, economic conditions etc and analyzing it to be able to find patterns that will help as work more efficiently, sustainably and profitably on a farm.

- **Collate information**

Collating information means to arrange the contents in an appropriate order. You may have multiple pages that need to be sorted and stapled or placed in a folder.

Data collection can be:

- ✓ Complete or
- ✓ Partial

Collection of data for statistical research in the Statistical Office shall be:

- A method of PAPI (Paper and Pencil Interviewing)
- The reporting method
- From administrative sources
- Through compilation of data Phases of research
- CATI, CAPI and CAWI method, since 2015, for several pilot studies

2.1.1. Agricultural data could be any of these items listed below:

- Occurrence of pest and disease infestations.
- Weather and climatic information
- programs and statistics
- Production costs per crop
- Rainfall & Soil sample
- Costs of agricultural inputs
- Agricultural photographic data
- Agronomic data
- Profit margins per cultivar / per crop /per block / per orchard / per Hectare
- Yield data
- Prevailing economic conditions in the sector, country
- Soil and fertilization costs and applications.
- Non-target species data
- Crop quality margins
- Pest and Weed Control application

2.1.2. The reasons why we would collect Agricultural Data

It is always useful to have detailed records and data of patterns of the environment and process of the biophysical environment in order to ensure that we make optimum decisions in order to maximize profits, production and quality, and to reduce risks and problems in production activities. Detailed records of data need to be integrated, compared and correctly and accurately reported on, in order to make data useful and applicable in an agricultural setup.

Patterns of the environment include rainfall, climate, dry cycles, original vegetation, seasons, movement patterns of animals, etc.

Processes of the biophysical environment include the interaction and the relationship between food webs, human activities, soil, climate, water, plants, animals and solar energy.

2.1.3. Methods of Data Collection in Agriculture

A. Scouting

Agricultural scouting is systematic, regular monitoring of a crop. Scouting, or monitoring pest populations, is part of an Integrated Pest Management (IPM) system. IPM prescribes treating the portions of a farm or field that have identified higher than threshold levels of pests, rather than treating the whole field, resulting in using less applied farm chemicals. The person doing this unit standard should acquaint him/herself with the methods of scouting on different crops, by sourcing training manuals or production manuals of each crop. Monitoring would imply to count and observe a certain data package or the collection of data over a certain time period.

B. Measuring

When applying the basics of collecting Agricultural Data, you will almost constantly be required to measure. But measurement may mean different things to different people.

C. **Counting, and Observing,**

Observing:

Observation basically means watching something and taking note of anything it does.

How and what to observe? Observation is one of the most important aspects of collecting Agricultural data. It is a skill developed through dedicated action and meticulous methodology. A

person doing this unit standard should be able to realize the importance of observation while collecting samples.

Counting

Counting plays a very big role in collecting Agri-data. A farmer may decide to count the number of weeds or pests in a specific area, in order to determine whether or not chemical pest control is necessary.

2.1.4. Method of data recording

Data are recorded in different methods: - for instance

A. **Field data records**: - can be kept in ordinary bound record, or on cards. There is no page or cord, per field per year. The virtue of loose leaf files or cords is that successive years for each field can be put together to make continuous record. Also, data for and single crop can easily be assembled as required. These records will from a type of diary for each field for subsequent reference.

   The items to be recorded include

   - Crop grown
   - variety
   - fertilizers and sprays used
   - Types of pest
   - Date of harvest
   - sowing date and

B. Rotational data record:-

This should be kept an a single sheet of paper, unless the number of fields is so large as to make it impossible the names and/or numbers of the field(and their areas if required)are listed down the left hand side and the remaining space is divided in to. Say Ten columns, representing, successive years, the crop grow on each field in each year is entered in the appropriate space.

C.Labor data recording

On farm with elaborate grapping systems and at peak times(and on many horticultural units labor may be fully deployed on essential productive work for most on even all of the year) the task may be recorded on time sheets, but these are laborious to analysis where a large staff is employed and are often in accurate, time sheets are more useful as a means of recording ordinary time and ever time worked for calculating wages, and as a means of transferring useful information from the field to the office, them for recording the labor hours spent on different jobs.

On farms with a limited number of major tasks at peak times, the information required about these can be recorded in a way that requires far less subsequent analysis than time sheet, the method involves recording certain details of each task, either in a pocket book kept by the head tractor driver, arable foreman or manager, or specially prepared small cards, one page or cord is needed for each job, unless it covers along period, in which case two or more pages cards, each covering one or weeks, will be required per job, the task such as main crop harvesting is written at the top. Normally there will be one entry per day. Format for recording data is differ according to the user and their Necessary for example format used for recording daily laborers controlling and recording data for plant management is not the same.

2.2 Assessing accuracy and relevance information

Legible datum are datum that readable or easily understandable datum, during recoding process. Making the recording legible is undout full for any decision making, the data must be free from errors incorrect information leads to wrong conclusion. Accurate data recording describes whether information represents datum represents a situation, level or state of an event as it really in information is relevant if an individual needs it in a particular decision making or problem solving situation.

Complete data recording

If a given set of data that recorded a user everything that need to be known about a particular situation or event, we say that it is complete data recording. If a recording on the other hand leaves on individual with a number of unsound questions, it is an incomplete set of recording.

2.3 .Reliable methods of data collection and making efficient use of crop management practice

Fast-evolving technologies in data collection and the emergence of new data sources and modes of data collection, are contributing to dramatic improvements in the availability, timeliness, frequency and quality of agricultural data. Computerization of data collection makes it possible to do things that are either very difficult or impossible with a paper-and-pencil interview. Attributes of data and information obtained from the field depend on instrumentation tools, data analysis methods and experimental designs.

Currently researchers across the world have been developing precision agriculture, which in addition to getting averages and variances of both crop and soil parameters, also enhance description and understanding of the spatio-temporal variability using new developed technologies.

Application of GPS/GIS into agriculture has caused a revolution called precision agriculture (PA), where fields are managed at a detailed scale based on information and knowledge. The PA cycle covers all steps in crop management. Recently, it has become possible to quantify within-field spatial variability because of the availability of technologies such as Global Positioning Systems (GPS) and Geographic Information Systems (GIS). The GPS enables collection of geo-referenced data, while the GIS allow spatial analysis and visualization of interpolated maps. New devices and sensors are making it possible to collect vast amounts of new data covering, in some cases, whole fields and giving details of spatial and temporal variability. More advanced data analysis methods are helping to extract more information from the data, develop more accurate prediction models, and optimize simulations for decision support in agriculture.

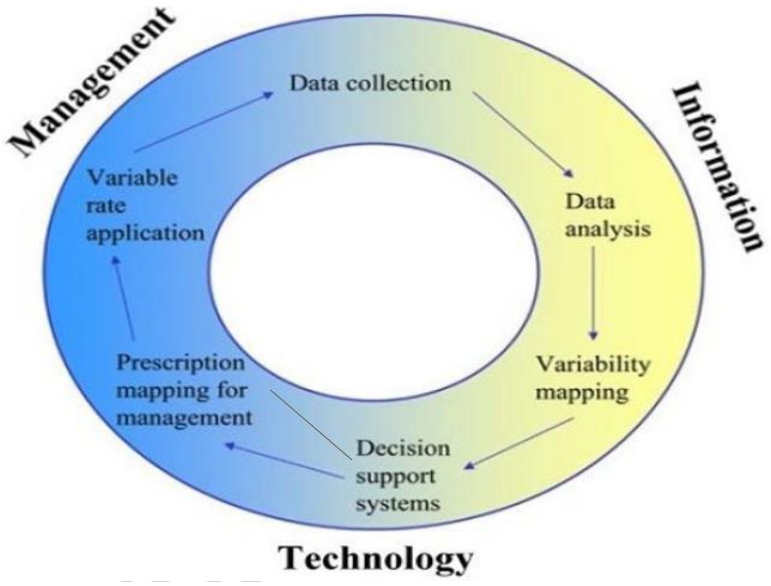


Fig 2.1. Precision agriculture cycle

2.3.1. Technics of reliable data collection

A. **Remote sensing approach** is described focusing on the spatial variability of crop and soil in an experimental field, using spectroscopic techniques from visible to near-infrared light energy reflection. **Sensors installed** on airborne platforms collected images of an experimental field and the differences between tillage practices and between fertilizers treatments were confirmed. S**oil sensors** and **crop sensors** are also introduced for providing the data of variability of soil and crop parameters.

A real-time soil spectrophotometer is one of the innovating tools to provide information about multiple underground soil parameters, such as moisture and soil organic matter content, as well as to supply correct location data.

B.Prototype of mobile fruit-grading robot is also an attractive approach for creating field maps of yield and quality of pepper fruits during in-situ grading operation. Multivariate methods are available for the analysis of high dimensional data such as those obtained from hyper-spectral sensors.

2.4. Using basic equipment to access, organize and monitor data

Information can be collected in a variety of ways. For example, you may receive a report by email, post, printer or fax, or through the internal mail. You may have to collect information from the internet, libraries, newspapers and television. In order to do all these things, you need to

be familiar with a range of business equipment and technology. You need to know what is used so you can process information quickly and efficiently.

To find and collect particular information and complete your tasks efficiently, you may need to use a wide range of business equipment and technology, some of which are described below. You must also know how to operate equipment safely and effectively

Computer

- Searching the library catalogue
- using a customer database
- accessing the internet
- sending and receiving email

Fax machines

- A fax machine converts paper-based information into electronic information for transmission. It is useful for transmitting and receiving information that requires people to check data, read a report or confirm information. Staff are usually shown how to use the fax machine during their induction session, as different organizations have different sorts of machines. Asking people to send information by fax rather than by post can save time.

Mobile

- Mobile devices such as smartphones and tablets are rapidly becoming an integral component of office business technology. With the appropriate application software, they can perform many of the tasks previously dedicated to single devices such as scanners, computers and telephones. Their portability also enables these functions to be performed beyond the office environment

Standard device in the production of agricultural data are

- Remote sensing
- Global Positioning System (GPS) and
- Geographical information system (GIS)

2.5. Updating, modifying, maintaining and storing information

Information used by organizations needs to be regularly monitored to ensure it is current, is still necessary and can be easily accessed. It may be your responsibility to do this, so make sure you are familiar with your organization's procedures for updating, modifying and storing information. Here is more information about these processes.

Update information

Updating means making sure the information is the latest, most current version. There may be serious consequences if the information an organization uses is not current. For example, a new customer may be annoyed if they are not sent a catalogue and newsletter because their name has not been added to the customer database. Or, the sales team may be working towards an incorrect target if updated sales figures are not regularly forwarded to them. If you receive more current information after you have already sent information to someone, make sure you also send the updated information as soon as possible.

Modify information

Modifying means changing or altering information. It may involve reformatting, changing the content, adding information, deleting information or moving information. You may need to modify information when existing information is no longer useful or needs to be used for a new purpose. Modifying may include:

- using an existing flyer as a template and changing the text to advertise a new product
- adding headings, page breaks and pictures to a draft report
- removing all of last year's meeting minutes from the meeting minutes file
- Changing a customer's address in the customer database.

File and store information

When you process information, you may be required to catalogue items in the filing system after you have collected, updated or modified them. You'll need to know:

- what information to keep

- the legal requirements of keeping the information
- your organization's filing procedures
- the security issues surrounding the information

Self-check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer (4 point)

1. From the following one is **not** included in agricultural data
    a. Rainfall and Soil sample
    b. Costs of agricultural inputs
    c. Recording technique
    d. Agronomic data

2. Accurate data recording describes:-
    a. Whether information represents datum represents a situation,
    b. Level or state of an event as it really information is irrelevant
    c. No needs in a particular decision making or problem solving situation
    d. Whether information not represents datum represents a situation

Test II: Short Answer Questions(3point)

1. Write technics of reliable data collection
2. Write Standard device used for the production of agricultural data
3. What is complete data recording means?
4. How information is updating and modifying?

LG #30	LO#3- **Compile and interpret data**

Instruction sheet-4

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- defining clearly and consistently objectives of data compilations
- Reliable and suitable methods of data compilation
- Clearing and justifying assumptions used in compilations of plant parameter
- Supporting conclusions by evidence

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Define Objectives of data compilations clearly and consistent with enterprise requirements.
- Methods of data compilation are reliable and suitable to research and other purposes.
- Justified clear and consistent assumptions used in compilations with plant parameters.
- Achieve sector objectives

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks

Information sheet -3

3.1 defining clearly and consistently objectives of data compilations

- Objective of statistical investigation may be
  - ✓ To supplement or disprove or to test some theory or hypothesis
  - ✓ To discover a new theory or hypothesis.
  - ✓ To know the existing state of affairs.

3.1.1. Interpretation of data

The interpretation of data is very simple if you are able to work through it systematically. The most important features of data are:

- Frequency
- Average
- Modus
- Median
- Range

Frequency is the number of times a certain value appears in a series of data. Example: Let us take the yield per hectar of 10 different potato varieties in ton: 20, 19, 20, 19, 20, 20, 21, 19, 21, 22. The information given in the list does not make much sense and needs to be better organized. We could organize the data in a frequency table, i.e. a table that shows us how often a certain amount of yield. If we put this series of data in a table, then the frequency would be much clear:

Number Tally Frequency

Number	Tally	Frequency
1	Ill	3
2	Illl	4
3	Il	2
4	I	1
		10

Note: When you are using the tally system to determine the frequency, you will draw a line for every time something occurs, i.e. I. When it occurs four times, you draw four lines, i.e. I I I I, but when you reach the fifth occurrence, you do not draw the fifth line next to the other four, but you draw a line through the other our lines to show that you have reached 5, i.e. I I I I. It makes it much easier to count when you reach the end.

- **Average**

Adding together all the values and then dividing it by the number of items calculate the average of a set of data. The average is also known as the **mean**.

Example:

We will use our previous set of data: 20, 19, 20, 19, 20, 20, 21, 19, 21, 22

To calculate the average, we first add together all the values:= 180

Then we count how many items are there, i.e. 10

Average = (Sum of all the values) ÷ (number of items)= = 180 ÷ 10 = 18

The average yield of potato varieties is 18 ton.

- **Mode**

The mode is the number that occurs most frequently in the series of data. In the series of data below, the mode is 20. 20, 19, 20, 19, 20, 20, 21, 19, 21, 22

- **Median**

The median in a series of data is the number that is exactly in the middle, or halfway between two numbers in the middle.

Example: From our set of data: 20, 19, 20, 19, 20, 20, 21, 19, 21, 22

We re-arrange it in chronological (numerical) order: 19, 19, 19, 20, 20, 20, 20, 21, 21, 22

Then what is the median?

- **Range**

The range is the difference between the highest number and the lowest number in a set of data.

The range in the set of data we have been using as an example will be as follows:

19, 19, 19, 20, 20, 20, 20, 21, 21, 22. Range = Highest Number – Lowest Number = 22 – 19 = 3

3.2 Reliable and suitable methods of data compilation

3.2.1. Methods of Data Collection

- The task of data collection begins after a research problem has been defined and research design plan prepared.
- While deciding about the method of data collection to be used for the study the researcher should keep in mind the types of data(primary and secondary)
- There are several method of data collection
  - Questionnaire
  - Interview /schedule
  - Observations
  - Focused group discussion (FGD)
  - Experimental method

1. Questionnaire
   - It is a self-report data collection instrument/method that is filled out by research participants.
   - Quite popular particularly in case of big inquiries.
2. Interview
   - The interview method of collecting data involves presentation of oral/ verbal stimuli and reply in terms of oral/verbal response.
   - This method can be used through personal (face to face) interviews and if possible through telephone interviews.
   - Flexibility of approach to questioning and do not follow predetermined questions.
3. Schedules
   - This method of data collection is very much like the collection of data through questionnaire with little difference which lies in the fact that schedules are being filled by enumerators who are specially appointed for this purpose.
4. Focused group discussion
   - A group of individual selected and assembled by researchers to discuss and comment on.
   - It is like interviewing a number of people at the same time.

- Purpose of FGD
  - ✓ Help to draw information that is not feasible using other methods.
  - ✓ Enable to gain large amount of information in a short period of time.
  - ✓ Elicit multiplicity of view and emotional processes within a group context.
  - ✓ Help to explore the degree of consensus on a given topic.
  - ✓ Useful at the preliminary exploratory stage of a study and after a program has been completed.

5. Observation
    - It is a very important method of data collection used in experimental and non-experimental, social and anthropological research.
    - It implies the use of eyes rather than ears and voice in scrutinizing collective behavior.
    - In this method the researcher observe participant in natural and/or structured environment.
    - The investigator obtains the data by watching and noting the phenomena as they occur, with regard to their cause and effect or mutual relations.
    - Observation can be carried out in two types of environment, laboratory observation (done in lab set up by researchers) and Naturalistic observation (done in real world setting).

The researcher should clearly identify and indicate on what specific key variables data are required, the method(s) of measurement and the unit of measurement. The selection of the variables should depend on what is to be done in the study. The researcher should also pay due attention to **the nature of data** (quantitative and /or qualitative, **the kinds of data** (secondary and /or primary data, **the sources of data** and how **to collect** the data. The choice of methods of data collection is largely based on **the efficiency** and **accurac**y with which the information will be collected and its **practicability of the methods** or techniques to the respondents.

3.2.2. **Nature of data**

A .Quantitative data; when the variables being studied in a numerical form and it can be ranked or ordered. SO it said to be quantitative data. Example; height, body temperature, money, age weights, numbers of students in the class, distance from Addis to Agarfa college.

Quantitative data collection methods -rely on random sampling and structured data collection instruments that fit diverse experiences into predetermined response categories. They produce results that are easy to summarize, compare, and generalize.

Quantitative research is concerned with testing hypotheses derived from theory and/or being able to estimate the size of a phenomenon of interest. Depending on the research question, participants may be randomly assigned to different treatments. If this is not feasible, the researcher may collect data on participant and situational characteristics in order to statistically control for their influence on the dependent, or outcome, variable. If the intent is to generalize

from the research participants to a larger population, the researcher will employ probability sampling to select participants.

Typical quantitative data gathering strategies include:

- Experiments/clinical trials.
- Observing and recording well-defined events (e.g., counting the number of patients waiting in emergency at specified times of the day).
- Obtaining relevant data from management information systems.
- Administer surveys with closed-ended questions (e.g., face-to face and telephone interviews, questionnaires etc).

I .Interviews

In Quantitative research (survey research); interviews are more structured than in Qualitative research. In a structured interview, the researcher asks a standard set of questions and nothing more and uses different types of Interviews. These are the followings:

a. Face -to -face interviews has a distinct advantage of enabling the researcher to establish rapport with potential participants and therefore gain their cooperation. These interviews yield highest response rates in survey research. They also allow the researcher to clarify ambiguous answers and when appropriate, seek follow-up information. Disadvantages include impractical when large samples are involved time consuming and expensive.

b. Telephone interviews are less time consuming and less expensive and the researcher has ready access to anyone on the planet that has a telephone. Disadvantages are that the response rate is not as high as the face-to- face interview as but considerably higher than the mailed questionnaire. The sample may be biased to the extent that people without phones are part of the population about whom the researcher wants to draw inferences.

c. Computer Assisted Personal Interviewing (CAPI): is a form of personal interviewing, but instead of completing a questionnaire, the interviewer brings along a laptop or hand-held computer to enter the information directly into the database. This method saves time involved in processing the data, as well as saving the interviewer from carrying around hundreds of

questionnaires. However, this type of data collection method can be expensive to set up and requires that interviewers have computer and typing skills.

II. Questionnaires

a. **Paper-pencil-questionnaires** can be sent to a large number of people and saves the researcher time and money.

People are more truthful while responding to the questionnaires regarding controversial issues in particular due to the fact that their responses are anonymous. But they also have drawbacks. Majority of the people who receive questionnaires don't return them and those who do might not be representative of the originally selected sample.

b. **Web based questionnaires**: A new and inevitably growing methodology is the use of **Internet b**ased research. This would mean receiving an e-mail on which you would click on an address that would take you to a secure web-site to fill in a questionnaire. This type of research is often quicker and less detailed. Some disadvantages of this method include the exclusion of people who do not have a computer or are unable to access a computer. Also the validity of such surveys is in question as people might be in a hurry to complete it and so might not give accurate responses.

Questionnaires often make use of Checklist and rating scales. These devices help simplify and quantify people's behaviors and attitudes. A **checklist** is a list of behaviors, characteristics, or other entities that researcher is looking for. Either the researcher or survey participant simply checks whether each item on the list is observed, present or true or vice versa

. A **rating scale** is more useful when a behavior needs to be evaluated on a continuum

B .Qualitative data: When variables being studied in a non-numeric form it is called qualitative data.

Examples -color, religious preferences sex and, etc

Qualitative data collection methods play an important role in impact evaluation by providing information useful to understand the processes behind observed results and assess changes in people's perceptions of their well-being. Furthermore qualitative methods can be used to improve the quality of survey-based quantitative evaluations by helping generate evaluation hypothesis; strengthening the design of survey questionnaires and expanding or clarifying quantitative evaluation findings.

These methods are **characterized** by the following attributes:

- they tend to be **open-ended and** have **less structured protocols** (i.e., researchers may change the data collection strategy by adding, refining, or dropping techniques or informants)
- they rely more heavily on interactive interviews; respondents may be interviewed several times to follow up on a particular issue, clarify concepts or check the reliability of data
- they use **triangulation** to increase the credibility of their findings (i.e., researchers rely on multiple data collection methods to check the authenticity of their results)
- generally their findings **are not generalization** to any specific population, rather each case study produces a single piece of evidence that can be used to seek general patterns among different studies of the same issue

Regardless of the kinds of data involved, data collection in a qualitative study takes a great deal of time. The researcher needs to record any potentially useful data thououghly,accurately,and systematically, using field notes,sketches,audiotapes,photographs and other suitable means. The data collection methods must observe the ethical principles of research. The qualitative methods most commonly used in evaluation can be classified in three broad categories:

In-depth interview - Is a technique designed to elicit a vivid picture of the participant's perspective on the research topic. During in –depth interviews the person being i**nterviewed** is considered the **expert** and the i**nterviewe**r is considered as the **student**. Researchers engage with participants by posing questions in a neutral manner, listening attentively to participants' responses, and asking follow –up questions and probes based on those responses. In- depth interviews are usually conducting face- to face and involve one interviewer and one participant. In- depth interviews are useful for learning about the perspectives of individuals, as opposed to,

for example, group norms of a community, for which focus groups are more appropriate. They are an effective qualitative method for getting people to talk about their personal feelings, opinions, and experiences. They are also an opportunity for us to gain insight into how people interpret and order the world

2. Observation methods –is a fundamental and highly important method in all qualitative inquiry. Observation entails the systemic nothing and recording of events, behaviors and artifacts (objects) in the social setting chosen for study. The observation record is frequently referred to as field notes-detailed, nonjudgmental, concrete descriptions of what has been observed

3. Document review -Documentation (to document) - is the term used in several different ways. Generally, it refers to the process of providing evidence. Documentation include

- written information for any read, projection or technical performing,
- data media of any format and for any reproduction,
- Other content.

Different ways of collecting evaluation data are useful for different purposes, and each has advantages and disadvantages. Various factors will influence your choice of a data collection method: the questions you want to investigate, resources available to you, your timeline, and more.

3.3 **Clearing and justifying assumptions used in compilations of plant parameter**

Justifying assumption used in compilations of plant parameter we must use one Example of data collected based on plant parameter. So that we used short data analyzed before for more understanding. Title; Effects of Enter and Intra-Row Spacing on Vegetative Growth Performance of Potato (Solanumtuberosum L)

Field data collection and procedure

The plants were picked at random carefully from the middle two ridges and dug out. Data on different components of growth yield and yield components were recorded.

- The detailed methodology adopted for collection of different data is shown below.
    2. Days to flowering: days to flowering were recorded when 50 percent of the plant population in each plot produced flowers.
    3. Days to maturity: According to IBPGR 177VPOV descriptor list, days to maturity was recorded when 50 percent of the plants of different treatments were ready for harvest as indicated by the senescence of the haulms. The days were counted from emergence to maturity of the crop
    4. Plant height: Plant height was measured as the distance in cm from the soil surface to the top most growth point of aboveground at full maturity.
    5. Number of main stem per hill: The actual number of stems per hill was recorded when 50 percent of the plants attained flowering stage.

3.3.3. Experimental design and treatments:

The experiment consisted of six levels of inter row spacing (60, 65, 70, 75, 80 and 85 cm) and three levels of intra row spacing (20, 30 and 40 cm) and was set up in a 6x3 factorial design arranged in RCBD with three replications. Potato varieties called ‘Jalene’ was used in this experiment as it is growing widely in the area and has got acceptance by farmers due to its high yielding and resistance to disease and pest as well as acceptability by consumers.

3.3.4. Data collection and analysis:

Data on growth and yield attributes were collected and subjected to analysis of variance (ANOVA) using SAS computer software version 9.2 (SAS, 2008). When ANOVA showed significant differences, mean separation was carried out using LSD (least significant difference) test at 5% level of significance.

3.3.5. Results and Discussion

Days to 50% flowering: The analyses of variance for the effects of inter row spacing showed significant ($p<0.05$) difference with respect to days to 50% flowering. The inter row spacing 80 cm took 58 days to reach its 50% flowering whereas inter row spacing 60 cm took relatively shorter period of time, 51.55 days to reach this flowering stage **.**Intra row spacing as a main effect or interaction with inter row spacing did not show any significant effect on days to 50% flowering at all. This is probably seedlings in a wider space got sufficient light that promote the transition of vegetative stage to the reproductive stage than those planted in a closer spacing. Plants in a closer spacing may compete for the available light and may remain in a vegetative sage for longer period than plants grown in a wider spacing.

Table 1:Inter and intra row spacing (cm) effect on potato days to 50% flowering

Treatments	Days to 50% flowering
Inter row (cm)	
60	51.55^{c}
65	53.33^{bc}
70	54.44^{abc}
75	56.22^{abc}
80	58.22^{a}
85	57.55^{ab}
LSD (5%)	4.47
Intra row (cm)	
20	53.83 ^{a}
30	56.16 ^{a}
40	55.66 ^{a}
LSD (5%)	3.35
CV (%)	8.97

Means followedby the same letter(s) within the same column are not significantly different at a probability level of 0.05

Days to maturity: The result of analysis indicated that interaction effects of inter and intra row spacing showed significant differences ($p<0.05$) with respect to potato days to maturity (Table 3). Treatment combination inter to intra row spacing of 70x30 and 75x20 cm matured earlier (81 days) as compared to potato planted at the other spacing combinations. A treatment combination of 80x40 cm and 85x40 cm on the other hand were found to mature 91 days after planting.

The results of this experiment is in line with the findings of Mengistu and Yamoah (2010) who reported that increasing plant density fastened days to maturity. As the number of plant per unit area is reduced by increasing the inter and intra row spacing there is a chance of availability of nutrients, light and space that the plants may find to grow more vegetative which extends maturity.

The days to reach maturity are relevant parameter for potato producers in order to develop planning for production season, marketing etc.

Plant height (cm): The analysis of variance of plant height showed significant differences ($p<0.05$) for the interaction effects of inter and intra row spacing (Table 3). The tallest plant height (82.66 cm) was observed in the combination of 80 cm inter row spacing and 40 cm intra row spacing, whereas, relatively shorter plant height (57.33 cm) was obtained in the treatment combination of 60x30 cm inter row and intra row spacing.

The increase in height may be due to better availability of nutrients, water and sun light since plants in wider spacing have less competition and grow more shoots. But, densely populated plants show intensive competition which leads to decrease in plant height. The result of the experiment was in line with the findings of Zamil *et al*. (2010) who reported that the widest spacing enhances growth and height of the plant which was significantly different from narrow spacing. This current finding is also supported by a study made by Gebre and Giorgis (2001). They reported that significant effect of spacing on plant height, as a result of availability of wider inter row spacing for growth factor.

Table 3: Interaction effect of inter and intra row spacing on days to maturity and plant height

Treatments	Maturity (days)	Plant height (cı
60×20	81.66^{fg}	60.66^{def}
60×30	83.33^{d-g}	57.33^{f}
60×40	88.33^{a-d}	61.66^{def}
65×20	88.00^{a-e}	67.33^{bcd}
65×30	88.33^{a-d}	66.33^{b-e}
65×40	84.66^{c-g}	66.00^{b-e}
70×20	85.66^{b-g}	58.66^{ef}
70×30	80.66^{g}	66.00^{b-e}
70×40	84.66^{c-g}	72.33^{b}
75×20	81.00^{g}	64.33^{c-f}
75×30	87.00^{a-f}	64.00^{c-f}
75×40	84.33^{c-g}	64.00^{c-f}
80×20	84.66^{c-g}	66.00^{b-e}
80×30	89.33^{a-c}	70.00^{bc}
80×40	90.66^{ab}	82.66^{a}
85×20	82.66^{efg}	67.00^{bcd}
85×30	89.33^{abc}	64.66^{b-f}
85×40	91.33^{a}	70.00^{bc}
LSD (5%)	5.39	7.95
CV (%)	8.97	7.25

Means followed by the same or no letter(s) within the same column are not significantly different at a probability level of 0.05

Number of main stems (branches): The analysis of variance for the number of main (primary) stem or branches showed that there were no statistical differences ($p>0.05$) with the combination of row and plant spacing (Table 4). Number of main stem or branch per plant were not influenced by plant spacing as reported by different workers Beukema and van der Zaag (1990) but stem number increased as a result of either by planting smaller tuber size or more tuber number per unit area pre plant (Sturz *et al*., 2003). It is a function of seed pieces type as their production was not affected by plant density nor excess application of fertilizers but, can significantly be affected by altering the planting date (Entz and LaCroix, 1984).

Table 3- Interaction effect of inter and intra row spacing on Main steam number

Treatments	Plant canopy (cm)	Main stem number
Inter row (cm)		
60	42.88^{b}	3.0^{ab}
65	48.55^{a}	3.0^{ab}
70	41.77^{b}	2.8^{Bb}
75	43.66^{b}	3.11^{a}
80	46.33^{b}	3.0^{ab}
85	47.00^{ab}	3.0^{ab}
LSD (5%)	4.75	0.18
CV (%)	10.93	6.31
Intra row (cm)		
20	43.27^{b}	3.0^{a}
30	45.88^{ab}	2.94^{a}
40	46.94^{a}	3.0^{a}
LSD (5%)	3.36	0.12
CV (%)	10.93	6.31

Means followed by the same or no letter(s) within the same column are not significantly different at a probability level of 0.05

3.4 Supporting conclusions by evidence

Example, assume that we have six level of treatments and 18 homogenous experimental units. The data obtained from the above plant parameter from the experiment are as follows:

- **Chain of evidence**

External observer can trace steps in either direction

Questions ⟷ Methodology ⟷ Data ⟷ Findings ⟷ Conclusions

3.4.1. Conclusion

Inter and intra row spacing and their interaction had significant effect on the emergence and successful seedling growth for both seed and ware potatoes except that the numbers of main stem are not affected by the number of plant population per plot of land. Potato seedlings require wider spacing for better and early emergence, maturity as well as for most of the growth variables. However, indefinite increases in spacing between plants and rows do not result to further change in these variables rather result to prolonged days to flowering and maturity.

Therefore, for proper emergence and growth of potato for both seed and ware according to this research an inter row spacing of 70-75 and intra row spacing of 20-30 cm can be considered as the best combinations of spacing for potato seedling emergence and establishment provided that tubers meant for seed and ware are planted separately in space or time.

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. Describe chain of evidence?
2. List some plant parameters that data collected from?
3. Justify another assumption of plant parameter?

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

LG #4	LO#4-**Presenting and Documenting Production Data**

Instruction sheet-4

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Preparing data in appropriate format, style and structure
- Using software programs for recording or storing data
- Clearing and conforming structure and format of report
- Reporting and distributing findings
- Obtaining feedback and comments

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Prepare data in an appropriate format, style and structure using suitable technology.
- Clear and conform structure and format of reports to sector requirements.
- Distribute report and findings in accordance with sector requirements
- Obtain Feedback and comments on suitability and sufficiency of findings in accordance with sector requirements.

Learning Instructions:

5. Read the specific objectives of this Learning Guide.
6. Follow the instructions described below.
7. Read the information written in the information Sheets
8. Accomplish the Self-checks

Information Sheet - 4

4.1 Preparing data in appropriate format, style and structure

Data preparation and entry is the early stage in which the data about the study phenomena is collected and prepared to enter into the system. **Data presentation** is the final stage in which the results of earlier analysis are presented in an appropriate way

Data presentation /Summarizing Tools

- ✓ **Tables**
  - Simplest way to summarize data
  - Data are presented as absolute numbers or percentages

e.g .Tables: Relative frequency

$$\frac{\text{Number of values within an interval}}{\text{Total number of values in the table}} \times 100$$

Year	# insect (n)	Relative frequency (%)
1900–1909	35	27
1910–1919	46	34
1920–1929	51	39
Total	132	100.0

- ✓ **Charts and graphs**
  - Visual representation of data
  - Data are presented as absolute numbers or percentages

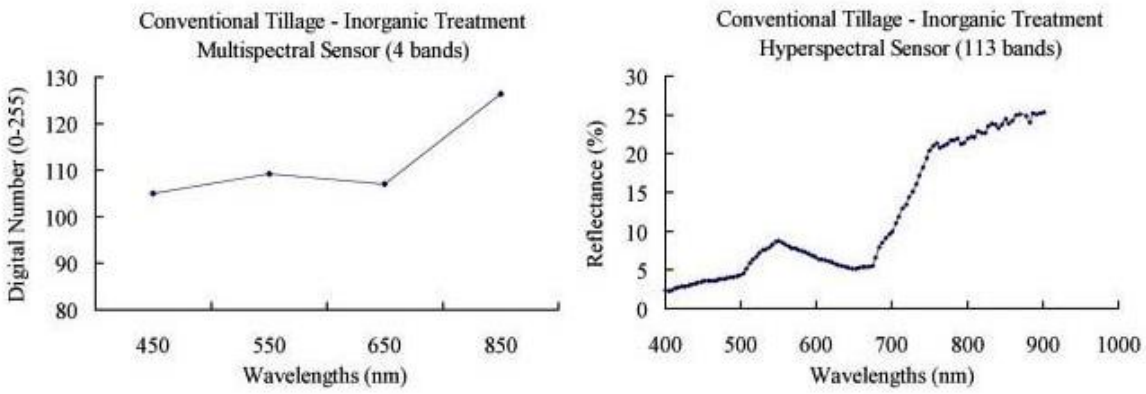


Fig. 4.Data extracted from multispectral and hyper spectral images collected on the Spectral curves correspond to conventional tillage-inorganic treatment

Basic guidance when summarizing data

- Ensure graphic has a title
- Label the components of your graphic
- Indicate source of data with date
- Provide number of observations (n=xx) as a reference point

Add footnote if more information is needed

4.2 **Using software programs for recording or storing data**

Remote sensing

Remote sensing is the process of gathering information about an object without direct physical contact. Passive remote sensing systems use solar radiation as a source to collect information about objects, based on the principle that visible (VIS, 400-700 nm), near infra-red (NIR, 700-2500 nm) and mid infra-red (MIR, 3000-5000 nm) light is absorbed, transmitted or reflected, and that in the thermal infra-red region (TIR, 7500-14000 nm) heat is emitted. Passive systems can also obtain information of gamma rays emitted from the Earth surface with wide application in geological surveys.

Active systems use either TIR or an artificial source of radiation as in the case of synthetic aperture radar. Currently, RS systems used in agriculture are mounted on space airborne-, and/or on ground-platforms. Spectra are collected using either multispectral or hyper spectral sensors, covering VIS, NIR, and/or TIR. Each band gives different information about the object under observation. Figure 2 below shows an airborne multispectral image and its

spectral bands, collected over a field in Japan where crop response to two types of tillage interacting with two types of nutrients is investigated. From these images it is clear that each band gives different information about treatments in the field.

While multispectral images use non -contiguous or wide bands in the VIS and NIR regions, hyper spectral images contain from 10 to hundreds of contiguous bands. The dimensionality of hyper spectral images allows the identification of bands most responsive to specific target characteristics and the potential for the improvement of classification analysis (Figure 4). Hyper spectral remote sensing is also known as imaging spectroscopy since it combines imaging and spectroscopy in a single system.

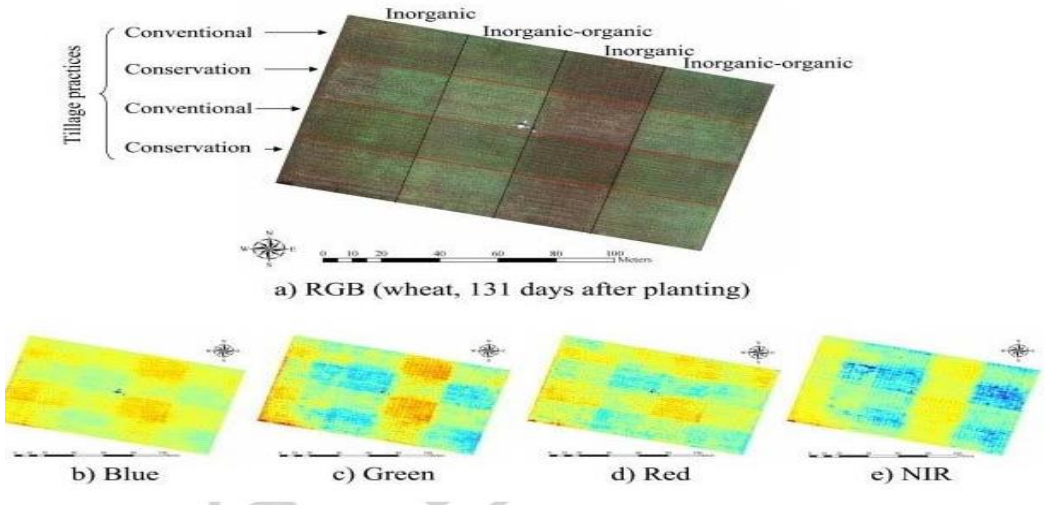


Fig 2.Multispectral airborne image and its spectral bands collected over an experimental field in Japan.

Geographical information system (GIS)

GIS is defined as a computerized system that facilitates the phases of data entry, data analysis and data presentation especially in cases when we are dealing with geo-referenced data. In general, GIS provides the four sets of capabilities to handle geo-referenced data. These are:

- Input
- Data management (data storage and retrieval)
- Manipulation and analysis
- Output

Why is GIS

GIS is important to analyze different types of geographical phenomena using different software packages for better understanding. It makes the observation to state what it is and where it is. GIS supports to represents the geographic phenomena digitally in computer.

GIS Data sources

Sources of geographic data can be obtained

- By digitizing
- Keyboard entry, for entering tabular data
- Scanning (images, aerial photo, maps and pictures)
- Importing form other sources
- Collecting by GPS

Global Positioning System (GPS)

GPS (a Global Positioning System) is satellite -based navigation Initially, GPS was developed for military purpose Now days can be accessed by both military and civilian users . GPS is used for navigation, cadastral surveying, finding route and locations. GPS provides continuous positioning and timing information ,anywhere in the world under any weather conditions. GPS consists, nominally of a constellation of 24 operational satellites. Depending on the type of receiver and the method used ,GPS can provides position information with an accuracy from 100m to less than 1cm

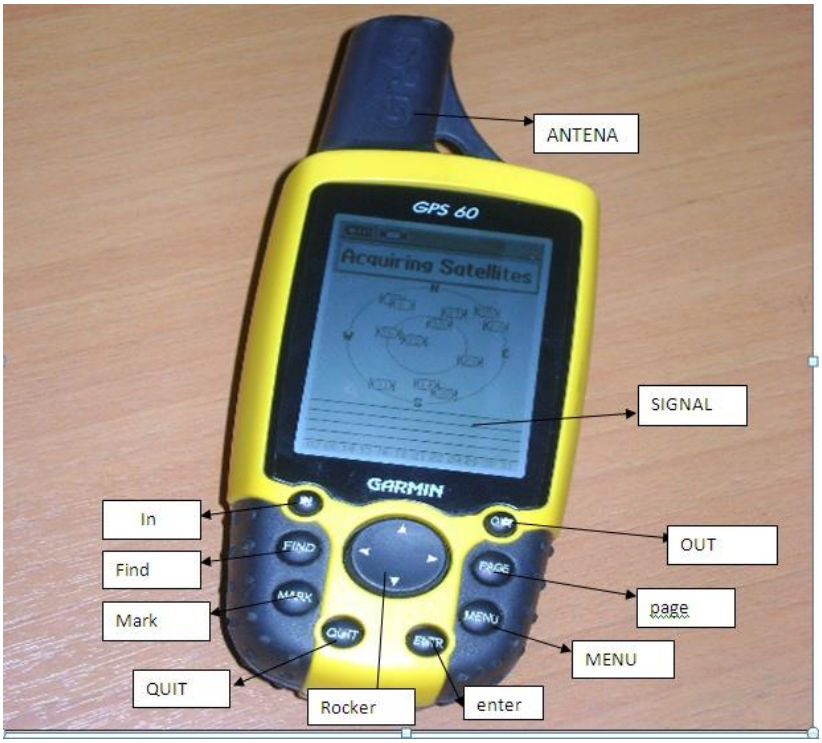


Fig .3.GPS

4.3 Clearing and conforming structure and format of report

The key elements of a report

Make sure your report contains all the right elements. Every report should have the

- Title page
- Title page
- Table of contents
- Executive summary
- Introduction
- Discussion
- Conclusion
- Recommendations
- References
- Appendices

Table of contents

This is optional depending on the length of the report—a 2 to 3 page report probably wouldn't have a table of contents but a 10 to 20 page report would.

Executive summary

- ✓ An executive summary is a brief overview of a report that is designed to give the reader a quick preview of the report's contents. Its purpose is to present the key points of a report in one place. After reading the summary, your audience will understand the main points you are making and your evidence for those points without needing to read your full report.
- ✓ It explains why you wrote the report, emphasises your conclusions or recommendations and includes only the essential or most significant information to support those conclusions
- ✓ Executive summaries are usually organised according to the sequence of information presented in the full report, so follow the order of your full report as you discuss the reasons for your conclusions
- ✓ Executive summaries are usually proportional in length to the larger work they summarize, typically 10 to 15 percent. Most executive summaries are 1 to 2 paragraphs.
- ✓ Write the executive summary after you have completed the report and have decided on your recommendations.
- ✓ Review your report and identify the key points and use these to organise a draft of your summary
- ✓ Make the summary concise, but be sure to show how you arrived at your conclusions
- ✓ Don't introduce any new information that is not in your report
- ✓ Executive summaries should communicate independently from your report

Introduction

The introduction should:

- ✓ briefly describe the context and background to the research
- ✓ describe the change, problem or issue to be reported on
- ✓ define the specific objectives and purpose of the report
- ✓ indicate the overall answer to the problem explored in the report
- ✓ outline the report's scope (the extent of the investigation, also known as its terms of reference or brief)
- ✓ preview the report structure
- ✓ Comment on the limitations of the report and any assumptions that are made.

Discussion

This is the main body of the report and it has two key purposes:

- ✓ to explain the conclusions
- ✓ to justify the recommendations

Key points to remember when you are writing the discussion include the following

- ✓ Present the analysis in a logical and systematic way
- ✓ If necessary, divide the material with appropriate headings to improve the readers' understanding
- ✓ Back up your claims with evidence—explain your findings
- ✓ Link theory to practical issues
- ✓ Persuade readers of the validity of your stance

Conclusion

The conclusion should:

- ✓ be arranged so that the major conclusions come first
- ✓ identify the major issues relating to the case and give your interpretation of them
- ✓ relate specifically to the objectives of the report as set out in the introduction
- ✓ be a list of numbered points
- ✓ follow logically from the facts in the discussion
- ✓ be clean-cut and specific
- ✓ be brief

Recommendations

Your recommendations point to the future and should be:

- ✓ action-oriented
- ✓ feasible
- ✓ logically related to the discussion and conclusion
- ✓ numbered
- ✓ arranged in order of importance
- ✓ brief

References

Appendices

Include in the appendices any essential extra material, such as tables and graphs that support your research but don't relate directly to the discussion of your findings.

4.4 Reporting and distributing findings

Types of reporting tools

- **Table**
  - Simplest way to summarize data
  - Data are presented as absolute numbers or percentages
- **Charts and graphs**
  - Visual representation of data
  - Data are presented as absolute numbers or percentages

Dispatching information

Once information is collected, it is important to collate it according to the type of information required, who requires it and when the information is needed. Collated information needs to be presented in an appropriate manner, so it is important that a cover page sets out the purpose and/or contents of the file, the documents/pages are in the correct order, enough copies are provided, it is bound according to the amount of information/pages in the file and if the information is confidential, that it is identified accordingly. Once collated this information can be dispatched by any of the following methods

http://www.workawesome.com/

internal mail – sending letters or packages between departments or agencies of the same organization which are located in different suburbs using an internal mail service

- placing information in an in-tray/inbox
- hand delivery – to the person requesting the information
- postal service – generally Australia Post (registered if confidential)
- fax transmission
- courier service – for door-to-door delivery or for delivery to a specific person
- email

4.5. Obtaining feedback and comments

What is Customer Feedback?

Customer feedback is information provided by customers about their experience with a product or service. Collecting customer feedback can help product, customer success, customer support, and marketing teams understand where there is room for improvement.

Feedback can be collected proactively by polling and surveying customers, interviewing them, asking for reviews, or implementing the right tools that collect implicit feedback. The pertinent question now is: howdo you utilize these channels to actually learn from the feedback? Before you establish the viability of a channel, it is crucial to develop a clear picture of WHY you are collecting feedback.

Why should you gather customer feedback?

Simply put, you cannot succeed without listening to your customers. How do you know if what you are doing is right or wrong? How do you know the way your customers are reacting? Customer feedback is the guiding light for your company. It not just helps improve your product, but impacts every part of your business. Be it marketing, sales, or customer service, customer feedback helps you understand what your customers truly like and dislike. Being close to your customers will set you on a growth trajectory that you haven't experienced before.

But remember, there is no one-size-fits-all tactic to gain information from your users. Different situations require different methods of collecting customer feedback. Now, let's find out what are the best methods of collecting customer feedback:

The best ways to collect customer feedback

There are hundreds of survey tools to collect feedback from customers. Here, we'll talk about the most popular and effective ways to ask customers for feedback.

1. Long form-based surveys

Customer feedback surveys are the most common way of completing the feedback loop. It usually includes sending a set of questions through email. The more questions your customer survey has, the less time your respondents spend, on average, answering each. The take away is to make the survey as short as possible.There is, however, no 'ideal' length for a survey. A few experts do say that anything between 5 and 10 questions is a decent number. To keep your surveys short, a good rule of thumb to keep in mind is: only ask questions that fulfill your end goal. Ensure that every question serves a clear purpose.

If you do not intend to use the information, do not ask that question. The aim is to collect customer feedback and not to have them write an essay. A great open-ended question is: 'What do you love the most about the product?. It is also a great hook to have your respondents start the survey on a positive note. When to use form-based surveys to collect customer feedback .

The best place to use this is when we want detailed inputs and have some open-ended questions to ask.

2. Short in-app surveys

Customers are constantly thinking of ways your product can work better for them. Maybe parts of your app do not have what they are looking for, or maybe the design could look a little better, or maybe they found something that is broken. More often than not, they will not reach out to you at your support address. That happens only when the problem is big. A great idea is to offer a survey while your customer is using your app. The survey can be prompted the moment a user has finished interacting with a particular feature in the app. Since the user is already in the process of using that feature, it is very likely that their feedback will be very precise and to the point, and not ambiguous.

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

4. What is Customer Feedback?
5. Write appropriate ways of data presentation /summarization
6. Write the key elements of a report
7. Write two key purposes discussion
8. Write the software program used for data collection and storage

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Reference Materials

Joseph Opio-Odongo .1982. Agents of change: the role of professionals in rural transformation

Calogero Carletto .2021.Better data, higher impact: improving agricultural data systems for societalchange

Web addresses

https://nap.nationalacademies.org/read/11990/chapter/7#106 (accessed date 01/09/22)

https://www.eolss.net/sample-chapters/c10/E5-17-05-02.pdf(accessed date 01/09/22)

https://hiverhq.com/blog/collect-customer-feedback(accessed date 01/09/22)

https://www.cabi.org/gara/mobile/FullTextPDF/2017/20173009615.pd f **(accessed date 01/09/22)**

https://aspiresolidusproduction.s3apsoutheast2.amazonaws.com/assets/BXINM201/samples/BXINM201.pdf (accessed date 01/09/22)