Crop Production

Level-II

Based on March 2022, Version 4 Occupational standard

Module Title:-Applying Interpreted Weather Data And Minimizing Crop Production Risks

LG Code: AGR CRP1 M07LO (1-3) LG (33-35)

TTLM Code: AGR CRP1 M07TTLM 0922v1

September, 2022

Addis Ababa, Ethiopia

Table of Contents

Introduction to the Module

This module covers the knowledge, skills and attitude required to assess weather and production data, identify weather and crop production data risk and opportunities and prepare weather and crop production risk management

LG #33	LO #1- Assess Weather and Production Data

Instruction sheet
This learning guide is developed to provide you the necessary information regarding the following content coverage and topics: • Obtaining and interpreting historical weather data • Identifying weather and crop production risk factors • Collecting information on normal and significant weather events and their impact • Detailing current and historical property and crop production situation • Reviewing short- and long-term sector goals • Sourcing, presenting and updating weather and production data 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: • Obtain and interpret historical weather data • Identify weather and crop production risk factors • Collect information on normal and significant weather events and their impact • Detail current and historical property and crop production situation • Review short- and long-term sector goals • Source, present and update weather and production data
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
5. Perform Operation Sheets
6. Do the “LAP test”

Information Sheet 1

1.1 Obtaining and interpreting historical weather data

Definition

I. Weather:

- State of the atmosphere at a particular time and place
- Highly variable over time and space, that constantly changes every hour and/or day
- Weather condition is the collection of values of weather variables at a given time and place
- All weather systems have well-defined cycles and structural features governed by the laws of heat and motion

II. Climate

- The average weather of a particular region over a long period of time.
- It is the fluctuating aggregate of the atmosphere conditions characterized by the state of the weather of a given area
- Climate includes averages and variations of all-weather elements for at least 30 years if sufficient data is available

Historical climate data could be used in many different ways that help us understand the drivers of observed climate variability and change. For example, it could help in determining whether observed changes in agricultural productivity are linked to variations in climate or some other factor, such as soil degradation. It can also support informed decision-making in agricultural practices. For instance, historical climate information can help in deciding on appropriate times for land preparation, selection of seed or animal breeds, planting, weeding, application of fertilizer, and control of pests and diseases.

Historical Weather Data is a database of the past weather conditions in a particular region. This record can include multiple weather variables such as temperature, rainfall, wind direction and speed, humidity, and barometric pressure. Historical weather data can be as recent as weather information from a week ago. However, it usually stretches back years, decades, and even centuries. The longer and the more detailed the record is, the more valuable it is to the meteorologist.

In the field of meteorology, this historical weather data is crucial not just for understanding current weather conditions but also to assist with the prediction of future weather conditions and events (weather forecasts).But for those of us with our own personal weather stations, gathering historical data is just as important to help us understand and forecast the weather specificity region to best understand its true value, we need to understand how meteorologists go about calculating and predicting weather conditions.

Weather and climate interpretations

Climatology is the scientific study of climates, which is defined as the mean weather conditions over a period of time. A branch of study within atmospheric sciences, it also takes into account the variables and averages of short-term and long-term weather conditions. Climatology and Weather Forecasting is important since it helps determine future climate expectations. Through the use of latitude, one can determine the likelihood of snow and hail reaching the surface. You can also be able to identify the thermal energy from the sun that is accessible to a region.

Meteorologists use a multitude of readings from sensors and devices around the planet to collect weather data. This includes sensors on the ground, in the ocean & air, and also space to collect the data needed for them to make important decisions and accurate forecasts. Land-based radar systems, remote weather stations, ocean buoys, weather balloons, and satellites are just a few examples of sources of data that are all captured and processed by a weather service. Historical weather data is so important in not just observing and understanding current weather, but especially for predicting future weather conditions**.** Historical and forecast weather data is perhaps the most valuable information available to a scout, as crop and pest development are strongly influenced by temperature and moisture.

1.2 Identifying weather and crop production risk factors

Production risk derives from the uncertain natural growth processes of crops and livestock. Weather, disease, pests, and other factors affect both the quantity and quality of commodities produced. There are different risk factors that affect agriculture production. These are:-

a. Crop pests

Along with other crop pests, weeds are expected to pose a significant challenge to global food security in coming decades, and thus a range of strategies including the development of genetically modified herbicide- and pest-resistant crops. The speed and the spread (outbreak) of diseases and pests prevailing in agricultural areas are the function of weather variables. Rainy weather associated with reduced evaporate transpiration usually favors development of plant diseases and pests. Weather affects for instance, the insect biology and its influence on crop productivity.

b. Landslides

A landslide is defined as the movement of a mass of rock, debris, or earth down a slope. Landslides are a type of "mass wasting," which denotes any down-slope movement of soil and rock under the direct influence of gravity. The term "landslide" encompasses five modes of slope movement: falls, topples, slides, spreads, and flows. These are further subdivided by the type of geologic material (bedrock, debris, or earth). Debris flows (commonly referred to as mudflows or mudslides) and rock falls are examples of common landslide types.

Almost every landslide has multiple causes. Slope movement occurs when forces acting down-slope (mainly due to gravity) exceed the strength of the earth materials that compose the slope. Causes include factors that increase the effects of down-slope forces and factors that contribute to low or reduced strength. Landslides can be initiated in slopes already on the verge of movement by rainfall, snowmelt, changes in water level, stream erosion, and changes in ground water, earthquakes, volcanic activity, disturbance by human activities, or any combination of these factors. Earthquake shaking and other factors can also induce landslides underwater. These landslides are called submarine landslides. Submarine landslides sometimes cause tsunamis that damage coastal areas. Human activities can be a contributing factor in causing landslides. Many human-caused landslides can be avoided or mitigated. They are commonly a result of building roads and structures without adequate grading of slopes, poorly planned alteration of drainage patterns, and disturbing old landslides.

Figure 1.1. Different types of Landslides

c. Crop failed

Crop failure, which is defined as the complete loss of crops on a farm has received more attention from researchers. Crop failure happens more in catastrophic weather conditions in which the crops are wiped out by pests, floods or droughts, whereas abandonment is at a marginal level and is a decision made by the farmer to stop cultivation of the field or some part of the field post-planting even when it is still viable due to some poor performance of the crop and committing to other crops the limited labor and other inputs where the prospects of better yields are higher. a failure of crops to yield sufficient food, etc., to maintain a community or to provide a surplus to sell. Researchers found an almost total crop failure and a severe shortage of drinking water. One major component of crop failure predictions is water scarcity. In a warmer world, water is a critical resource. Climate change will shift precipitation patterns, drying out some regions and inundating others. Most of the world's breadbaskets are headed in the drier direction.

Figure 2 pictures of crop failed due to scarcity of rain fail

d. Soil erosion

Soil erosion is a naturally occurring process that affects all landforms. In agriculture, soil erosion refers to the wearing a way of a field's topsoil by the natural physical forces of water and wind or through forces associated with farming activities such as tillage. Erosion, whether it is by water, wind or tillage, involves three distinct actions – soil detachment, movement and deposition. Topsoil, which is high in organic matter, fertility and soil life, is relocated elsewhere "on-site" where it builds up over time or is carried "off-site" where it fills in drainage channels. Soil erosion reduces cropland productivity and contributes to the pollution of adjacent watercourses, wetlands and lakes.

Soil erosion can be a slow process that continues relatively unnoticed or can occur at an alarming rate, causing serious loss of topsoil. Soil compaction, low organic matter, loss of soil structure, poor internal drainage, salinization and soil acidity problems are other serious soil degradation conditions that can accelerate the soil erosion process.

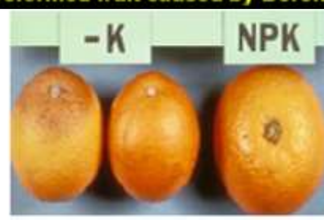
Figure 1.3 The erosive force of water from concentrated surface water runoff.

Figure 1.4. The erosive force of wind on an open field

e. Nutrient deficiency

Nutrient deficiency symptoms occur as yellowing of leaves, inter venial yellowing of leaves, shortened internodes, or abnormal coloration such as red, purple, or bronze leaves. These symptoms appear on different plant parts as a result of nutrient mobility in the plant.

Potassium deficiency



Potassium deficiency

Potassium deficiency

1.3 Collecting information on normal and significant weather events and their impact

You often hear on the radio and TV or in the newspapers that extreme weather events such as floods, storms and typhoons have affected hundreds of people and damaged buildings, water supplies and sanitation facilities. Extreme weather events are expected to increase in the future because of climate change. Knowing what extreme weather events occur in Ethiopia can help WASH workers plan and prepare to reduce the impacts. Extreme weather' and learn about three types of extreme weather event that occur in Ethiopia: floods, droughts and heat waves, and also about wildfires, which are not themselves weather events but are associated with very dry weather.

Weather varies from day to day, month to month and year to year. Most of the time, these fluctuations occur within a normal range. Some periods are hotter, colder or wetter than others, but these variations are not unusual. Extreme weather events are periods of weather outside the normal range of weather conditions. For example, floods that happen because of excessively high rainfall, or droughts, or heat waves and wildfires resulting from a period of unusually high temperature, are extreme weather events.

We expect certain weather in different regions of Ethiopia – hot and dry in the lowland areas, but cooler and wetter in the highlands. We expect some areas to flood and some areas to have drought from time to time. Globally, there are many types of extreme weather events, but we will focus on floods, droughts, heat waves and wildfires because they are the most likely to affect Ethiopia.

i. Floods

Floods are extreme weather events that have had major effects in Ethiopia at different times and in different locations. In recent decades, major floods outside the normal pattern of flooding have occurred in Ethiopia with increasing frequency. They have been responsible for many deaths of people and livestock, and caused damage to homes, livelihoods and infrastructure in many parts of the country. Major flood events in 2005 and 2006, which were the worst in recent years in terms of deaths and economic damage in Ethiopia.

Figure 1.5 Homes damaged by the 2006 flood in Gambela town, Ethiopia.

ii. River floods and their causes

River floods occur when the water level rises and water spills over the top of the river banks. The overflow runs into nearby low-lying areas, where it collects as flood water (Douben, 2006). River floods in Ethiopia generally occur because of intense heavy rain at high altitudes, which results in water flowing down into lowland rivers, which then burst their banks. Unlike flash floods, river floods tend to build up slowly, but they remain for much longer periods. Figure 10.2 shows river floods in Dire Dawa and Gambela

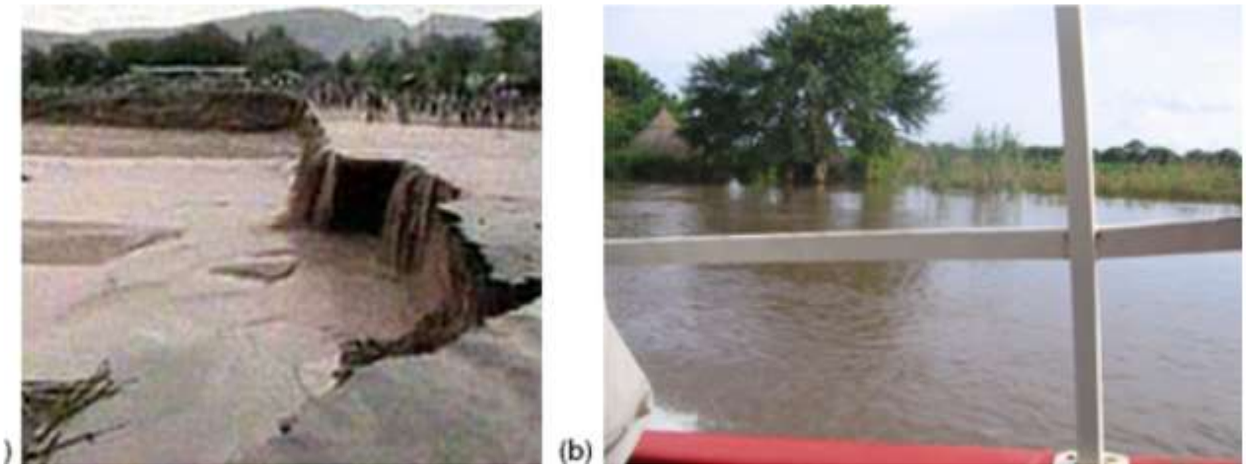


Figure 1.6 Floods in (a) DireDawa and (b) Gambela in 2006, resulting from the overflow of the Dechatu and Gambela rivers respectively.

iii. Drought

Drought is the absence of rain for an extended period, often for a season or more. Climate change is associated with the significant reduction in rainfall and increase in droughts that is already apparent in some parts of Ethiopia. Droughts have caused loss of human life, livestock and property, as well as migration of people.

More than 85% of the population of Ethiopia are farmers. Most of the agriculture in the country is small scale and therefore highly dependent on rainfall and traditional technologies. Drought affects agriculture by damaging crops and decreasing crop yield, which causes food shortages not only in rural areas but also in towns and cities. In the worst periods of drought there may be widespread famine, when the extreme shortage of food results in many deaths. The drought that occurred in 1984, leading to a famine that killed more than one million people, is still fresh in the memories of many Ethiopians.

Figure 1.7. Crop failure due to drought in Ethiopia.

1.4 Detailing current and historical property and crop production situation

Current climate.

Ethiopia's topography is characterized by large regional differences, which are reflected in its climate. The lowlands in the southeast and northeast are tropical with average temperatures of 25-30°C, while the central highlands (over 1500 meters in elevation, covering about 45% of the country's surface) are much cooler with average temperatures around 15-20°C. The highland plateau is divided by the East African Rift Valley.

Ethiopia is one of the countries that are most vulnerable to the impacts of climate variability and change on agriculture. The sensitivity of Ethiopia's agriculture to climate arises from the fact that it is primarily rain fed and practiced by smallholder farmers who have limited capacity to respond to climate variability and extremes. Climate variability, particularly rainfall variability and associated droughts, have been major causes of food insecurity and famine in Ethiopia.

The parts of Ethiopia that experience higher variability are also characterized by higher probability of crop failures. The Belg season suffers from greater rainfall variability than the Kiremt season and most Belg season growing areas (eastern, north eastern and southern part of the country) are suffering from unreliable onset of the season and frequent crop failures.

1.5 Reviewing short- and long-term sector goals

Seasonal forecast it is important to understand that forecasts are made at different tome scales and horizons, from the familiar weather forecasts to climate change projections. Different forecasts are based on different premises. For example:

Weather forecast predicts the short-term evolution of atmospheric conditions over a period of a few days and is mostly based on our knowledge of current atmospheric conditions.

Seasonal forecasts predict the climatic conditions several months ahead and are based on the fact that warmer or cooler sea surface temperatures, such as in the case of ENSO or IOD, impact large scale circulations that bring moisture into the continents and impact rainfall.

Climate Change projections attempt to predict the evolution of climate several decades ahead and are based on the change of atmospheric composition thus the change in the energy that our climatic system receives and redistributes via global ocean and atmosphere circulations and uses to melt the ice and increase the temperature of the oceans and continents.

It is important to understand that the longer the horizon of the forecast, the greater the uncertainty and the less precise the forecast in terms of spatial and temporal resolution as well as amounts.

Weather conditions impact a wide range of the agriculture industry. The impacts of weather help to determine when and what crops a producer decides to plant when chemicals and fertilizers are applied. On the other end of the spectrum, weather conditions determine how much supply of a specific crop occurs each year. Weather forecasts can be used to ensure that fertilizer is applied in the right conditions—when it's dry enough so that it doesn't wash away (which would create a waste of resources and money) but moist enough so that it gets worked into the soil.

Key constraints to agricultural productivity in Ethiopia include low availability of improved or hybrid seed, lack of seed multiplication capacity, low profitability and efficiency of fertilizer use due to the lack of complimentary improved practices and seed, and lack of irrigation and water constraints. The world is facing a threat from climate warming despite the degree of the impact and its distribution is still debatable

- Countries in temperate and polar locations may benefit their agricultural sectors from the additional warming.
- However countries in tropical and sub-tropical regions are vulnerable to warming because additional warming will affect their marginal water balance and harm their agricultural sectors.

The problem is expected to be most severe in Africa where:

- information flow is the poorest
- technological change is the slowest, and
- water supply variability is common,
- soil degradation , and
- recurring drought events
- the domestic economies depend the most heavily on agriculture

1.6 Sourcing, presenting and updating weather and production data

As a mandated government institution, Ethiopia's National Meteorological Agency (NMA) regularly provides weather and climate information for different users and sectors, the main one being that of agriculture. This information is provided through different channels that includes newspapers, television, radio, weather bulletins, emails, social media, word of mouth, and through its web page. This section provides a brief overview of the NMA's web page. The official web page of the NMA1 offers a wealth of information about the NMA (history, mission, strategies, reports, etc.) and climate data and information products. These products include information on how to request data; daily, three-day,2 and ten-day sub-seasonal and seasonal climate forecasts; satellite images; different types of bulletins3 ; and the ENACTS map room. Some of these products, such as all the bulletins and sub-seasonal and seasonal forecasts, can also be downloaded in PDF format allowing them to be shared offline with users such as farmers that do not have constant internet access. Users (stakeholders, users, farmers, research/sector professionals) are encouraged to explore this webpage to be used for agricultural, policy, and other decision-making. Short-term forecasts or monthly climate projections for agricultural producers are usually preferred by farmers when making agricultural decisions. The use of non-forecast climate information on seasonal pattern analysis, i.e., historical climate information, long-term climate outlooks, and decision calendars, can also be valuable as a practically useful reference for cultivation tasks and agricultural risk management. The seasonal pattern of weather types requires probing into years of historical data of various weather factors, and feature patterns can be extracted through effective and efficient data-mining techniques to explore more information that might not otherwise be disclosed.

The investigation of weather features and historical meteorological data throughout the year can be a reference for agricultural decisions in various cultivation activities, such as species selection, planting, harvesting, transplanting, defoliation, fertilization, and irrigation. In addition, necessary precautions can be further adopted to preempt crop stress control, sheltering, disease risk reduction, and pest control, as well as to explore sustainable resource mechanisms in terms of collection, storage, and utilization.

Three types of production data:

A. **Station data** are exact measurements in a given location, mostly at the surface of the Earth, although radar and stationary balloons also record information about the atmosphere above. However, there are regions of the globe with very few stations making the measurements.

B. **Gridded data** partition Earth's surface in small squares and attributes a value of a weather/climate variable to each square. In this way Earth's surface is evenly covered with values, even in places where there is no observation. The way in which the values in places without observations are derived depends on the dataset and its specifics and ranges from a simple mean of closest observed values to more complex methods that include, for example, the elevation. The advantage of such datasets is that there are no areas without values which helps with a lot of analyses.

3. **Satellite data** is a special class of gridded data. Satellites can observe vast swaths of Earth and atmosphere, even in remote, hard to access oceanic areas. However, they too have some issues: There are different types of satellites – some orbit around the Earth and pass over the same place approximately every 15 days. This means that they measure weather/climate variables every 15 days. Some are stationary over a given place, which means that they observe every minute the conditions in that place and a circle of several kilometers around but there is not enough of them to have measurements covering the entire globe.

Satellites make observations from a very long distance and the measurements can be affected by what is going on between the satellite and Earth's surface. For example, on a cloudy day they don't 'see' Earth's surface thus cannot measure surface temperature. Similarly, they will have difficulties having exact values of temperature if there is a lot of pollution or smoke.

Self-check 1	**Written test**

Name…………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below.

Test I: Short answer questions (3pt each.)

1. Define weather and climate?
2. What is the main difference between weather and climate?
3. What are the mechanisms that used to reduce crop production risks?

4. What is the impact of drought on agriculture?

5. What are the source of information about weather?

6. List at least four crop production risk that affect crop yield?

Note: **Satisfactory rating – 9 points** **Unsatisfactory – below 9 points**

LG #34	LO #2- Identifying weather and crop production data, risk and opportunities

Instruction sheet
This learning guide is developed to provide you the necessary information regarding the following content coverage and topics: • Collecting and forecasting of seasonal weather data • Identifying weather opportunity risks • Determining impact on production of different weather and risk factors • Identifying and developing qualitative and quantitative risk and opportunities • Evaluating importance of weather variability and significant production events • Outlining tactics to address a range of different weather variability, production risks and opportunities • Identification of contingency options for production and the risk factors 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: • Collect and forecast of seasonal weather data • Identify weather opportunity risks • Determine impact on production of different weather and risk factors • Identify and developing qualitative and quantitative risk and opportunities • Evaluate importance of weather variability and significant production events • Outline tactics to address a range of different weather variability, production risks and

opportunities Identify of contingency options for production and the risk factors
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 5. Perform Operation Sheets 6. Do the “LAP test”

Information Sheet 2

2.1 Collecting and forecasting of seasonal weather data

Weather data includes any facts or numbers about the state of the atmosphere, including temperature, wind speed, rain or snow, humidity, and pressure. These days, we have some amazing ways to collect this kind of data. We have high-tech equipment that can measure everything with amazing accuracy. And, we can measure it from all sorts of places: the ground, the air, and even from space. In this lesson we are going to talk about some of the equipment we use to take these measurements and why making measurements from different locations is helpful.

Data Collection Devices

Meteorologists use all kinds of equipment to measure the weather. These include thermometers, radar systems, barometers, rain gauges, wind vanes, anemometers, and hygrometers. Let's go through them one at a time and talk about what they do.

Thermometers are probably the most well-known weather data device. They measure the temperature by allowing a liquid inside the thermometer to expand as it gets hotter and contract as it gets cooler. There are also digital thermometers in wide use.

Radar systems are used to create maps of rain and snow and measure the motion of rain clouds. This works by bouncing radio waves off the clouds and measuring how long it takes for them to return.

Barometers are devices that measure the pressure in the atmosphere. Pressure is how thick the air is: how much air can be found in a particular volume. For example, the higher up a mountain you go, the less air there is. These devices can be quite simple and generally involve a liquid which gets pushed up or down an inverted tube depending on how strong the atmospheric pressure is.

Rain gauges are also very simple, and measure how much rain falls into a container.

Wind vanes are simple sails that get pushed by the wind to show the wind speed. These work alongside **anemometers**, which measure wind speed by catching the wind in a cup-shaped container causing a dial to turn.

Last of all, **hygrometers** measure the humidity (how much water the air contains) at a particular location. They work in lots of different ways, but one way is by measuring how easily the air conducts electricity, since water conducts electricity better than air itself.

- **What is weather forecasting?**
-
- Weather forecasting is the prediction of atmospheric conditions based on location and time. Every location will have its weather projections, making it relatively simple for farmers to know how and when to move. As a result of the interaction between weather and agriculture, precise weather forecasting is required for farmers to make informed decisions that will not result in losses. Temperature, sunlight, and rainfall all have a significant impact on crops. Temperatures, as well as proper water and food, are critical for animals. In simple words, weather forecasting can be roughly understood as a prediction or a statement indicating how and what will be the weather likely be the next day or the next few days.

Types of weather forecasting.

1. Short-range weather forecasting

This forecast will be valid for 1-2 days. The weather has a huge impact on people's daily routines, food production, and personal comfort zones. Forecasting is important in the planning of existing and future operations. As a result, several other factors could have a significant impact on the forecasting results. Accurate forecasting, on the other hand, is critical. Forecasting is a useful tool for a variety of investigations. The most accurate global model is the ECMWF. The ECMWF outperforms the GFS by a wide margin.

2. Medium range weather forecasting

This type of prediction might last anywhere from 3-4 days to 2 weeks. Following the nature of the firm, medium-term predictions are created for modest strategic resolutions. They are particularly essential in the domain of corporate planning and development, and firm budgets are determined based on this forecast. Inaccurate forecasting can have major consequences for the rest of the company; the company will be obliged to keep unsold goods and will have to spend more money on production

3. Extended range weather forecasting.

This type of forecast is valid for a period ranging from ten days to four weeks. This kind of forecast is employed in a variety of fields, including agriculture. This form of forecast is mostly used to indicate divergence from the normal.

Top 5 Reasons why weather forecasting is important in farming.

Seasons and weather play a major role in agriculture and farming. When it comes to the growing of various fruits, vegetables, and legumes, the temperature is quite important. Farmers may now get all their updates on their smartphones, thanks to advances in technology and the availability of advanced weather forecasting mechanisms. Clear weather is required for sowing operations, it must be preceded by seed zone soil moisture storage. Crop weather factors mean that crops and cropping practices vary across areas within the same season. The effects of unseasonal temperature variations, as well as their potential negative impacts on host plants and pests, are well understood. Unseasonably high temperatures on the farm may result in poorer plant productivity and an increase in pests. To safeguard the farm and crops from insects, pests, and disease control is necessary. Farmers can use weather forecasts to choose when to apply pesticides and insecticides to avoid crop loss. Climate-smart pest management is a multi-sectorial strategy aimed at drastically reducing pest-related crop losses.

1**. Weather Forecasting and Fertilizer's Timing Relation**

Weather forecasting helps the farming to know when the correct time is to apply fertilizer along with the application rate and type of fertilizer. The bad timing of fertilizer and its application may spoil the crop's growth. The field must be dry enough for the fertilizer to not wash away, but moist enough for the fertilizer to penetrate the soil. Working in the field has its good and terrible days. This is dependent on the moisture and temperature of the soil. Accurate weather data can assist farmers in determining when they should work most efficiently in their day-to-day operations.

2. Pest control

Weather forecast helps in controlling the pests and other crop diseases to spread over the field. Weather factors can influence crop-destroying pests. Information in this area can help to determine when pesticides should be used. Crop dusters, which spray fungicidal or insecticidal chemicals on plants from above, should only be used when the wind will not cause the sprayed chemicals to miss their intended targets.

3. Role of renewable energy in weather forecasting

A farmer can plan how to use the renewable energy that will be exposed to the farm based on weather forecasting. This will assist a farmer in determining how much solar, wind and anaerobic energy the farm will receive. A farmer can use this information to harness the power of solar and wind energy by constructing solar panels and wind turbines to capture it. The farmer will be able to put this energy to good use after harvesting and storing it.

4. Field workability

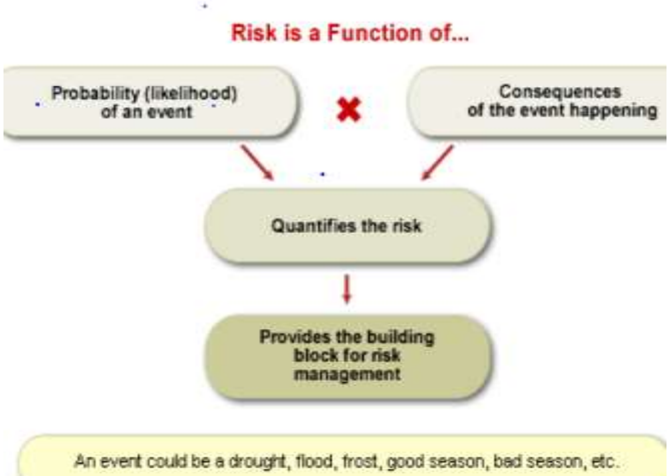
The availability of days that are ideal for fieldwork is referred to as field workability. Soil moisture and temperature are the most important factors. Accurate field-level meteorological data can assist farmers in determining the workability of their fields and making day-to-day activities more efficient.

5. Irrigation method is improved with the help of weather forecasting

Irrigation is the process of applying water to land artificially to increase agricultural production and farming. Weather unpredictability has an impact on irrigation and agricultural growth requirements. Two major weather-related criteria are the amount of timing and evapotranspiration. Climate change is something that all farmers must deal with. Drought, or extended periods of dry weather, is one of the most significant effects on the irrigation system. So, if they do a good job forecasting, the odds of losing money are far smaller than projected. Due to reduced humidity and higher temperatures, drought can increase crop water usage daily. Weather data is becoming more important in the developing field of smart farming, a farming approach that focuses on accuracy and control when it comes to crop production.

2.2 **Identifying weather opportunity risks**

Risk can be defined as the chance of an event occurring, multiplied by the damage or loss should that event take place, For instance, a high risk activity (say, going over a waterfall in a barrel) is one that has both a significant chance of a negative outcome (e.g., it is likely the barrel will break), and a large impact if that outcome occurs (the person inside is severely injured). In agriculture, risk could mean the likelihood of a dry year, an extreme frost or even a sudden rise in fuel costs that in turn will result in a substantial loss of crop or income. Sometimes people describe risk and opportunity as the opposite ends of the spectrum. Similarly, what may be a risk for some may actually be an opportunity for others. For instance, a La Niña event may increase the chance of flooding or water logging in some areas and thus significantly reduce crop yield, while in other areas it may in fact create the right conditions for a bumper crop.



Risk management is the activity when we:

- identify various risks and assess their significance;
- develop methods to minimize or avoid some risks using available resources;
- Develop strategies to manage the risk that remains.

Climate risk management involves being proactive in tackling the risks that Australia's highly variable climate can raise, rather than simply taking what comes. The best way to do this is by the strategic use of climate information when planning and making on farm decisions. A broad range of actions are possible to combat those times when climate becomes a risk. These may include:

- using early warning and response systems, such as seasonal outlooks or weather forecasts;
- strategic diversification to spread the risk;
- whole-farm planning and resource allocation to activities or seasons or years;
- careful assessment and use of relevant financial instruments such as insurance, sales contracts, hedging etc. and;
- Infrastructure design, e.g., dams, wind breaks, animal shelters, land contours, drip irrigation and so on.

Changes in ozone, greenhouse gases and climate change affect agricultural producers greatly because agriculture and fisheries depend on specific climate conditions. Temperature changes can cause habitat ranges and crop planting dates to shift and droughts and floods due to climate change may hinder farming practices. Weather hazards include hurricanes, tornadoes, thunderstorms, lightning, hail, winds, and winter weather. Many of these phenomena are related to atmospheric conditions that can be monitored and forecast.

Opportunities Weather Modifications

- Human beings can change weather and climate

- It has been possible to create **clouds** and water-droplets with about **-5°C** and produce rain by seeding substances such as **silver iodide**
- Cloud seeding causes ice crystals to form water droplets that can grow large enough to fall as rain despite its effect over large areas is still unproven.
- Moreover, weather near the ground is routinely modified for agricultural purposes e.g.
  - ✓ Forest burning to clear the vegetation
  - ✓ Darkening the soil is to raise its temperature
  - ✓ Turning on fans during clear, cold nights to stir warmer air down to the ground to prevent frost damage
  - ✓ To increasing production
  - ✓ To increase productivity
  - ✓ To enable double production in a year.
  - ✓ Good weather improves people's lives
  - ✓ Weather determines the kind of clothing to be worn by people in an area.
  - ✓ Knowledge of the weather of a place enables people to carry out economic activities which can be sustained by the weather in that place. E.g. dairy cattle do well in a cool and wet place.
  - ✓ By studying the weather of a place over a long time, we can establish its climate.

Risk Weather Modifications

- Unintentional effects created by human activities on weather and climate through adding gases such as CO_2 and methane to the atmosphere:
  - ✓ increases the greenhouse effect
  - ✓ contributed to global warming by raising the mean temperature of the earth

- More recently, chlorofluorocarbons (CFC), which are used as refrigerants and in aerosol propellants, have been released into the atmosphere:
  - ✓ reduces the amount of ozone worldwide

- ✓ causing a thinning of the ozone layer especially over Antarctica

2.3 Determining Impact on production of different weather and risk factors

Climate recognition and study of the agricultural plants requirements are some of the most important factors contributing to crop productions. Understanding and managing the effect of weather parameters on crop production could lead to increase in their yield. This issue is especially more crucial in rain fed farming conditions because climate shows the greatest impact on yield in rain fed farming. In reality, crop yield depends on a number of factors beyond the seasonal rainfall total: the timing of the onset and cessation dates, the timing of planting and harvest dates, the intra-seasonal distribution of rainfall, the number and length of dry spells, the frequency and severity of heat waves, and a host of non-climatic factors (soil fertility, management practices, land use pressures, etc.).

Impact of weather and climate on crops

- Climate change and agriculture are interrelated processes, both of which take place on a global scale.
- Global warming is projected to have a significant impact on conditions affecting agriculture, including temperature, CO_2, precipitation and the interaction of these elements.
- These conditions determine the carrying capacity of the biosphere to produce enough food for the human population and domesticated animals.
- Higher temperature cause heat stress in plants. In some cases the plants do not reproduce at all since excessive heat causes sterility of the pollen(masculine reproductive part of the flower)
- There are different effects on plants due to abnormal temperature
    - ✓ Chilling injury(temperature above freezing point difficult for warm T^O adopted plants)

- ✓ Freezing injury(temperature below freezing point of water, forms ice crystal)
- ✓ Heat injury(extreme temperature

Impact of weather and climate on natural system

- Earth is composed of many natural systems with numerous interactions within and between these systems. The main natural systems of Earth include:
- Biological systems, i.e., individuals, species populations, and communities;
- Ecosystems, i.e., the interactions amongst living organisms and physical and chemical factors in the environment;
- Global energy budget, i.e., flow of energy originating from the Sun into and out of Earth's systems;
- Water cycle (hydrological cycle);
- cycling of carbon, nitrogen, and other elements or molecules (biogeochemical cycles);

2.4 **Identifying and developing qualitative and quantitative risk and opportunities**

A quantitative assessment is a risk analysis performed with a focus on numerical values of the risks present. The quantitative risk analysis allows you to determine the potential risk of a project. This can help you decide if a project is worth pursuing. It also is useful in the development of project management plans, as understanding the risks present allows you to reduce the likelihood of certain risks and to prepare for others that you cannot fully eliminate.

Benefits of quantitative risk analysis

When performing a risk analysis, the first decision is whether you want to perform a qualitative or quantitative assessment. These are the top reasons you may choose to perform a quantitative risk analysis: Objective assessment: Because a quantitative assessment involves assigning numerical values to each risk, it returns objective results. Conversely, a qualitative assessment expresses risk in subjective terms, which people may interpret differently. Objective estimates help ensure that all parties have the same understanding of the projected risks.

Detailed information: A quantitative assessment breaks down a project by the expected cost of each potential risk. This allows you to focus reduction efforts on the risks deemed "most likely" or "most costly."Client confidence: When presenting a project assessment to a potential client, the specificity of a quantitative assessment may provide more confidence because there is little room for misinterpretation. By providing your client with a specific number regarding potential financial risk, they can more confidently make their decision about the proposal.

Improved decision making: By creating risk assessments with objective measures, you and others involved in decision making have an accurate assessment of potential risks. This can help you make the best decision for the company.

A qualitative risk analysis is the primary alternative to a quantitative risk analysis. Although there are many significant benefits to quantitative analysis listed above, there are also reasons that you may prefer to perform a qualitative assessment instead.

In a qualitative assessment, instead of using exact numbers, you calculate risks using descriptive scales. For example, a simple qualitative risk analysis may rate potential risks as either high, medium or low based on how likely they are to occur.

Although a qualitative assessment does not allow for as precise of calculations, you can complete it more quickly and with fewer resource investments, as there is no need to make precise calculations of probabilities and costs. A qualitative analysis is effective for smaller projects that do not merit a more exhaustive investment of resources and time or for situations where you need to make a quick assessment but are not confident enough to set a precise probability.

2.5 **Evaluating importance of weather variability and significant production events**

Climatic variation

Most of the earth's climate variation is caused by uneven heating associated with:

i. Diurnal variation:

- rotation of the earth on its axis

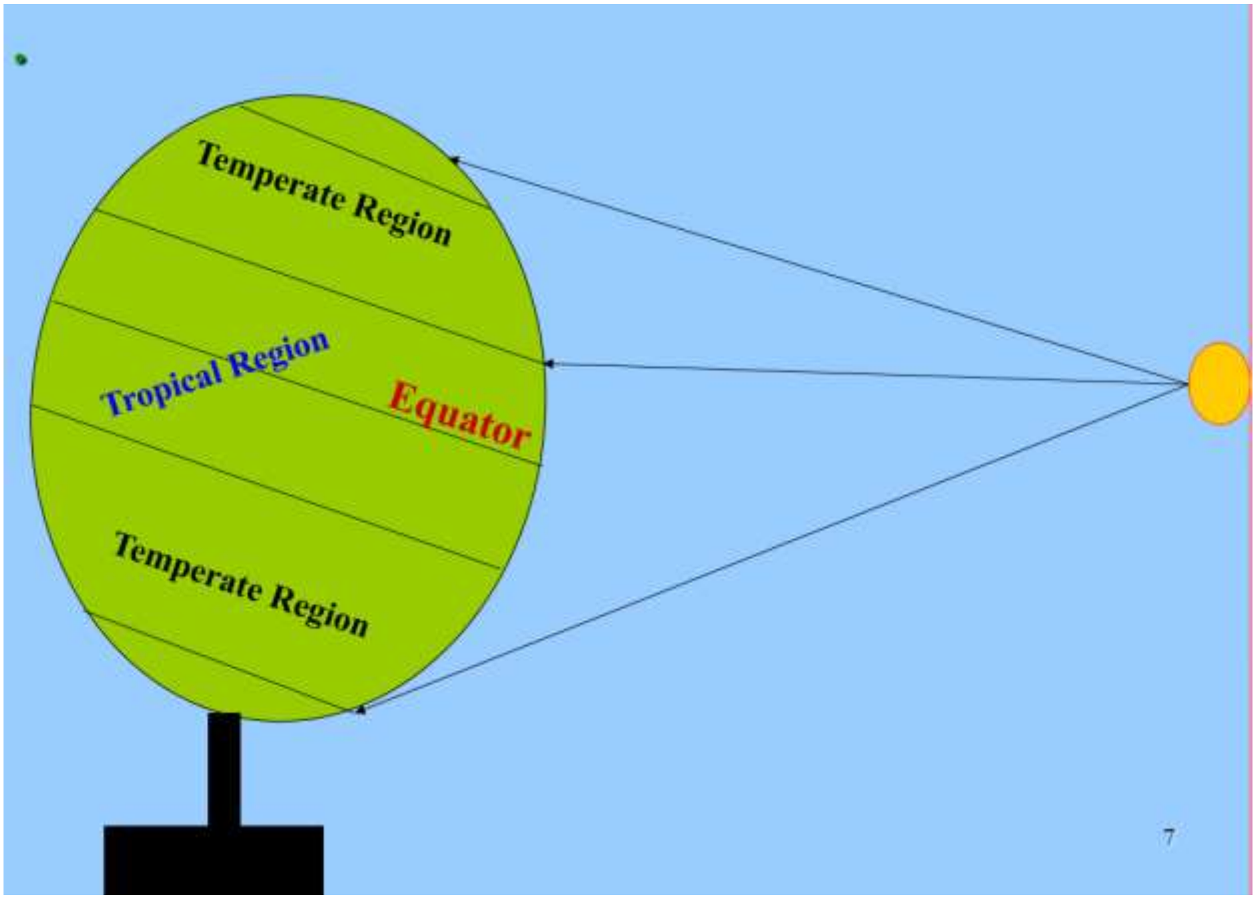
ii. Latitudinal variation:

- Global climate varies from ice-covered Polar Regions to the hottest deserts in the tropics. This variation is associated with the spherical shape of the earth
  - ✓ Lower latitudes receive more incoming solar radiation than the poles, since sun's rays are almost perpendicular to the surface
  - ✓ At higher latitudes the radiation is weaker since it:
    - is spread over a larger surface unit ground area.
    - travels longer path through the atmosphere and part of it is:
      - absorbed,
      - reflected, or
      - scattered before it reaches the surface

- This deferential heating creates temperature gradient on the earth’s surface
- The temperature gradient in turn leads to pressure gradient in the atmosphere which is the major driving force of the global as well as regional atmospheric circulation
- The atmospheric circulation influences patterns of precipitation

iii. Seasonal variation:

- Tilted position of earth’s axis by 23.50^0 as it rotates around the Sun
- As a result the latitude at which the sun is directly overhead changes with seasons
- During north summer, the northern hemisphere is tilted towards the sun and receives more solar energy than the south, and the vise versa.



- The axis of Earth’s rotation is fixed at 23.5˚ relative to its orbital plane about the sun.
- This tilt in Earth’s axis results in strong seasonal variations in day length and the solar **irradiance**, i.e., the quantity of solar energy received at Earth's surface per unit time. During the spring and autumn equinoxes, the entire earth’s surface receives approximately twelve hours of daylight
- At the northern-hemisphere summer solstice, the sun’s rays strike Earth most directly in the northern hemisphere, and day length is maximized.
- At the northern-hemisphere winter solstice, the sun’s rays strike Earth most obliquely in the northern hemisphere, and day length is minimized.

- The summer and winter solstices in the southern hemisphere are six months out of phase from those in the north. Variations in light and temperature also play an important role in determining the types of plants that grow in a given climate and the rates at which biological processes occur.

- Many biological processes are temperature-dependent, with slower rates occurring at lower temperatures.
- Diurnal variations in day length (photoperiod) provide important cues that allow organisms to prepare for seasonal variations in climate.

Iv. Altitudinal Variation

- Lower altitudes are usually hotter than higher altitudes mainly due to:
  - ✓ Semitransparent nature of the atmosphere
  - ✓ Reverse heating process
  - ✓ Atmosphere turbidity at lower altitudes.

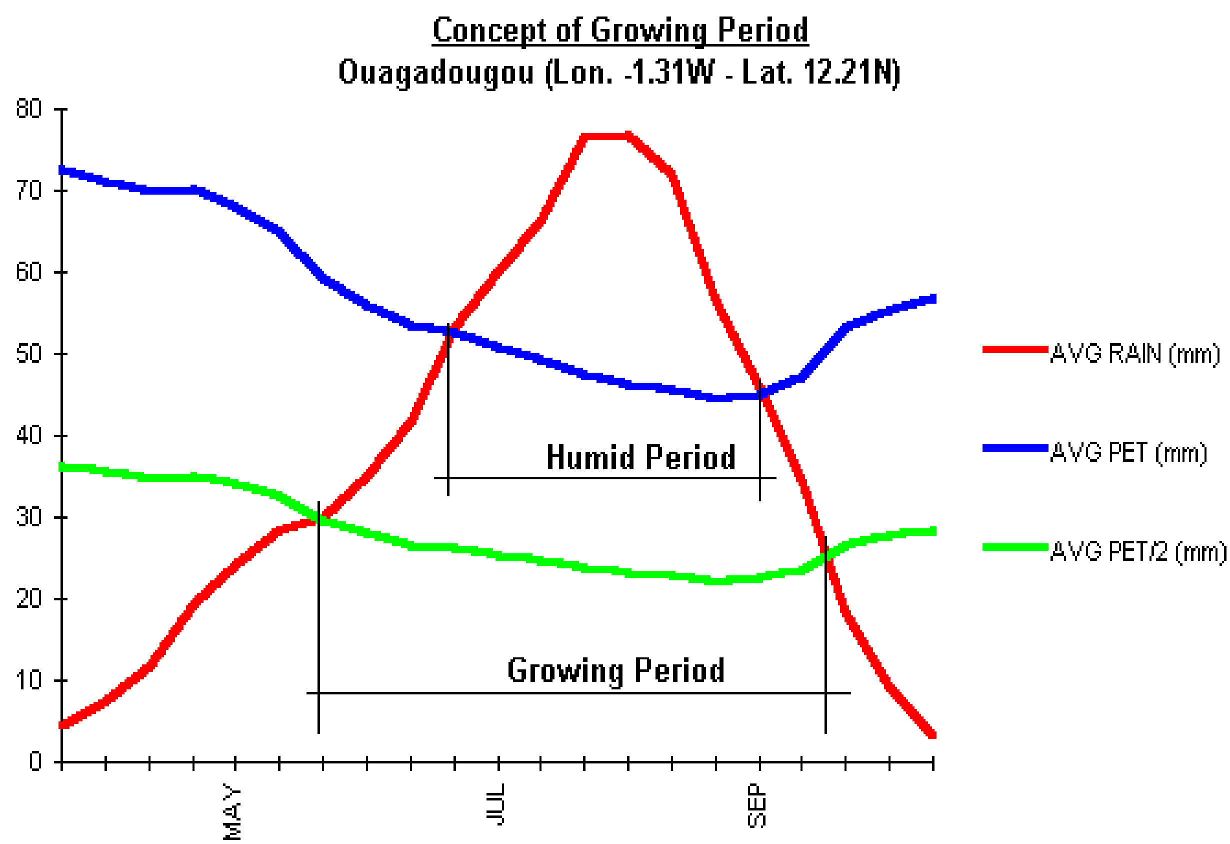
Growing period

It is the period in which agricultural production is possible regarding moisture availability in the absence of temperature limitations. LGP is one method of assessing rainfall-evaporation relationships.

The concept of the growing period is essential to AEZ, and provides a way of including seasonality in land resource appraisal. In many tropical areas, conditions are too dry during part of the year for crop growth to occur without irrigation, while in temperate climatic regimes crop production in winter is limited by cold temperatures. The growing period defines the period of the year when both moisture and temperature conditions are suitable for crop production. The growing period provides a framework for summarizing temporally variable elements of climate, which can then be compared with the requirements and estimated responses of the plant. Such parameters as temperature regime, total rainfall and evapotranspiration and the incidence of climatic hazards are more relevant when calculated for the growing period, when they may influence crop growth, rather than averaged over the whole year.

The determination of the beginning of the growing period is based on the start of the rainy season. The first rains fall on soil which is generally dry at the surface and which has a large soil moisture deficit in the soil profile. In the absence of soil moisture reserves, seedbed preparation, seed germination and the initial growth of crops are therefore entirely dependent on the amount and frequency distribution of these early rains.

Experimental work indicates that the effectiveness of early rains increases considerably once P is equal to, or exceeds, half ET. The growing period continues beyond the rainy season, when crops often mature on moisture reserves stored in the soil profile. Soil moisture storage must therefore be considered in defining the length of the growing period.



Ai is the principal parameter involved in the estimation of LGP

$$Ai = AET/PET$$

Ai -Available water balance

AET -Actual evapotranspiration

PET - Potential evapotranspiration

Categories of growing LGP, based on Ai values

1. Normal
2. Intermediate
3. Normal with bimodal tendency
4. Double growing period

2.6 Outlining tactics to address a range of different weather variability, production risks and opportunities

Adapting Agriculture to Climate Change

Changing weather introduces a number of issues for farm owners to address, and climate change adaptation strategies in agriculture are objectives of primary importance.
Adaptation and mitigation of climate change in agriculture are not all-cure solutions and should be customized in each particular case. Thinking of how to adapt to changing weather conditions, crop producers should consider the climate specifics of their area, farming potential and needs, affordability of applied methods.

Agriculture and climate change adaptation are of major concern not only to crop producers but scientists as well. Botanists are working to provide farmers with species that are more tolerant to water deficiency or excess and temperature leaps. Ecologists encourage effective soil management by reducing depletion, promoting carbon sequestration, sparing natural resources, eliminating chemical applications, and harmful emissions

.

Regarding agriculture and climate change, the following techniques and practices prove to be helpful

Daily forecasts up to 14 days ahead with air temperatures, precipitations, wind, humidity, cloudiness. Aware of the upcoming conditions, farmers can schedule field activities (like sowing or harvesting as well as herbicide/fertilizer applications).

Historical weather data (accumulated precipitation, daily precipitation, daily temperatures, the sum of active temperatures) enabling to outline general tendencies of weather changes in the selected region.

Cold and heat stress feature, which is important due to temperature leaps that are critical for plant health and growth. Neither excessively high nor excessively low temperatures contribute to high yields. So, farmers have to be aware of the threat and address it in time.

Ensuring Ecosystem Compatible Drainage

Proper water infiltration prevents flooding and waterlogging as well as helps to avoid chemical and water leakage. It enables farmers to reduce the usage of water resources and tackle soil erosion. However, this technique of agriculture and climate adaptation needs a thoughtful approach to ensure ecosystem biodiversity. First, there must be enough water to maintain plant health (especially those that need wetlands to grow). Second, drainage must not contribute to excessive herbicide or fertilizer runoffs.

Improved Irrigation Efficiency

Irrigation is vital for vegetation in the lack of rainfall, and water supply should be sufficient to ensure stable plant development. Nonetheless, improved irrigation systems and drip or tape irrigation, in particular, help farmers to provide necessary moisture with reduced water spend.

Mulching and crop residue also beneficially contribute in this regard, assisting to resolve the farming and climate change issues

.

Rainwater Harvesting

Collecting rainfalls is an economic method of water supply that is valuable in drought-subjected areas. This additional source of moisture saves water resources, yet involves extra inputs to operate rainwater storages. However, the success is not without a drawback since collected rainwater may cause drops in groundwater levels and thus influence the ecosystem balance

Precision Farming

Smart farming is an important achievement in global climate change and agriculture solutions. Precision agriculture is based on site-specific farm management that helps to save farmer's resources and reduce environmental pollution. It widely employs advanced technologies like drone observations and satellite-retrieved data as well as online farming software for data processing and interpretation. Agricultural tools allow farmers to detect critical areas and focus on them instead of treating the whole field.

Cover Crops

Planting cover crops is a successful method of farming that helps to prevent soil erosion, promotes water retention, and nitrogen fixation. Thus, legumes are known as nitrogen producing crops participating in the conversion of the atmospheric nitrogen to plant-ingestive forms. Cover crops also serve as organic manure or material for fodder and grazing cattle.

No-Tillage Or Minimum Tillage

No-till farming is a field-management practice with no or minimum soil disturbance. No-till agriculture prevents soil erosion and promotes carbon sequestration, which is beneficial regarding climate change and farming. This method reduces soil depletion, improves its climate and natural environment as well as decreases inputs for tillage activities and maintenance of tilling equipment.

Adaptive plants are more vibrant and resilient to unfavorable climatic conditions. They require fewer herbicides or fertilizers and are more resistant to waterlogging or droughts. Reduced chemical inputs contribute to nature protection, and thus adaptive species are a winning solution in terms of climate change and agriculture.

Crop Diversification and Rotation

Crop rotation is an old and efficient agricultural method that proved to be successful in weed and pest management as well as chemicals application. Crop diversification is beneficial for the ecosystem biodiversity and gastronomic experiences of mankind.

2.7 Identification of contingency options for production and the risk factors

A contingency plan is executed when the risk presents itself. The purpose of the plan is to lessen the damage of the risk when it occurs. Without the plan in place, the full impact of the risk could greatly affect the project. The contingency plan is the last line of defense against the risk. It is very difficult to forecast about the rainfall received in the previous years. The crop production can adversely affect if the rains would be insufficient or erratic. In such conditions, the contingent planning of crop cultivation is essential. To grow crops successfully farmers need to know about the following

:

- climate requirements
- soil type and soil fertility requirements
- when to sow
- suitable varieties

- how to combine legume crops with other activities on the farm

The contingency plan is worked out to minimize the risk and to protect crop from major failures. For avoiding crop losses due to adverse effect of irregular and erratic seasonal climate the contingent planning should be based on the following points.

1. Late onset of seasonal climate.
2. Dry spell during crop period or long dry spell in the seasonal climate.
3. Early withdrawal of seasonal climate.

The information regarding availability of certified seed/quality seed which shows sufficient availability of seed during the season is needed.

When rains are received normally, the following steps are needed to derive full benefit.

- Land shaping and soil conservation including contour bunding should be practiced on a watershed basis.
- Adequate water harvesting and water storage practices should be adopted for use at later stages as supplementary irrigations.
- Land preparation operations should be completed before on-set of seasonal climate so that timely sowing can be done with soaking rains.
- Set rows if practiced should be across the general slope of the field.
- Organic manure like F.Y.M. and compost manure and recommended dose of fertilizer should be applied.
- Mixed/inter-cropping practices are profitable.

The farmers are also advised for a contingent crop planning to adopt the following basic recommendations.

- Watershed approach in conservation of soil and water.
- Conservation of runoff water in farm pond.
- Preparation of land in advance of monsoon.

- All agronomic practices across the slope.
- Maximum use of farm yard manure.
- Application of fertilizer as per recommendation.
- Complete control of weeds.
- Maintenance of maximum plant population in a unit area.
- Timely plant protection.
- Adoption of inter cropping to reduce the risk.
- Adoption of recommended variety especially short duration High yielding variety
- Conservation of moisture by timely inter-culturing and use of plastic as mulch.
- Adoption of relay cropping in late rainfall conditions.

Self-Check – 2	**Written test**

Name…………………………………………… ID………………………… Date…….

Test I: Short Answer questions (3pt.each)

1. What are the cause of climatic variations?
2. What does means contingency options for crop production risks?
3. What are the categories of growing length of growling periods?
4. What is the main advantages of weather forecasting/ prediction?

5. What is the impact of weather and climate on crop production?

Note: **Satisfactory rating – 7.5 points** **Unsatisfactory – below 7.5 points**
You can ask you teacher for the copy of the correct answers.

LG #35	LO #3- Preparing weather and crop production risk management

Instruction sheet 3
This learning guide is developed to provide you the necessary information regarding the following content coverage and topics: • Collection of weather variability and seasonal weather forecasts. • Addressing insurance and other options. • Addressing major weather risk factors. • Predicting impacts on the environment, property value and equity. • Selecting and reviewing preferred crop production, weather risks or alternative solution • Presenting a planned solution to cope with variable weather and crop production risk management. 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: • Collect weather variability and seasonal weather forecasts • Address insurance and other options. • Address major weather risk factors. • Predict impacts on the environment, property value and equity. • Select and review preferred crop production, weather risks or alternative solution. • Present a planned solution to cope with variable weather and crop production risk management.
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
5. Perform Operation Sheets
6. Do the "LAP test"

Information Sheet 3

3.1 Collection of weather variability and seasonal weather forecasts

A greater aspect of our weather and climate is its variability. This variability ranges over many time and space scales such as localized thunderstorms and tornadoes, to larger-scale storms, to droughts, to multi-year, multi-decade and even multi-century time scales.
Climate change can affect the intensity and frequency of precipitation. Warmer oceans increase the amount of water that evaporates into the air. When more moisture-laden air moves over land or converges into a storm system, it can produce more intense precipitation—for example, heavier rain and snow storms

a. The temporal precipitation variation

The temporal variation in global precipitation is directly linked to the seasonal changes in the heating of the Earth. This affects the movement of global pressure systems and air masses. Areas of high precipitation are usually moving north and south during the year following the migration of global pressure and wind systems. The migration of the ITCZ across the Equator keeps this region very moist.

The north - to - south shifting of ITCZ creates: summer dry climates poleward of the subtropical high but summer wet - to the equator ward side. However, into the mid-latitudes, frontal uplifts keep most of the seasons humid and moist. As one moves poleward, the precipitation becomes more variable and seasonal as the drying effect of the subtropical is experienced. In the cold Arctic or Antarctic very little moisture is available in the air for the formation of precipitation.

b. Spatial variability

As we go far from the equator, the rainfall becomes more variable and seasonal. In the tropics (10^o - 23.5^o) the maximum amount of precipitation falls during summer. As the ITCZ shifts pole-ward it brings precipitation with it. Later as it moves out of the subtropical region and shifts back to equator-ward, a dry season follows (sets in). The length and intensity of the dry season tends to increase toward the poleward limits of the tropics. The subtropics (23.5^o- 35^o) can be very dry or wet, depending on the location of ITCZ. The equator-ward side of the subtropics tends to be quite dry. As one moves poleward of the subtropics, the amount of precipitation increases though it has a seasonal character

In Africa it is at about 23.5^o N that the great Sahara Desert is found where the average annual rainfall is estimated to be only about 43.8 mm (1.74 in). The extremely dry conditions are a result of the combustion effect of the subsiding from the subtropical high. But annual precipitation increases as we move to the poleward limits of the subtropics, especially on the east coast of continents. This is mainly due to the moist air masses that blows onshore.

- Precipitation decreases as one moves from the equator toward the subtropical regions and the poles.
- The largest annual precipitation totals straddle the equator while the driest regions on Earth lie near the Tropic of Cancer.
- In addition, precipitation becomes more seasonal as one moves away from the equator primarily due to the shifting locations of global wind and pressure systems.
- The ITCZ is the region where trade winds originating in the semi-permanent subtropical highs converge causing air to rise.
- The combination of convergence and convection lifts, the air becomes cool and ultimately condense its moisture into clouds and precipitation.

3.1.1 Weather Forecasting

Forecasting: is the process of estimating the value of some variable at some future time.

Is the prediction of what the weather will be?

Broadly there are three types of weather forecast based on the validity of the forecast:

1. Short range forecast: valid for 3 days

2. Medium range forecast: valid for 3-10 days

3. Long range forecast: valid beyond 10 days up to a season or a year beyond.

Weather forecasts and warnings are the most important services provided by the meteorological profession. Forecasts are used by government and industry to protect life and property and to improve the efficiency of operations, and by individuals to plan a wide range of daily activities. High-speed computers, meteorological satellites, and weather radars are tools that have played major roles in improving weather forecasts.

Statistical methods allow a wider variety of meteorological elements to be predicted than do the models alone, and they tailor the geographically less precise model forecasts to specific locations. Satellites now provide the capability for nearly continuous viewing and remote sensing of the atmosphere on a global scale.

At monthly and seasonal ranges, day-to-day weather changes are not predictable, either in theory or in practice, and forecasts are concerned instead with the probability that average temperatures and total precipitation for the forecast period, typically a month or a season, will be above or below normal.

Weather radar and geostationary satellites are particularly valuable tools for this purpose.

1) For the period 0 to 12 hours: The behavior of small, short-lived, severe local storms is predictable only for periods of the order of several minutes to an hour.

2) For the period 12 to 48 hour: development and movement of large extra tropical weather systems, and of the associated day-to-day variations in temperature, precipitation, cloudiness, and air quality, can be made throughout this period.

3) For the period 3 to 5 days: Large-scale circulation events such as major storms and cold waves usually can be anticipated 3 to 5 days in advance.

4) For the period 6 to 10 days: Mean temperatures and precipitation for the period can be predicted

5) Monthly and seasonal forecasts: Slight skill exists in forecasting average temperatures and precipitation for the month or season.

3.2 Addressing insurance and other options.

Insurance is an arrangement by which a company or the state undertakes to provide a guarantee of compensation for specified loss, damage, illness, or death in return for payment of specified premium.
It is a way to manage your risk. when you buy insurance you purchase protection against unexpected financial losses. The insurance company pays you or someone you choose if something bad happens to you. If you have insurance and an accident happens, you may be responsible for all related costs.
Crop insurance is a type of protection policy that covers agricultural producers against unexpected loss of projected crop yields or profits from produce sales at market.

1. **Property Insurance**

Property insurance compensates a business if the property used in the business is lost or damaged as the result of various types of common perils, such as fire or theft. Property insurance covers not just a building or structure but also the contents, including office furnishings, inventory, raw materials, machinery, computers and other items vital to a business's operations. Depending on the type of policy, property insurance may include coverage for equipment breakdown, removal of debris after a fire or other destructive event, some types of water damage and other losses.

3.3 Addressing major weather risk factors

.

Weather risk is the potential for severe weather to disrupt business operations or damage assets. In some industries, such as construction weather risk has a significant impact. For the most part, this impact can be anticipated as every year has at least some severe weather

Weather hazards include hurricanes, tornadoes, thunderstorms, lightning, hail, winds, and winter weather. Many of these phenomena are related to atmospheric conditions that can be monitored and forecast.

Types of weather extremes:

- Tornado: clouds, strong wind, rain, hail.
- Hurricane or cyclone: strong wind, heavy rain.
- Blizzard: heavy snow, ice, cold temperatures.
- Dust storm: strong winds, arid conditions.
- Flood: heavy rainfall.
- Hail storm: cold or warm temperatures, rain, ice.
- Ice storm: freezing rain.

3.4. Predicting impacts on the environment, *property value* and equity.

Climate change is the single biggest health threat facing humanity. Climate impacts are already harming health, through air pollution, disease, extreme weather events, forced displacement, pressures on mental health, and increased hunger and poor nutrition in places where people cannot grow or find sufficient food.

Changes in the real estate market can lower the value of your home. Natural disasters and climate change can lower your property value because the property is a greater risk to purchase. Foreclosures in your neighborhood can also drive down property value.

One reasonable theory about weather and Wall Street suggests that severe weather interrupts business processes, supply chains and consumer movements, among other factors. In fact, the financial media often blames a sluggish quarter of gross domestic product (GDP) growth or stock market performance on weather problems.

While increased precipitation can replenish water supplies and support agriculture, intense storms can damage property, cause loss of life and population displacement, and temporarily disrupt essential services such as transportation, telecommunications, energy, and water supplies.

Weather has a profound effect on human health and well-being. It has been demonstrated that weather is associated with changes in birth rates, and sperm counts, with outbreaks of pneumonia, influenza and bronchitis, and is related to other Morbi dirty effects linked to pollen concentrations and high pollution levels.

A study found that weather and temperature changes do not affect stock market returns directly, which means that there is no significant correlation between sunshine and high stock returns. Chuang, *et. al*., (2020) found that the effects of weather depend on how sensitive individuals to weather changes.

Effects of Climate Change

Hotter temperatures. As greenhouse gas concentrations rise, so does the global surface temperature.

- ✓ More severe storms
- ✓ Increased drought
- ✓ A warming, rising ocean
- ✓ Loss of species
- ✓ Not enough food
- ✓ More health risks

- ✓ Poverty and displacement.

3.5. Selecting and reviewing preferred crop production, weather risks or alternative solution

Weather hazards include hurricanes, tornadoes, thunderstorms, lightning, hail, winds, and winter weather. Many of these phenomena are related to atmospheric conditions that can be monitored and forecast.

5 steps in the risk assessment process

1. Identify the hazards
2. Determine who might be harmed and how
3. Evaluate the risks and take precautions
4. Record your findings
5. Review your assessment and update if necessary.

Risk assessments are very important as they form an integral part of an occupational health and safety management plan. They help to: Create awareness of hazards and risk. Identify who may be at risk (e.g., employees, cleaners, visitors, contractors, the public, etc.).

Table 2: Risk Ratings

Description	Colour Code
Immediately Dangerous	
High Risk	
Medium Risk	
Low Risk	
Very Low Risk	

3.6. Presenting a planned solution to cope with variable weather and crop production risk management.

The three main factors of weather are light (solar radiation), water (moisture) and temperature. Climate change is a risk management problem
current climate policy is based on an understanding of what is expected to occur, when in fact there is substantial risk that future temperatures could be more extreme.
Risk management in a production context refers to strategic choice of input and output mix ("self-insurance") when production is risky.

Farmers need to understand risk and have risk management skills to better anticipate problems and reduce consequences. Risk affects production such as changes in the weather and the incidence of pests and diseases. Equipment breakdown can be a risk as can market price fluctuations.
Production risks relate to the possibility that your yield or output levels will be lower than projected. Major sources of production risks arise from adverse weather conditions such as drought, freezes, or excessive rainfall at harvest or planting.

Self-check 3	Written test

Name………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer (4 point)

1. Write the three types of weather forecast based on the validity of the forecast?
2. What doe weather forecast mean?
3. Describe the five steps in the risk assessment process?

4. Define the term insurance?

Note: **Satisfactory rating – 8 points** **Unsatisfactory – below 8**

Reference Materials

Books:

Web addresses

https://ownyourweather.com/importance-of-historical-weather-data/(August **25/22)**

http://omafra.gov.on.ca/english/engineer/facts/12-053.htm (August 26/22)
https://www.open.edu/openlearncreate/mod/oucontent/view.php?id=79970&printable=1(August 28/22)

https://www.researchgate.net/publication/311922918_Agriculture_under_a_Changing_Climate_in_Ethiopia_Challenges_and_Opportunities_for_Research (August 27/22)

https://www.indeed.com/career-advice/career-development/quantitative-risk-analysis(August 30/22)

https://tractorgyan.com/tractor-industry-news-blogs/887/5-reasons-why-weather-forecasting-is-important-for-farming (semptember1/22)

https://eos.com/blog/climate-change-and-agriculture/(sempteber 2/22)

AKNOWLEDGEMENT

Ministry of Labor and Skills wish to extend thanks and appreciation to the many representatives of TVET instructors and respective industry experts who donated their time and expertise to the development of this Teaching, Training and Learning Materials (TTLM).

The experts who developed the learning guide

No	Name	Qualification	Educational background	Region	Phone number	E-mail
1	**Eyaya Tigabie**	**MSc**	**Agronomy**	**Afar**	**0921944452**	**eyayatigabie@gmail.com**
2	Fikadu Tilahun	BSc	Plant science	Afar	0917363367	Fikadutilahun80@gimail.com
3	Imam Mohamed	BSc	Plant science	Oromia	0913624360	leylasalo@gimail.com
4	Gosa Shura	MSc	Horticulture	Oromia	0923041032	Gossashura@gimail.com
5	Tilahun Getu	MSc	Biotechnology	Amhara	0918726766	Tile21eme@gimail.com
6	Degefa Guluma	MSc	Soil science	Oromia	0913440464	deguluma@gimail.com
7	Bayisa Abeshu	MSc	Agronomy	South west	0921434086	bayoabeshu@gimail.com
8	**Birhanu Asefa**	**BSc**	Plant science	South west	**0922182673**	**berehanuasefa@gimail.com**
9	Wendimu Tefera	BSc	Plant science	Oromia	0911266570	gurachoterfa@gimail.com
10	Taka Megersa	MSC	Horticulture	Oromia	0917210371	Takamagarsa430@gimail.com
11	Elias Mohammed	BSc	Horticulture	Oromia	0946706670	rewedal@gimail.com