NATURAL RESOURCES CONSERVATION AND DEVELOPMENT

Level-II

Learning Guide-63

Unit of Competence: Identify Different Water Sources and Irrigation Methods

Module Title: Identifying Different Water Sources and Irrigation Methods

LG Code: AGR NRC2 M14 L61 L01-LG-61

TTLM Code: AGR NRC2 M14 TTLM 0919v1

LO3: Gather & record relevant information

Instruction Sheet	Learning Guide #63

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

- Collecting and collating Data on soil type and climatic variables
- Identifying Crop type based on land use capability
- Determining Land gradient of the command area
- Indigenous irrigation methods practice

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

- Collect and collate Data on soil type and climatic variables
- Identify Crop type based on land use capability
- Determine Land gradient of the command area
- Indigenous irrigation methods practice

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 and 4.
3. Read the information written in the information "Sheet 1, Sheet 2, Sheet 3 and Sheet 4
4. Accomplish the "Self-check 1, Self-check 2, Self-check 3 and Self-check 4," **in page -4, 8, 11 and 14** respectively.

Information Sheet-1	Collecting and collating Data on soil type and climatic variables

1.1 Data on soil type and climatic variables

1.1.1 Agricultural Data Collection

The process of gathering information, such as profit margins per cultivar, pest and disease infestations, weather and climatic information, rainfall, costs, economic conditions and analyzing it to be able to find patterns that will help us work more efficiently, sustainably and profitably on a farm.

What kinds of data do we collect?

- ✓ Occurrence of pest and disease infestations.
- ✓ Weather and climatic information – year on year.
- ✓ Rainfall & Soil sample data.
- ✓ Costs of agricultural inputs.
- ✓ Yield data.
- ✓ Prevailing economic conditions in the sector, country and internationally.
- ✓ 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.
- ✓ Agronomic data.
- ✓ Profit margins per cultivar / per crop / per block / per orchard / per Hectare.
- ✓ Agricultural photographic data.

The reasons why we would collect Agricultural Data?

- ✓ We collect agricultural data in order to gather information on the patterns and processes of the environment. 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.
- ✓ It is always useful to have detailed records and data. This will help us to ensure that we make optimum decisions in order to maximize profits, production and quality, whilst keeping risks and problems to a minimum.

Rainwater collection systems consist of three basic components: a catchment surface, a delivery system, and a storage reservoir. Storage reservoirs include various types of surface and sub-surface tanks, ponds, rock catchments dams, earth dams, hafirs, and sub-surface or sand dams in sand rivers and soils. Use of these systems depends on the quantity and pattern of rainfall; catchments surface area, storage capacity, and demand for consumable water, cost of unit water, alternative water sources, and the local water management strategy. Households' rainwater harvesting systems also provide useful quantities of water for domestic small-stock, vegetable gardens, and supplementary irrigation of rain-fed crops.

Rainfall data

Rainfall rates vary, especially in areas receiving less than 500mm of precipitation annually. Rainfall also varies across locations, so data from a specific rain gauge station may be misleading when applied to a rainwater harvesting system in a different location.

Rainfall Intensity, Duration, and Frequency

Rainfall intensity refers to the depth of rainfall occurring in duration equal to a unit of time. Units of measurement include mm/hr, mm/d, inch/h, and inch/d. Rainfall depths and intensities are useless by themselves; they must be related to a frequency of occurrence. The frequency of occurrence establishes the risk of failure.

The rainfall characteristics of a place can be defined if the intensities, durations, and frequencies of the various storms are known. Whenever intense rainfall occurs, meteorological readings report its magnitude and duration.

Rainfall quantity (mm/year): The amount of water available to the consumer is a product of the total available rainfall and the catchment surface area. A loss coefficient is often included to allow for evaporation and other losses. The mean annual rainfall data tells us how much rain falls in an average year.

Rainfall pattern: Climatic conditions vary widely throughout the world. The rainfall pattern and the total rainfall often determine the feasibility of rainwater harvesting systems. A climate where rain falls regularly throughout the year will mean that the storage requirement is low, hence the system cost will be low and vice versa. The more detailed the data available, the more accurately the system parameters can be defined.

Catchment surface area (m2): Rooftop catchments systems are restricted by the size of the roof of the dwelling. Sometimes other surfaces are used to supplement the rooftop catchment area.

Water-holding capacity is an important quality of soil. Soils that have limited moisture-holding capacity are likely to have limitations in variety of crops that can be grown. They also present fertility and other management problems. The ranges in water-holding capacity for the soils in the capability classes vary to a limited degree with the amount and distribution of effective precipitation during the growing season. Within a capability class, the range in available moisture-holding capacity varies from one climatic region to another.

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. The reasons why we would collect Agricultural Data? (5pts)

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

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

Answer Sheet

Score = ___________
Rating: ____________

Name: _________________________ Date: _______________

Information Sheet-2	Identifying Crop type based on land use capability

2.1 Identifying Crop type based on land use capability

The land in any place is used for several purposes such as crop and livestock production, forestry, housing, recreation, residential areas, markets, roads, railways etc. Land comprises the physical environment, including climate, relief, soils, hydrology and vegetation, to the extent that these influence potential for land use. It includes the results of past and present human activity, e.g. reclamation from the sea, vegetation clearance, and also adverse results, e.g. soil salinization. Purely economic and social characteristics, however, are not included in the concept of land; these form part of the economic and social context. The most desired way of using a particular land is possible when one can understand the type of the soil in the land capability classification which gives complete information regarding various parameters based on which classification is done.

There are several different methods of assessing land capability, each one being developed with a particular country of region in mind. The British method of land capability mapping is an adaptation of the US Department of Agriculture method. It is an assessment of the capability of the land from known relationships between crop production and management and the physical factors of soil, topography and climate. It is essentially a negative approach in which land is graded according to mixed qualitative and quantitative measures of limitations to land capability. There are seven land capability classes in the British method. Class 1 has a wide range of uses with few (if any) limitations, while the remaining six classes suffer from increasingly severe limitations and are progressively less flexible in the range of their potential land uses. Land capability subclasses are defined on the basis of one of more permanent or semi-permanent physical factors that limit production. Each of these subclasses is denoted by a letter (w, s, g, e, c) attached to the relevant class number (e.g. 2w or 6gs). These are outlined below:

Class	Description	Suitable uses
1	Land with very minor or no physical limitations to use	Any, esp. arable
2	Land with minor limitations that reduce the choice of crops and interfere with cultivations	Any,esp. arable
3	Land with moderate limitations that restrict the choice of crops and/or demand careful management	Arable/pasture
4	Land with moderately severe limitations that restrict the choice of crops and/or require very careful management practices	Pasture/arable
5	Land with severe limitations that restrict its use to pasture, forestry and recreation Pasture/forestry	Rough pasture/
6	Land with very severe limitations that restrict use to rough grazing, forestry and recreation	forestry/rec.
7	Land with extremely severe limitations that cannot be rectified	Recreation only

Subclass limitations:

Wetness (w)

This includes interactions between soil properties, relief and climate resulting in wet soils which cause problems of delayed spring growth, compaction and puddling by farm machinery, poor root development, asphyxiation, denitrification, etc. Wetness may result from:

1. low permeability (especially in fine textured soils such as clays);
2. impermeable layers (e.g. indurated layers and ironpans);
3. high groundwater table;
4. flushing by springs;
5. flooding from streams and rivers; and
6. high rainfall.

Soil limitations (s)

These include shallowness, stoniness, poor soil texture and structure or inherent low fertility. Shallow soils can have low available water capacities and restrict rooting and adequate nutrient uptake. Ploughing may be impractical if the bedrock is too near the surface. Stony soils affect plant growth and farm operations depending on the size and number of stones. Stones hinder growth and machanised harvesting of root crops whilst reducing water capacity and nutrient uptake depending on their geology. Soil texture and structure affect drainage and permeability. Water capacity is determined largely by soil texture (i.e. clay = high and sandy = low). Naturally low soil fertility can be difficult to correct by management and so is included as a physical limitation.

Gradient and soil pattern limitations (g)

Gradient (or slope) has a marked effect on mechanised farming as follows:

Gradient	g Class	Problems
0-3°	Gently sloping (1)	None
3-7°	Moderately sloping (2)	Difficulties with weeders, precision seeders and some mechanised root crop harvesters
7-11°	Strongly sloping (3)	Use of combine harvester resiricted
11-15°	Moderately steep (4)	Limit of use of combine harvester and of two way ploughing (depending of field configuration)
15-25°	Steep (5)	Not suitable for arable crops, with slopes over 20° being difficult to plough, lime or fertilise
>25°	Very steep (6)	Mass movement occurs, animal tracks across slope appear and mechanisation impossible without specialised equipment

Soil pattern can affect capability in that small and intricate variations can mean that a mixture of land of poor capability prevents the cultivation or land of good capability (e.g. variation in soil depth can be marked).

Liability to erosion (e)

Two major forms of erosion are recognised: wind and water. Wind erosion is prevalent on sandy or light peat soils in exposed conditions, especially when the vegetation cover is removed. Water erosion includes coastal erosion, sheet, rill and gully erosion on steep bare slopes (or even gentle slopes after very heavy rainfall) and river bank erosion.

Climatic limitations (c)

Differences in macroclimate influence land capability. Emphasis is placed on water balance and temperature during the main part of the growing season (i.e. April - September) to delinated three climatic groupings defined as:

Group Definition

I	R-PT < 100mm and T(x) > 15°C No or only slight climatic limitations imposed on crop growth
II	R-PT < 300mm and T(x) > 14°C Moderately unfavourable climate which restricts choice of crops
III	R-PT > 300mm or T(x) < 14°C Moderately severe to extremely severe climatic which further limits the range of crops

where R = average rainfall (mm)

PT = average potential transpiration (mm)

T(x) = long term average of mean daily maximum temperature

www.agriculture.gov.au › abares › aclump › Documents

Self-Check - 2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Explain Gradient and soil pattern limitations(5pts)

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

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

Answer Sheet

Score = ____________

Rating: _____________

Name: ___________________________ Date: ________________

Information Sheet-3	Determining Land gradient of the command area

3.1 **Determining Land gradient of the command area**

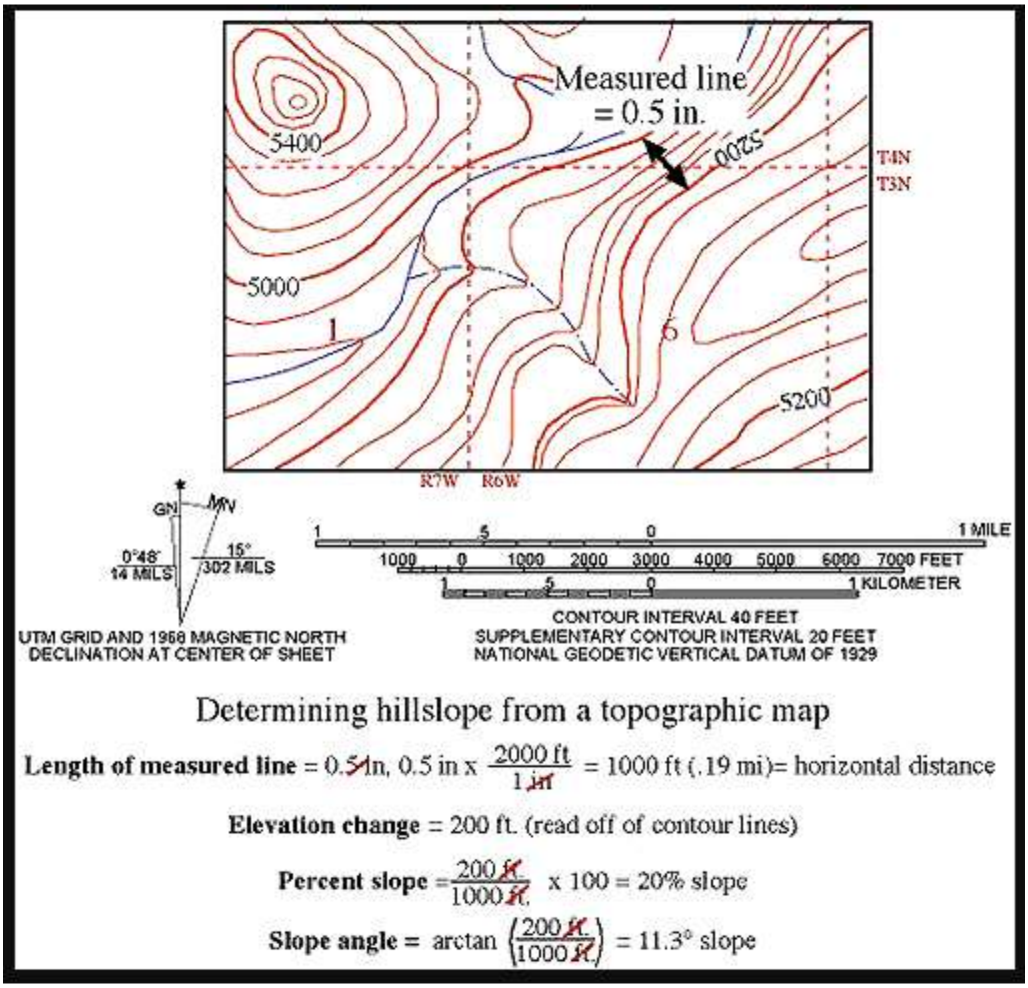
Determining the average slope of a hill using a topographic map is fairly simple. Slope can be given in two different ways, a percent gradient or an angle of the slope. The initial steps to calculating slope either way are the same.

- ✓ Decide on an area for which you want to calculate the slope (note, it should be an area where the slope direction does not change; do not cross the top of a hill or the bottom of a valley).
- ✓ Decide on an area for which you want to calculate the slope (note, it should be an area where the slope direction does not change; do not cross the top of a hill or the bottom of a valley).
- ✓ Once you have decided on an area of interest, draw a straight line perpendicular to the contours on the slope. For the most accuracy, start and end your line on, rather than between, contours on the map.
- ✓ Measure the length of the line you drew and, using the scale of the map, convert that distance to feet. (insert image with the line drawn on it, conversion calculation)
- ✓ Determine the total elevation change along the line you drew (subtract the elevation of the lowest contour used from the elevation of the highest contour used). You do not need to do any conversions on this measurement, as it is a real-world elevation change

To calculate a percent slope, simply divide the elevation change in feet by the distance of the line you drew (after converting it to feet). Multiply the resulting number by 100 to get a percentage value equal to the percent slope of the hill. If the value you calculate is, for example, 20, then what this means is that for every 100 feet you cover in a horizontal direction, you will gain (or lose) 20 feet in elevation.

To calculate the angle of the slope, divide the elevation change in feet by the distance of the line you drew (after converting it to feet). This is the tangent value for the angle of the slope. Apply an arctangent function to this value to obtain the angle of the slope (hit the 'inv' button and then the 'tan' button on most scientific calculators to get the slope angle). The angle you calculated is the angle between a horizontal plane and the surface of the hill.

Using the example above, (click here or on image for larger picture) a hill with a 20% slope is equivalent to an 11° slope.


Measured line = 0.5 in.
5400
5200
5000
1
6
5200
T4N
T3N
R7W
R6W
GN
MN
0°48'
14 MILS
15°
302 MILS
UTM GRID AND 1968 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET
1 .5 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER
CONTOUR INTERVAL 40 FEET
SUPPLEMENTARY CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
Determining hillslope from a topographic map
Length of measured line = 0.5 in, 0.5 in x 2000 ft / 1 in = 1000 ft (.19 mi)= horizontal distance
Elevation change = 200 ft. (read off of contour lines)
Percent slope = 200 ft. / 1000 ft. x 100 = 20% slope
Slope angle = arctan (200 ft. / 1000 ft.) = 11.3° slope

Self-Check - 3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Explain the steps how to calculate slope from topographic map (5pts).

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

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Information Sheet-4	Gathering Indigenous practice irrigation methods

4.1 Indigenous practice irrigation methods

Where indigenous communities have traditionally practiced dry-land farming, irrigation technologies and associated management systems and cropping strategies, have much to offer. Just as irrigation development sparked the Green Revolution, irrigation can play a key role in supporting sustainable livelihoods in the future. Yet irrigation is a powerful tool that can have transformational effects on rural societies. This power implies the need for careful consideration in designing irrigation interventions among culturally distinct indigenous communities.

Every indigenous agricultural community owes its existence to countless generations of ancestors who accumulated and transmitted knowledge about the environment and the cultivation of crops. Respecting that knowledge, and actively seeking to understand it, is a logical pre-requisite to introducing any new technologies or management arrangements.

When new technologies are consciously designed to incorporate the essential features of the pre-existing technologies, the effect can be to strengthen indigenous institutions and culture, even as the traditional technology becomes superseded by the new. An example is seen in the modernization of traditional river diversion weirs in northern Thailand. The communal organizations, which managed the irrigation systems served by traditional bamboo weirs, requested local government aid in replacing the bamboo weirs with permanent concrete structures. The result is improved infrastructure, and also a strengthened organization.

In contrast, the technical interventions in Balinese subak systems introduced by the Asian Development Bank in the 1980s resulted in severe social and cultural impacts (as well as environmental ones). The ADB project replaced the seemingly inefficient proportional dividers (which defined water allocation to individual subaks) with conventional division boxes, resulting in confusion and conflicts over water rights. The design issues relating to the physical infrastructure of indigenous irrigation systems constitute an important domain of interest, which has attracted research attention both by engineers9 as well as by social scientists. The larger component of the indigenous knowledge of irrigated agriculture pertains not to the irrigation system, but to the agricultural system: the crops and agricultural practices.

The richness of indigenous agricultural knowledge is difficult for outsiders to appreciate because it is predicated on a very different set of assumptions than most rational Westerners are accustomed. For most, and perhaps all indigenous peoples, agriculture is as much a spiritual practice as a subsistence practice.

Irrigation development can also contribute to the preservation of these traditions through helping ensure the economic feasibility of agriculture. Yet irrigation's role can be helpful to cultural diversity only if the style of both the irrigation and the agriculture is consistent with those traditions. For example, a Balinese ceremony blessing the fish in the rice paddies presumes that the fish have not been killed by pesticides. A respect for indigenous agricultural traditions will almost inevitably lead to choices about irrigation development that will support those agricultural traditions, and more broadly, other cultural and spiritual traditions of the particular society.

Self-Check - 4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

2. **Why we Gather Indigenous practice irrigation methods**?(10pts)

Note: **Satisfactory rating 10 points** **Unsatisfactory - below 10 points**

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Reference

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