**The first lecture**

**INTRODUCTION**

***1-1 Definition of Agrometeorology***

Agrometeorology, abbreviated from agricultural meteorology, science of meteorology to the

service of agriculture, in its various forms and facets, to help with the sensible use of land,

to accelerate the production food, and to avoid the irreversible abuse of land resources

(Smith, Agrometeorology is also defined as the science investigating the logical,

climatological, and hydrological conditions that are sign if agriculture owing to their

interaction with the objects and processes culture production (Molga, 1962). The definition

of biometeorology adopted by the International Society Biometeorology (ISB) states,

“Biometeorology is an interdisciplinary science dealing with the application of fields of

meteorology and climatology biological systems” (Hoppe, 2000, p. 383). The general scope

includes kinds of interactions between atmospheric processes and living isms—plants,

animals, and humans. By this definition, it becomes that there are roughly three sub

branches of biometeorology: plant, and human biometeorology (Hoppe, 2000). The domain

of agrometeorology is the plant and animal sub branches. The third sub branch,

biometeorology, is outside the scope of agrometeorology.

***1-2 Importance and applications of Agrometeorology***

There is hardly a branch of human activities as dependent on the weather as agriculture.

Agricultural production is for a large part still dependent on weather and climate despite

the impressive advances in agricultural technology over the last half a century. More than

ever, agrometeorological services have become essential because of the challenges provided

to many forms of agricultural production by increasing climate variability and associated

extreme events as well as climate change, all of which affecting the socio-economic

conditions, especially of developing countries.

***1-2-1 Applications***

The practical application of this knowledge is linked to the availability and accuracy of

weather and climate forecasts or expected weather and climate patterns, depending on the

time scale. The requirements range from accurate details of short-range weather forecasts

(less than two days), medium range forecasts (less than ten days) at certain critical times to

seasonal predictions of climate patterns. To ensure that development plans are not rendered

meaningless by a significant change in weather and climate behavior, indications of possible

climatic variability, and of increasingly frequent and serious extreme events in the context

of global climate change, are necessary as agrometeorological services in addition to the

application of other agrometeorological information. Although reliable long-term weather

forecasts relevant to the agricultural community are not yet available on a routine basis all

over the world, significant services may be provided by means of agrometeorological

forecasts such as on the dates of phonological events, the quantity and quality of crop yields,

and the occurrence of animal and crop epidemics. regionally and at world scale. Long-term planning of global food production must therefore take into account the effects of year-to-year fluctuations in weather patterns,

The global climate is influenced by a lot of factors. Two of the most important components are CO2 and water vapor in the atmosphere. Beside the oceans, forests absorb CO2 and release water vapor. Burning forests produce considerable masses of CO2. So it is necessary to promote reforestation and protect forests against fire and human beings as well as against other destruction, such as by insects, diseases and pollutants.

Forest meteorology as a component of agrometeorology provides useful information and services for application to the forest authorities, the foresters and in case of forest fires to the fire-brigades. Agrometeorological services in developing countries have to shoulder greater responsibilities due to greater population pressure and changing modes of agricultural practices. More and more demands pertaining to agrometeorological information and services are expected from the farming communities in the future on technologies, farming systems patterns, water management, weather based pest and disease control etc., preferably with local innovations as starting points. Thus the future challenges include the necessity to emphasize a bottom up approach so that forecasts, specific advisories and contingency planning reach even the small farmers for applications in their planning and day-to-day agricultural operations.

Other important advisory fields that require attention are:

Management and modification of microclimate.

Meteorological information for guiding irrigation and drainage.

Environmental risks and disaster mitigation.

Highland and mountain agriculture.

Prediction of El-Nino and rainfall variability for agricultural planning.

Information on weather based pesticides/insecticides applications.

Arial transport of pollutants and knowledge regarding low level winds for

operational activities.

Workday probabilities (e.g. in marine and lake fishing).

Agro advisory services for farmers on a regional level to strengthen and provide

accurate forecasts and advisories for the farming community.

Communication of information in a format/language understandable to users.

In more advanced agricultural production, with potential for technology transfer where the

absorption capacity exists, we may add:

Crop weather modelling with special emphasis on crop growth simulation models.

Development of complex data collection systems and speedy processing and

interpretation of large spatial data collections.

Geographical information systems and their use for crop planning at smaller than

present scales.

The use of remote sensing technologies to generate information/ advisories for large

areas.

Quantifying Carbon sequestration.

Use of audio-visual media and internet for quick dissemination of information to

the users.

***2-1 The relation between physical climatology and Agrometeorology and their***

***Effects***

A branch of meteorology that examines the effects and impacts of weather and climate on

crops, rangeland, livestock, and various agricultural operations. The branch of agricultural

meteorology dealing with atmospheric-biosphere processes occurring at small spatial scales

and over relatively short time periods is known as micrometeorology, sometimes called crop

micrometeorology for managed vegetative ecosystems and animal biometeorology for

livestock operations. The branch that studies the processes and impacts of climatic factors

over larger time and spatial scales is often referred to as agricultural climatology.

Agricultural meteorology, or agrometeorology, addresses topics that often require an

understanding of biological, physical, and social sciences. It studies processes that occur

from the soil depths where the deepest plant roots grow to the atmospheric levels where

seeds, spores, pollen, and insects may be found.

Agricultural meteorologists characteristically interact with scientists from many disciplines.

Agricultural meteorologists collect and interpret weather and climate data needed to

understand the interactions between vegetation and animals and their atmospheric

environments. The climatic information developed by agricultural meteorologists is

valuable in making proper decisions for managing resources consumed by agriculture, for

optimizing agricultural production, and for adopting farming practices to minimize any

adverse effects of agriculture on the environment. Such information is vital to ensure the

economic and environmental sustainability of agriculture now and in the future.

Agricultural meteorologists also quantify, evaluate, and provide information on the impact

and consequences of climate variability and change on agriculture. Increasingly,

agricultural meteorologists assist policy makers in developing strategies to deal with

climatic events such as floods, hail, or droughts and climatic changes such as global

warming and climate variability. Agricultural meteorologists are involved in many aspects

of agriculture, ranging from the production of agronomic and horticultural crops, trees, and

livestock to the final delivery of agricultural products to market. They study the energy and

mass exchange processes of heat, carbon dioxide, water vapor, and trace gases such as

methane, nitrous oxide, and ammonia, within the biosphere on spatial scales ranging from

a leaf to a watershed and even to a continent. They study, for example, the photosynthesis,

productivity, and water use of individual leaves, whole plants, and fields. They also examine

climatic processes at time scales ranging from less than a second to more than a decade.

**Agricultural Climatology**

In general, the study of climate as to its effect on crops; it includes, for example, the relation

of growth rate and crop yields to the various climatic factors and hence the optimum and

limiting climates for any given crop. Also known as agroclimatology.

**Biometeorology**

A branch of meteorology and ecology that deals with the effects of weather and climate on

plants, animals, and humans. The principal problem for living organisms is maintaining an

acceptable thermal equilibrium with their environment. Organisms have natural

techniques for adapting to adverse conditions. These techniques include acclimatization,

dormancy, and hibernation, or in some cases an organism can move to a more favorable

environment or microenvironment. Humans often establish a favorable environment

through the use of technology.

**Climatology**

The scientific study of climate. Climate is the expected mean and variability of the weather

conditions for a particular location, season, and time of day. The climate is often described

in terms of the mean values of meteorological variables such as temperature, precipitation,

wind, humidity, and cloud cover. A complete description also includes the variability of

these quantities, and their extreme values. The climate of a region often has regular seasonal

and diurnal variations, with the climate for January being very different from that for July

at most locations. Climate also exhibits significant year-to-year variability and longer-term

changes on both a regional and global basis. The goals of climatology are to provide a

comprehensive description of the Earth’s climate over the range of geographic scales, to

understand its features in terms of fundamental physical principles, and to develop models

of the Earth’s climate for sensitivity studies and for the prediction of future changes that

may result from natural and human causes.

**Crop Micrometeorology**

The branch of meteorology that deals with the interaction of crops and their immediate

physical environment.

**Micrometeorology**

The study of small-scale meteorological processes associated with the interaction of the

atmosphere and the Earth’s surface. The lower boundary condition for the atmosphere and

the upper boundary condition for the underlying soil or water are determined by

interactions occurring in the lowest atmospheric layers. Momentum, heat, water vapor,

various gases, and particulate matter are transported vertically by turbulence in the

atmospheric boundary layer and thus establish the environment of plants and animals at

the surface. These exchanges are important in supplying energy and water vapor to the

atmosphere, which ultimately determine large-scale weather and climate patterns.

Micrometeorology also includes the study of how air pollutants are diffused and transported

within the boundary layer and the deposition of pollutants at the surface. In many

situations, atmospheric motions having time scales between 15 min and 1 h are quite weak.

This represents a spectral gap that provides justification for distinguishing micrometeorology from other areas of meteorology. Micrometeorology studies phenomena

with time scales shorter than the spectral gap (time scales less than 15 min to 1 h and

horizontal length scales less than 2–10 km). Some phenomena studied by micrometeorology

are dust devils, mirages, dew and frost formation, evaporation, and cloud streets.

**Ecosystem**

An ecosystem is a complete community of living organisms and the nonliving materials of

their surroundings. Thus, its components include plants, animals, and microorganisms; soil,

rocks, and minerals; as well as surrounding water sources and the local atmosphere. The

size of ecosystems varies tremendously. An ecosystem could be an entire rain forest,

covering a geographical area larger than many nations, or it could be a puddle or a backyard

garden. Even the body of an animal could be considered an ecosystem, since it is home to

numerous microorganisms. On a much larger scale, the history of various human societies

provides an instructive illustration as to the ways that ecosystems have influenced

civilizations.