Concept & Scope of Agrometeorology

Agro-Meteorological Information Systems Development Project
Component-C of Bangladesh Weather and Climate Services Regional Project
Department of Agricultural Extension (DAE), Ministry of Agriculture,Bangladesh

History of Evaluation of Subject of Agrometeorology

- Major disastrous weather phenomena like cyclones, floods, droughts and frosts attract major attention for provision of relief to affected personnel.
- However, millions of farmers suffer considerable crop losses annually from aberrations in the temporal march of weather parameters.
- Thus in order to develop a science to understand and providing service, the subject of Agrometeorology is evolved.
- Agriculture is the primary national concern. The study of meteorology from the angle of agricultural operations is therefore the greatest importance.

Definition of Agrometeorology

- Meteorology: Science of of weather phenomena, science of weather, science of the atmosphere,: science dealing with processes processes that take place in the atmosphere.
- Agrometeorology : transforming knowledge on weather & climate to useful information for agriculture .
- Agricultural meteorology is the science which deals with the interaction of atmosphere with crops, grasses, trees, animals, poultry, fishery pest and diseases etc.
- Agrometeorology puts the science of meteorology to the service of agriculture, in its various forms and facets, to help the sensible use of land, accelerate production of food and to avoid the irreversible abuse of land resources.

Role of Agrometeorology

- To increase the efficiency of agricultural planning by accurate forecasting of weather, predicting crop yields and quality, estimating livestock production and climatic hazards and controlling the physical environment.
- To transfer of laboratory and green house results to the open field. Under laboratory or green houses, the biological responses have been measured under controlled conditions and these are extended for field conditions.

Agrometeorology: An Inter-disciplinary science

- Agrometeorology is an inter-disciplinary science in which the main scientific disciplines involved are:
- atmospheric and soil sciences which are concerned with the physical and chemical environment; plant sciences and animal sciences including their pathology, entomology and parasitology etc. which deal with the content of biosphere.
- The agricultural meteorology links together the physical environment and biological responses under natural conditions. Thus, agrometeorology makes use of several physical, biological and applied agricultural sciences. The physics of the air and soil forms the foundation of agrometeorology.

Task of of agrometeorology

- Detecting the effects of meteorological conditions on plants.
- Processes of of plant production and
- Activities associated with plant production
- The task of an agro-meteorologist is to apply every relevant meteorological skill to help the farmer to make the most efficient use of his physical environment for improving agricultural production both in quality and quantity
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The major activities/components undertaken under agricultural meteorology

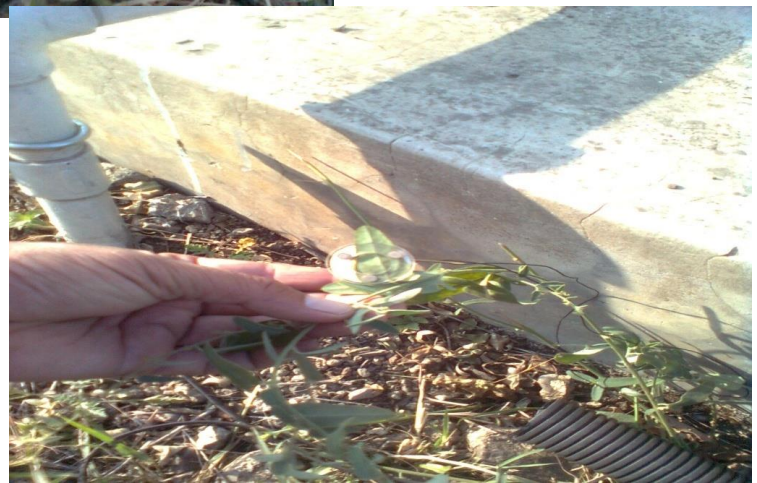
- **Observational network, data generation and archiving.**
- **Operational weather services to farmers.**
- **Crop weather studies and preparation of crop weather calendars. Crop modelling and yield forecast.**
- **Drought & other extreme events studies.**
- **Pests and diseases study including study of desert locust.**
- **Application of remote sensing.**
- **Research activities.**

Data collection

Vast network of various observatories, data is generated, scrutinized and then archived •

The base of information services: data collection based on the principle of parallel of observation (data collection based on the whole of air-soil -plant system).

- Data processing : (control, correction, organization).
- After proper processing data can be used for research, information purposes.



Meteorological observations and measurements

- The most important factors concerning crop production :
- solar radiation
- air temperature
- soil temperature –in the upper layers of the soil soil(2, 5, 10, 20 cm), 3 times a day in depths of 50, 100, 150 of 200 cm, once a day
- precipitation((once a day , in the morning)

Agrometeorological observation network

- Agrometeorological stations are are listed into three groups :
- **Main agrometeorological station**

•They perform detailed and and simultaneous meteorological and phenological observations

•They conduct agrometeorological research (observatories)

- **General agrometeorological station**
- they are mostly related to a given synoptic or climate station performing specifically tasks associated also with agricultural production.
- **Additional agrometeorological stations.**
- Agricultural observations are only intermittently

Crop weather studies and preparation of crop weather calendars

- **The role of weather on crop growth, their development is studied and crop weather calendars are prepared for the major crops grown in the district.**

- **The components of crop weather calendars include**

  (i) weather warning for the crops at various crop phenophases,

  (ii) normal weather with weather favourable for pests and diseases development.

CROP WEATHER CALENDAR

STATE : ANDHRA PRADESH
CROP : GROUNDNUT(K)
VARIETY : TMV-2, JL-24, TMV-2, K3 (IMPROVED)
SOIL : RED SANDY LOAM/ SANDY CLAY LOAM
DISTRICTS : KHAMMAM, WARANGAL, KRISHNA, KARIMNAGAR
NON-IRRIGATED
DURATION : 100-110 DAYS

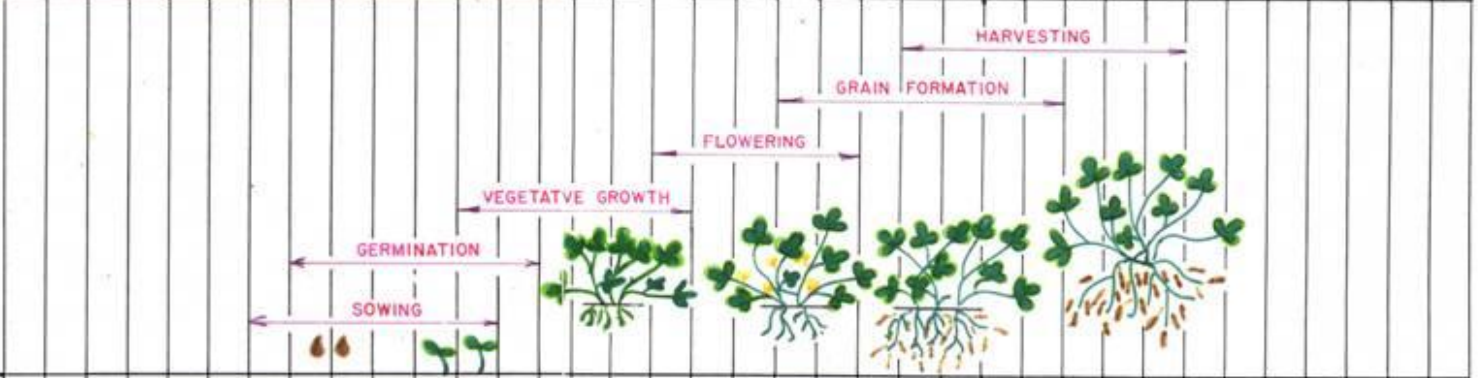
Weather warnings	Rain	> 50 MM	> 50 MM	> 30 MM
	Duration Of Wet Spell	> 10MM FOR 3 DAYS	> 30 MM FOR 3 DAYS	> 30 MM FOR 3 DAYS
	Cloudy Weather		CLOUDY WEATHER	CLOUDY WEATHER
	Drought	> 20 DAYS	> 20 DAYS	> 20 DAYS
	High Winds			
	Temperature	MAX.TEMP. > 35°C, MIN. TEMP. < 10°C	MAX. TEMP. > 40°C, MIN. TEMP. < 18°C	MAX. TEMP. > 40°C, MIN. TEMP. < 18°C
	Hail Storm			HAILSTORM
Weather conditions favourable for incidence of pests and diseases	Pests	APHIDS, ROOT GRUB, LEAF FOLDER LEAF MINOR	APHIDS, THRIPS, LEAF FOLDER, LEAF MINOR	RED HAIRY CATERPILLAR
	Weather	CLOUDY WEATHER, RAIN, HIGH RH WITH LOW TEMP.	LOW TEMP AND HUMIDITY, CLOUDY WEATHER, AND RAINS	LOW TEMP AND LOW RH, CLOUDY WEATHER RAINS
	Diseases	COLLAR ROT, STEM ROT, WILT, LEAF WEBBR	TIKKA, LEAF SPOT, SPEDOTIVE, BUDNECROSIS	TIKKA, LEAF SPOT, RUST, ROOT ROT, COLLAR ROT
	Weather	HIGH RH, LOW TEMP, CLOUDY WEATHER	HIGH RH, LOW TEMP, CLOUDY WEATHER	HIGH RH, LOW TEMP, CLOUDY WEATHER

Normal phase wise Water requirement (mm): 54.3 | 118.4 | 172.5 | 127.6 | 99.5

Weekly normal weather

Standard weeks	Rainfall (mm) total	Max. temp. °C	Min. temp. °C	Sunshine hours
24	28.3	37.5	26.6	5.6
25	44.2	36.0	26.3	5.6
26	48.8	34.0	25.4	4.0
27	50.3	33.6	25.0	4.0
28	54.9	33.1	24.9	4.9
29	57.4	33.1	25.0	4.7
30	64.1	32.7	24.7	4.8
31	50.7	31.8	24.5	4.
32	42.1	32.2	24.5	4.9
33	43.2	32.5	24.6	5.9
34	48.2	31.8	24.6	4.3
35	43.3	32.2	24.4	5.0
36	47.3	32.2	24.2	4.5
37	39.8	32.6	24.4	6.0
38	42.7	32.7	24.3	5.4
39	38.6	32.7	24.1	5.8
40	25.1	33.3	23.7	5.3
41	21.2	33.1	23.3	6.7
42	23.0	32.6	22.7	7.2
43	18.1	32.3	22.0	7.3
44	19.0	31.6	21.5	7.8
45	13.3	31.5	20.4	8.1

Life history and mean dates of important epochs of crop growth



Standard weeks: 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48

Months: JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER

SSH → Sunshine hours, DUR → Duration, RH → Relative Humidity

Pests and diseases study including study of desert locust

- **Temperature (both the maximum and the minimum), relative humidity, rainfall, cloudiness, soil moisture, wind, light, have influence on occurrence of pests and diseases and hence, are useful in developing forewarning models.**

- **Pest weather calendars are also prepared by using these parameters, which can act as reference tool.**

PEST WEATHER CALENDAR

STATE:KERALA **CROP:RICE** **SEASON : KHARIF**
STATION:PATTAMBI **PEST:GALL MIDGE**

Weather warnings	Max. temp. 0C	>33.3°C(36 wk)							
	Min. temp. 0C								
	Morning RH (%)								
	Afternoon RH (%)	<71.0%(36 wk)							
	Sunshine hours	>7.4hour(36 wk)							
	Total Rainfall (mm)								
Weekly normal weather	Rainfall(mm) total	37.9	33.8	41.5	65.7	47.2	55.2	78.1	61.7	53
	Max. temp. °C	30.1	30.5	30.6	30.5	30.8	31.2	31.5	31.4	31.9
	Min. temp. °C	22.8	22.9	22.9	22.9	22.9	22.9	22.9	22.8	22.7
	Sunshine hours	6.3	6.8	6.3	6.3	6.0	6.3	5.7	6.2	6.7
	Morning RH (%)	94	94	94	94	95	95	95	94	94
	Afternoon RH (%)	70	67	70	67	69	68	68	67	64
Mean dates of important epochs of crop growth and pest development		 Egg	 Larva	 Adult			 Flowering			
		Transplanting			Vegetative growth					
Standard weeks		36	37	38	39	40	41	42	43	44
Months		SEPTEMBER					OCTOBER			

Radiation and Thermal balance at the ground surface

- A detail investigation into the processes which control the thermal balance at the ground surface is necessary for an understanding of physics of air and soil layers near the ground.
- A knowledge of the radiant energy received from the Sun and the Sunlit sky and its absorption by the ground and air layers near it and of the radiative exchange between the ground and the atmosphere in the infra-red regions of the spectrum is of great importance.
- Apart from the fact that Solar radiation is a major control in all atmospheric processes, the duration and intensity of this radiation are important for photo-synthesis which plays a vital role in plant growth.

Rainfall Analysis for Agriculture

- Rainfall is highly variable in the Dry Farming Tract both in time and space.
- The Dry Farming Tract is defined as an area where annual rainfall varies from 40 cm to 100 cm.
- Computation of coefficient of variation (CV) and frequency of departure of rainfall from normal are prepared.
- Hence, those maps are prepared for annual and monthly rainfall.
- Information about expected amount of rainfall at various risk levels is more useful for planning and management of agriculture especially in the tropics.

Agroclimatic Classification

- In order to bring out agricultural potential of a region, its agroclimatic classification is made.
- This classification is done on objective and rational basis.
- Rainfall alone is not sufficient for evaluating the agricultural potential of the area because the influence of same amount of rainfall will be different depending on the atmospheric demand and type and depth of soil.
- A methodology for agroclimatic classification involving (i) risk factors and (ii) minimum water requirement factor at various phytophases of the crops are made.

Agroclimatic Atlas

- To develop new genetic strains and evolving the most effective agricultural practices, much climatic information is required.

- This relates not only to rainfall and atmospheric temperature, humidity etc., but also to radiation, evaporation and soil moisture.

- In view of this Agroclimatic Atlas at country level is prepared. It is anticipated that this will be useful to different agricultural scientists / planners.

Agrometeoroloical models/ *Crop Yield Forecasting*

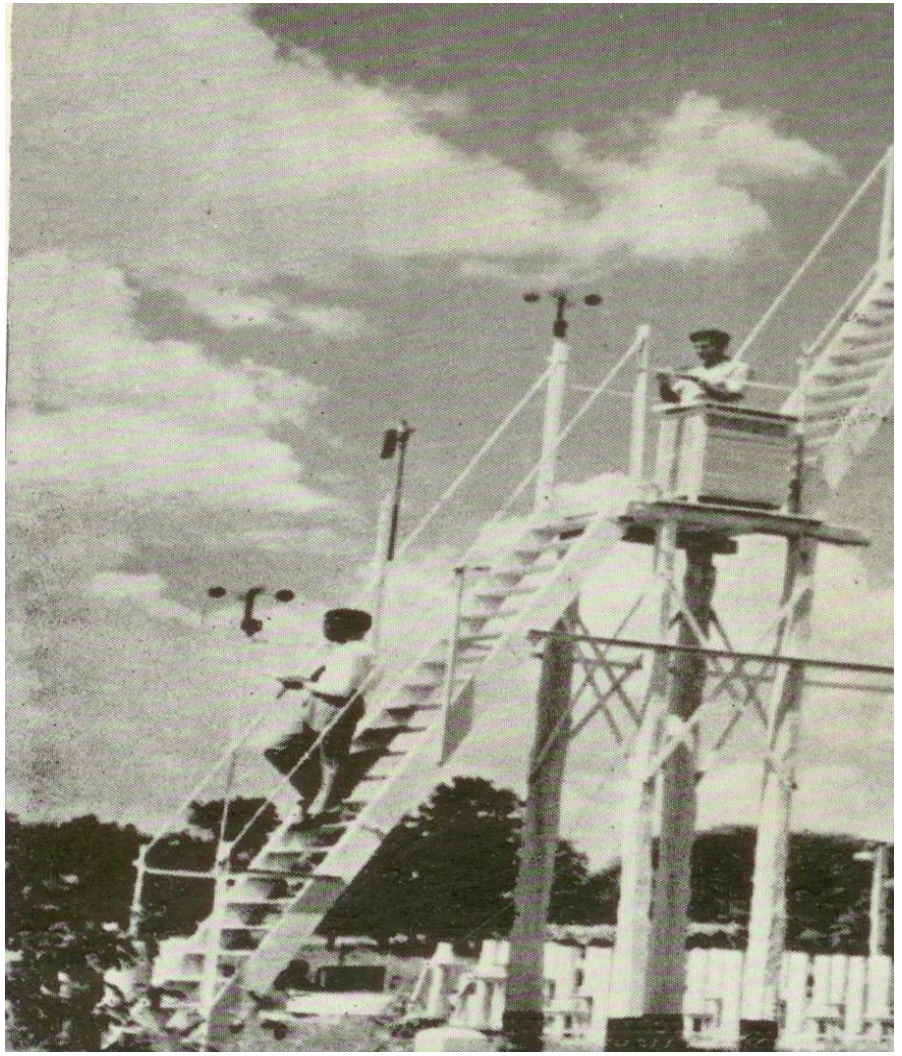
- **Crop yield forecast models are prepared for estimating yield much before actual harvest of the crops. By use of empirical-statistical models using correlation and regression technique crops yield are forecast.**
- **Empirical/statistical Model**
- Crop growth is often described by an empirical model, consisting of a regression equation. These models can generate accurate yield predictions, especially when the regression parameters are estimated on the basis of extensive sets of experimental data.
- **Crop simulation model**
- A crop simulation model is a computer model used to simulate reality. These models are designed to predict the effect of a future land use scenario on a suite of plant indicators (growth, development and yield etc.). Crop simulation models are state of the art technology that allow the user to estimate crop growth and yield as a function of weather conditions and management scenarios

Phenological Studies

- Phenology is the science which deals with the recurrence of the important phases of animal and vegetable life in relation to the march of seasons during the year.
- There is every chance that phonological observations, i.e. recording of the dates such events as leafing, flowering, fruiting and leaf-fall of trees, migration of birds, the appearance of insects and the like which recur every year, may provide some indication at least in a quantitative way, of the nature of the coming season.

Microclimatic Study

- It is interesting to note that crops find to develop characteristic microclimatic climates which significantly from and are not in simple manner with the climate of open.
- Systematic observations on the characteristic micro-climates of the air layers close to the ground in the open and inside various crops are recorded, and a large volume of micro-climatological data collected for its use..



Adverse weather phenomena

- The fluctuations of weather may often occur so thus prepared suitable diagrams of the frequencies of occurrence of various adverse weather phenomena (like hail storms, frosts, etc.) that affect growing crops, extremes of temperature met with in summer and winter, estimated evaporating power of the atmosphere etc.
- Such diagrams help to show how often the farmer may be called upon to mitigate the effects of adverse weather phenomena by resorting to possible protective measures like artificial heating, use of wind brakes, etc.

Vine affected by frost **Wind break of jowar stalks in vine garden at**

Importance of Agrometeorological Information at High Resolution Scale.

- Land-based agrometeorological network and data analyses can not give a true national picture of weather-induced setbacks to crops due to great areal variations in incidence of weather.
- Satellite imageries of agrometeorologically relevant parameters are increasingly coming into vogue to get a realistic picture of areal extent and distribution of crops, periods, times and regions of occurrence of crop droughts, floods, frosts etc. and their severity

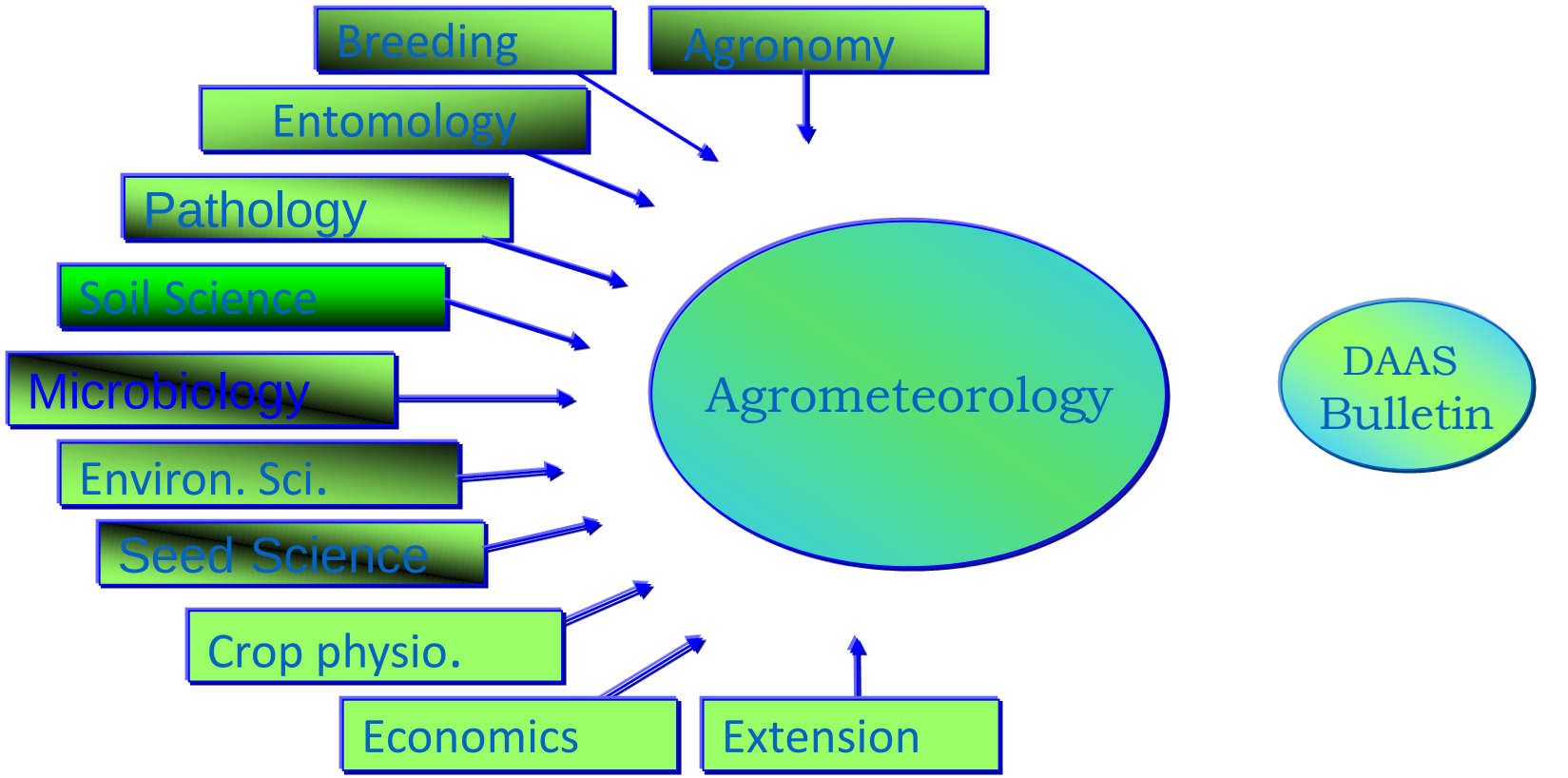
Application of remote sensing

- Crop yield estimation using meteorological, agrometeorological and remote sensing data and development of crop specific and area specific crop growth and yield models.
- **Spectral response of crops at various phenophases is used in this study.**
- **NOAA AVARR data on daily basis can help in monitoring agriculture. Estimation of surface temperature based on NOAA AVARR data enables computation of evapotranspiration.**
- **Estimation of soil moisture using remote sensing technique.**
- **Crop water stress using remote sensing data, crop acreage and production estimation.**

Agromet Advisory Services

- A national meteorological or other agrometeorological services contributes to the national economy and obtain best recognition and remuneration for the investments made in agricultural meteorology throughout the effective use of information by the agricultural community in the widest sense.
- The scope and purpose of Operational Agrometeorology is to apply relevant meteorological skill to help the farmers to make the most efficient use of physical environment with the prime aim of improving agricultural production both in quality and quantity.

Panel of Experts from Different Departments at universities involved in preparation of Agromet Advisories



Drought studies

- **To monitor drought on a real time basis, aridity anomaly maps & Standard Precipitation Index for the whole country are prepared and is issued once in a fortnight.**

- **The departure of aridity index (which basically is the ratio of water deficit to water need) from the normal value is expressed in percentage and accordingly drought is categorized.**

Research in Agrometeorology

- The thresholds : between upper and lower values of which the production is possible and economic, or below or upper of them the plants are damaged or completely destroyed.
- The territorial extremes: between which life phenomena of the individual plants occur in a particular area.
- Probability values of the meteorological conditions in in a given production that characterize economic growing of the individual plants, conditions of the performance of the agricultural work, and favourable conditions of the effective implementation of agricultural procedures.

Research

- Agrometeorological researches can be classified into three groups: :

1. Agroclimatological research
2. Filed trials
3. Methodological research


THANK YOU