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CAgM, USDA and the National Drought Policy Commission Associated with WAMIS

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ABSTRACT

Agrometeorological information is essential in many agricultural decisions if it reaches the user in a timely and appropriate manner. Agriculture is the backbone to local, regional, and global economic development. Thus, strengthening agrometeorological application to diverse agricultural sectors will benefit economic development. This paper discusses three distinct organizational missions that all share the same need for improved information technology. The World Meteorological Organization's (WMOs) Commission for Agricultural Meteorology (CAgM) has global responsibility for improved agrometeorological services of Members to aid agricultural production and to conserve natural resources. The United States Department of Agriculture, World Agricultural Outlook Board, publishes monthly World Agricultural Supply and Demand Estimates, considered to be a benchmark for both government and industry in production and trade decisions. The National Drought Policy Commission (NDPC), created by an act of the United States Congress, formulated a national drought policy based on preparedness rather than on crisis management. All three organizations recognize the need for IT applications in agricultural meteorology and have been active in implementing this technology. The development of information technology offers new means of dissemination of agrometeorological products. World Agrometeorological Information Service (WAMIS) has taken advantage of the global Internet application to offer WMO Members a dedicated web server to host agrometeorological bulletins and training modules.

Key words : **WAMIS, CAgM, Agrometeorology, Internet, WAOB, IT applications, Agrometeorological product**

I. WMO CAGM

In 1951, the WMO, one of the specialized agencies of the United Nations, was established. The Organization is comprised of the Congress, the Executive Council, the six Regional Associations, the eight Technical Commissions of which the CAgM is one, and the WMO Secretariat.

As defined under Annex III (Structure and terms of reference of technical commissions) of the Basic Documents No. 1 (2003 edition) of WMO, the Commission for Agricultural Meteorology shall be responsible for matters relating to:

1) Applications of meteorology to agricultural cropping systems, forestry, and agricultural land use and livestock management, taking into account meteorological and agricultural developments both in the scientific and practical fields;
2) Development of agricultural meteorological services

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of Members by transfer of knowledge and methodology and by providing advice in particular on:

a) The most practical use of knowledge concerning weather and climate for agricultural purposes such as conservation of natural resources, land management, intensification of crop production, increase in the area of agricultural production, reduction of production costs, the improvement of agricultural products and the selection of varieties of plants and breeds of animals that are better adapted to the climatological conditions and their variability;
b) The combating of unfavourable influences of weather and climate on agriculture and animal husbandry, including weather related pests and diseases;
c) The protection of agricultural produce in storage or in transit against damage or deterioration due to the direct and indirect influences of weather and climate;
d) The use of weather and agrometeorological forecasts and warnings for agricultural purposes;
e) The interactions between air pollution and vegetation and soil.

3) Methods, procedures, and techniques for the provision of meteorological services to agriculture including farmers and forestry and rangeland operations;
4) Formulation of data requirements for agricultural purposes;
5) Introduction of effective methods for disseminating agrometeorological information, advice and warnings to agriculture by mass media;
6) Meteorological aspects of desertification;
7) Fisheries (food aspects only).

The following projects are currently being implemented by the Agricultural Meteorology Programme.

Project 1 - Agrometeorological Applications

To promote further development and application of basic knowledge on relationships between meteorological factors and agricultural production including its quality and protection of the agricultural resource base and the output for sustainable management of farming systems, forestry and livestock in line with the World Food Summit Plan of Action. One of the major activities includes the organization of training activities on applications of geographical information systems, agroecological zoning and other operational methodologies.

Project 2 - Use of Climate Forecasts in Operational Agriculture

The specific objective of the project is to promote more active use of seasonal to inter-annual climate forecasts and current weather advisories in agricultural planning and operations. Regional workshops on use of seasonal and inter-annual climate forecasts in agricultural planning and operations will be emphasized. Provision of support for selected case studies on use of seasonal and inter-annual climate forecasts and current weather advisories in agricultural planning and operations and their publication is also envisaged.

Project 3 - Agrometeorological data management

The specific objective of the project is to provide Members with techniques and methods to observe, register, collect, manage, store and exploit ground-based, radar and remotely sensed meteorological, climatological and agronomic data in the most timely and personnel-efficient manner. Regional training workshops on agrometeorological data management and an expert group meeting on software for agrometeorological data management will be organized. Publication of reports and multiplication and distribution of tested software on agrometeorological data management are envisaged.

Project 4 - Communication of Agrometeorological Information

The specific objective of the project is to develop methods, procedures and techniques for the dissemination of agrometeorological information. The development of a bottom-up approach of the full involvement of users is envisaged to ensure that the methods and procedures so developed will adequately respond to the appropriate needs of the users. A comprehensive review on current methods, procedures and techniques for the dissemination of agrometeorological information will be published. Appropriate methods and procedures with the active involvement of the users through interactive workshops will be developed.

Project 5 - Agrometeorology for extreme events

The specific objective of the project is to focus on

studies and applications of agrometeorological information needed to cope better with droughts and desertification, flooding, tropical cyclones, storm surges, locust invasions, and other spreading and intensifying environmental hazards. This project envisages to provide support to desertification information systems.

Project 6 - Agrometeorological Adaptation Strategies to Climate Variability and Climate Change

The specific objective of this project is to develop agrometeorological adaptation strategies to climate variability and climate change especially in the vulnerable regions where food and fibre production is most sensitive and vulnerable to climatic fluctuations. Regional workshops on agrometeorological adaptation strategies will be held and roving seminars to disseminate the results of these workshops are planned.

The long-term objectives of the program are to promote economically viable and high quality production so it can be sustainable and environmentally friendly by strengthening Members indigenous capabilities to provide relevant meteorological services to agriculture; and, to foster a better understanding by farmers and other end-users of the value and use of meteorological information for planning and operational use.

Agriculture is the backbone to local, regional, and global economic development. Weather and climate information plays a crucial role in many agricultural decisions. The application of this information to diverse agricultural sectors needs to be strengthened and adapted for local use which will benefit economic development.

II. USDA/WAOB

The World Agricultural Outlook Board (WAOB), created by the Secretary of Agriculture in 1977, serves as the Departmental global economic intelligence focal point for gathering information and analyzing developments that affect agriculture. Under the Board = s direction, interagency committees of experts develop official forecasts of supply, utilization, and prices for commodities. The Board is also responsible for coordination and clearance review of all commodity and agricultural outlook and situation analyses prepared within the Department of Agriculture. A major WAOB responsibility is to improve the consistency, objectivity, and reliability of outlook and situation material developed in the Department. Parallel to its role in Departmental forecasting work, the Board coordinates weather, climate, and remote sensing activities among USDA agencies. In addition, the Board has operational global responsibility for monitoring and analyzing the impact of weather on agriculture.

A primary focus of public interest is the monthly *World Agricultural Supply and Demand Estimates* report released by the Board. The forecasts in this monthly report, covering major commodities for the United States and the world, are considered authoritative as they are backed by USDA's unparalleled access to information and are based on a systematic and objective process. This report is considered as the benchmark for both government and industry. Information disseminated by the Board is used for essential production and trade decisions by farmers, ranchers, agribusiness, commodity traders, exporters, food processors, farm input suppliers, and other domestic and foreign agricultural sectors.

Weather plays a crucial role in agriculture. Daily farm management decisions are often dictated by weather events. Crop success or failure is determined by seasonal weather conditions. Extreme weather events and severe weather and climate anomalies can result in economic hardships at the regional and national levels.

How is weather information used by the Board? A staff of meteorologists from the National Weather Service works closely with agricultural meteorologists of the Board to gather and analyze global weather data (Motha and Heddinghaus, 1986). Reports are received from about 10,000 stations around the world. This activity, conducted jointly by NWS and WAOB since 1978, is referred to as the Joint Agricultural Weather Facility (JAWF). JAWF is located at USDA. The meteorologists are assigned from the Climate Prediction Center. Accurate assessments of weather = s impact on crops, grown throughout the world, contribute significantly to improving short-term supply/ demand forecasts. Great strides have been made by JAWF in obtaining near real-time weather monitoring tools, and in gathering more comprehensive crop and climate data for better analysis of weather = s impact on crops during the growing season.

On a daily basis, meteorologists track global weather developments and keep analysts informed of forecasts

and predictions in the major crop areas around the world. The agricultural meteorologists interpret the impact of seasonal weather to date on crops at their various growth stages. As part of a daily package of commodity and weather highlights, the Board sends a written summary of daily agricultural weather conditions, including NWS outlooks for the next 6-10 days, to the Secretary of Agriculture and top departmental staff.

The *Weekly Weather and Crop Bulletin*, published since 1872, has been a major responsibility of JAWF since 1978. Agricultural weather summaries of all major crop areas around the world are included in this report and are released to the public every Wednesday. The Board also formally briefs the Office of the Secretary each week on major commodity and weather developments.

The importance of weather information for commodity analysis cannot be over emphasized. Weather data are closely scrutinized to analyze the impact on crop yield potential. The monthly crop forecasts, which are used to revise the global supply and demand estimates, reflect the impact of observed weather during the growing season. Errors in the crop forecasts associated with critical growth stages may be introduced by imprecise information with respect to timing of weather events or by weather forecasts that do not verify. To narrow the crop forecasting error in its monthly revised estimates, the Department employs a normal weather assumption with respect to the remainder of the crop season. Valuable information is, however, gleaned from weather and climate predictions as an early-alert to help narrow scenarios for the remainder of the growing season.

III. NDPC

In the United States, drought has occurred in various parts of the country on a routine basis. After the 1930s, major drought episodes occurred in the Southern Plains during the early 1950s, in the Northeast in the early 1960s, in the far West during the mid-1970s, and again I the early 1980s, in the Midwest and parts of the Southeast in 1988, and in Hawaii and the East in the late 1990s. In July 1998, the U.S. Congress enacted Public Law 105-199, the National Drought Policy Act (Motha, 2000). This law created the National Drought Policy Commission (hereafter referred to a s NDPC) to advise Congress on the formulation of a national drought policy based on preparedness, mitigation, and risk management rather than on crisis management. The law directed the Commission to conduct a thorough study of ongoing drought programs, to present a strategy that shifts from ad hoc federal action toward a systematic process similar to those for other natural disasters, and to integrate federal programs with state, local, and tribal programs to ensure a coordinated approach to drought response.

Although drought frequently occurs in any given area of the United States, there is no national drought policy that focuses on reducing the impacts of this natural disaster. Many state and local governments include drought in their comprehensive water management, land use, and long-term planning strategies. State, local, and tribal governments must deal individually with each Federal agency involved with drought assistance. Although the Federal Government plays a major role in responding to drought events, there is no single Federal agency in a lead or coordinating position regarding drought. Therefore, crisis management, rather than planning and proactive mitigation measures, often characterizes the Federal response to drought emergencies.

The consequences of drought are immense. At its most severe, drought creates vast, windblown dust bowls, eroding landscape, damaging terrestrial and aquatic wildlife habitat, contributing to widespread wildfire, and causing significant monetary losses. Drought may cause economic ruin to farmers and ranchers. It brings hardship to water-dependent enterprises such as commercial fishing. In many small towns and villages, downturns in farming have a rippling effect to other local businesses. Drought can have a devastating impact on agricultural workers and lead to difficult decisions regarding allocation of water and stringent water-use limitations. Drought puts drinking water supplies at risk and may hamper rural fire-fighting efforts. Drought creates or exacerbates conflicts over access to river basins and water systems. Thus, drought's impact is far-reaching and damage to the ecosystem may be irreversible.

What makes this issue even more complex is the very definition of drought, or, more specifically, the lack of a single definition that is applicable to all segments of society. A generic definition is "drought is a persistent and abnormal moisture deficiency having adverse impacts on vegetation, animals, or people." Declarations of droughts are often triggered by specific and well-

defined conditions, such as specific reservoir level on a specific date. In some cases, there are well-defined exit points that trigger a resumption of normal activity. These drought triggers become the practical definition of drought for a particular region and for specific issues. Defining these triggers is an inseparable part of planning for and responding to droughts. Once these triggers are defined, a region is much better able to estimate the costs, expected frequency, and risks of drought response.

Preparedness is a fundamental concept in a national drought policy. Preparedness includes drought planning, plan implementation, proactive mitigation measures, and public education. Preparedness may well reduce the social, economic, and environmental impacts of drought and the need for Federal emergency relief expenditures in drought-stricken areas. The NDPC found that 30 of the 50 states in the United States had drought plans, with most oriented toward relief rather than preparedness. The assessment revealed that in most states, drought responsibilities are normally located in the agencies that are responsible for the functions of agriculture, natural resources, water management, environment, or emergency management. Fewer than five states have independent, designated drought coordinators, while more than 20 states have drought task forces.

Local governments must be able to plan for future needs, but they need the technical data, tools, and resources to develop and implement these plans. Local governments must also inform and educate the local population about the need for drought planning, especially when an emergency is not imminent. It is at the local level where the most efficient and direct communication channels can be established to keep the population informed of drought emergencies that may be directly affecting a particular area.

Tribal lands in the western United States have experienced the vagaries of climate for many thousands of years, and the scope of tribal drought issues in current times is immense. There are 306 federally recognized tribes within the conterminous 48 states, with 289 of those west of the Mississippi River, where 95 percent of all tribal trust land is located. A total of six tribes were found to be developing drought contingency plans through cooperative agreements with the federal government. Some tribes lack access to basic weather data that is essential not only for planning but also for triggering emergency response efforts.

In response to individual challenges over the years, Congress has created federal programs to lessen the impacts of drought. The NDPC found that 88 drought-related federal programs were funded with the past 10 years and were spread over a number of federal departments and agencies. The programs were classes into four broad program categories: (1) preparedness, including planning and mitigation; 2) information, including monitoring/prediction and research; 3) insurance; and 4) emergency response. Of these programs, 7 provide assistance for drought planning; 42, drought mitigation; 22, drought-related monitoring/prediction and research; and 47, response. These numbers total more than 88 because some programs cover more than one facet of drought. For example, some of the mitigation programs also contain drought planning and response elements. Although these numbers seem large, a major criticism that was repeatedly heard at the meetings and public hearings of the NDPC was that the federal action was an ad hoc approach to drought. Moreover, limited authorities and funds as well as lack of coordination among and within federal agencies hindered planning efforts.

To succeed in the development of national drought policy, the guiding principles should be:

1) Favor preparedness over insurance, insurance over relief, and incentives over regulation.

2) Set research priorities based on the potential of the research results to reduce drought impacts.

3) Coordinate the delivery of federal services through collaboration with nonfederal entities.

This policy requires a shift from the current emphasis on drought relief. Preparedness must become the cornerstone of the national drought policy. To achieve this objective, a pooling of nonfederal and federal experience and the establishment of nonfederal/federal partnerships must be nurtured to develop the tools needed to formulate drought preparedness strategies, including incorporation of environmental concerns.

Report Recommendations:

The NDPC recommended that Congress pass the National Drought Preparedness Act, which would establish a nonfederal/federal partnership through a National Drought Council. The primary function of the council would be to ensure that the goals of national drought policy are achieved. The five goals are briefly summarized:

Goal 1: Incorporate planning, implementation of plans and proactive mitigation measures, risk management, resource stewardship, environmental considerations, and public education as the key elements of effective national drought policy.

Goal 2: Improve collaboration among scientists and managers to enhance the effectiveness of observation networks, monitoring, prediction, information delivery, and applied research and to foster public understanding of, and preparedness for, drought.

Goal 3: Develop and incorporate comprehensive insurance and financial strategies into drought preparedness plans.

Goal 4: Maintain a safety net of emergency relief that emphasizes sound stewardship of natural resources and self-help.

Goal 5: Coordinate drought programs and respond effectively, efficiently, and in customer-oriented manner.

IV. INTERNET APPLICATIONS

All three unique organizations that are described have a common need for agrometeorological products and an effective means of disseminating these products to a vast array of user communities. Proper application of weather and climate information can help increase agricultural production, conserve natural resources, mitigate natural disasters, and, improve planning and decision making in the entire agricultural business community.

Great studies have been made in the latter half of the 20th century at research institutions around the world to gain more practical knowledge on the relationships between meteorology and agriculture. A significant task of agrometeorological bulletins has been to glean from these research studies useful operational tools to assist farmers and other agribusiness planners and decision makers with appropriate and timely information.

There are three types of services provided in a bulletin (Motha, 2001). The first is current measurements and observational data services. These services consist of the operation of acquisition programs, observing systems, data collection and quality control, and networks to provide data essential to defining the state of the atmosphere and it impacts on agriculture. They are largely concerned with assembling weather observations into usable data bases and providing them in a format for use in analyses and applications. Some users prefer the actual data and basic products as input to their own decision-making process. This type of bulletin service would most suit these users.

The second type of service is agroclimate services. These services provide for the acquisition, storage, management, and summarization of historical weather and agricultural data. They also include the analyses of climatological, phenological, physiological data to characterize agroclimatic conditions or regimes for different geographical areas or time periods. Climate services may also include the development of normals, freeze/heat probabilities, and drought indices. Users of this type of service, often do not want the basic data, but instead want the results of analyses presented in a format that can be readily used in making decisions or planning for some action.

The third type of service is forecasting services. Prediction of future weather events or climatic conditions and their associated probabilities are extremely important for both daily farming decisions, such as planting, spraying or fertilizing, and, long-term planning decisions both on the farm and in agribusiness. Users of this third type of service understand the risk of forecast verification and proceed to make decisions based on their confidence level of the service provided in the advisory. The proper mix of these three services in a bulletin or advisory depends largely on the needs of the user community.

An agrometeorological bulletin may include a synopsis of recent weather conditions; and outlook of weather conditions in the near future which may include probability forecasts; information about crops, their stages of development, ongoing agricultural operations, infestations of pests and disease, and; adequacy of agrometeorological advice for decision making by farmers.

General agricultural weather forecasts and advisories provide information to farmers to help them make their own operational decisions. They do not advise them as to how to minimize damage from unfavorable weather, or to take advantage of favorable weather. Too many variables at the local level are required and are known only by the farmer or other decision maker in that regard. However, a well interpreted and appropriately worded bulletin is needed, giving the expected effects of weather on the individual crops and incorporating the advice to farmers on field operations.

In addition to information related to meteorological

factors, an agrometeorological bulletin should contain information on field operations and crop conditions. Crop calendars serve a very useful purpose in this regard. The weather elements that influence the agricultural operations and crop production can be assessed and forecast up to different time spans. Regarding forecasts, with increased time spans, the accuracy of the forecast decreases, however.

Specific weather elements in a bulletin include: cloud cover and duration of sunshine, rainfall (and probability), temperatures, wind speed and direction, humidity and dew, drying conditions, and soil water status. Special agricultural weather forecasts that aid farmers in making certain high cost decisions include: planting dates (soil moisture and temperature); application of agricultural chemicals (temperature, precipitation, and wind speed); irrigation scheduling (evaporation loss, rainfall); crop curing (drying conditions); control of plant diseases (temperature, humidity, cloudiness, and precipitation); transportation of agricultural products (climatological and current weather information); and, agricultural aviation (wind, fog, and snow).

Bulletins should be prepared in consultation with agricultural scientists to ensure appropriate data are being analyzed and interpreted. The quality of meteorological data should be verified before being analyzed and disseminated to users. Given these requirements, this information can be of great economic value to the user community through effective use in the decision process. The WMO CAgM, USDA WAOB and NDPC have all independently strived to develop a channel of information delivery through the promotion of agrometeorological bulletins, advisories, and drought monitors to meet these stringent operational standards.

The Internet can potentially provide an efficient means of dissemination, although there are obstacles still present for global widespread use. Once the global infrastructure is overcome, it may be limited only to the imagination as to the applications of the Internet for the delivery of temporal and spatial products. Web development requires specific knowledge of user needs. The World Agrometeorological Information Service (WAMIS) dedicated web server offers an exciting potential for such a global Internet application.

WAMIS is a dedicated web server to make agrometeorological bulletins and advisories issued by WMO Members available to the global agricultural community. WAMIS also hosts training modules to aid Members in improving their agrometeorological products. By providing a central location for agrometeorological information, WAMIS will aid users to quickly and easily evaluate the various bulletins and gain insight into improving their own bulletins. The web site will also host training modules to further help Members improve the quality and presentation of their products.

Disseminating information is part of a process that begins with scientific knowledge and understanding and ends with the evaluation of the information. In order for this information to be useful, it must be accurate, timely, and cost-effective. The Internet is one of the new technologies that can accomplish an efficient transfer of information since vast amounts of timely information are readily available. CAgM helped facilitate the implementation of this new technology by hosting a workshop on expert group meetings leading to the development of WAMIS, which became operational in 2003.

적 요

본 논문은 정보기술 향상 필요성을 공감하고 있는 독특한 세 기구의 임무를 소개한다. 세계기상기구의 농업기상위원회는 회원국의 농업생산 지원과 자연자원 보전을 위한 농업기상서비스 개선에 대한 전구적인 책임을 지니고 있다. 미국 농무성의 세계농업전망위원회는 매월 전세계 농업 생산과 수요 예측을 발표하는데, 이는 정부와 산업계에서 생산량과 교역량 결정시 벤치마크로 사용하고 있다. 미국의 하원결의로 조직된 한발정책위원회는 위기 관리보다는 대응책 수립에 주안을 둔 국가단위 한발정책 수립을 담당하고 있다. 이 세 기구는 모두 농업기상에서의 IT활용의 필요성을 인식하고 있으며 이들 기술을 보완하는 데 지금까지 적극적인 자세를 취해오고 있다. 농업기상정보는 사용자에게 적시에 적절한 방법으로 전달된다면 여러 가지 농업의사결정에 중요한 역할을 담당하는 필수적인 요소가 될 것이다. 농업은 국지, 지역 및 전구단위 경제발전의 중추역할을 담당한다. 그러므로 다양한 농업분야에서 농업기상 응용물의 활용강화를 통해 다양한 경제발전을 도모할 수 있다. 정보기술의 발달은 또한 농업기상 현장활용물의 전달을 위한 새로운 수단을 제시할 수 있을 것이다. 세계농업기상정보서비스(WAMIS)는 세계기상기구 회원국들에게 농업기상 회보와 훈련기회를 제공하는 농업기상 전용웹서버로 전구 인터넷망의 장점을 이용하고 있다.

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