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Better Use of Technological Advances in Communication of Information

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농업기상정보교환에 있어 첨단기술의 효율적 활용

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ABSTRACT

In recent years, technology has advanced so much, especially in the developed world, such that its application in development activities may be lagging behind. The lag between technological advances and its application affects agrometeorological science as well. This paper discusses technological advances that may be better used to communicate agrometeorological information. It is important to bear in mind that technological advances are only channels of communication that may be used to speed up the transference of information from the source to the user. The paper begins with a review of the definitions of 'communication' to put the discussion into context. After reviewing several papers, in simple terms, communication can be defined as the sharing of meaning. The paper also looks at operational communications channels and comes to a conclusion that operational communications channels are pretty much universal irrespective of the development level of a country, although some are more easily accessible in some parts of the world than others. The common communications channels include: newspapers, farming papers, radio, television, fax, email, mobile phones (SMS) and Internet web sites. As part of technological advances, mobile phones are becoming increasingly useful all over the world. In order to make better use of this technology, it is important for those that will use this technology to understand how the technology works, not necessarily in detail, but to be able to operate the technology and obtain the data they need. When it comes to constraints, communication of agrometeorological information requires a substantial amount of resources and it is generally expensive especially when sophisticated models must be operated.

Key words : **information communication, agrometeorological information, communication channel, technology advance**

I. INTRODUCTION

In recent years, technology has advanced so much that its application in development activities may be lagging behind. It is common to find an advanced electronic gadget or software with several functions but less than half are being used effectively for everyday activities. The lag between technological advances and application affects agrometeorological science as well. It has been said that information is a very important element of contemporary life. However, there is so much information of various kinds around that it can be said that society is "flooded" with it. It is really difficult to find in this tangle necessary knowledge of interest at

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a specific time. On the other hand, there is also lack of information accessibility, even when there is so much technological advancement in the world. This is especially evident in such a dispersed sphere as agriculture. Farmers need to know what the weather will be like today, tomorrow and in the future.

In September 1999, a World Bank funded workshop "Users responses to seasonal climate forecasts in southern Africa: what have we learned" convened in Dar-es-salaam, Tanzania, and came up with two aspects significant for sustainable agricultural production and food security. The first was that there were communication barriers and that there was a need to develop appropriate information channels. The second was that there were bottlenecks in the effective use of seasonal climate forecasts by farmers (Cicero Report, 1999). The former is of interest to this paper as it provides a basis to ascertain how technological advances can better be used in communication. Technological advancement is not an end in itself but a means to communicate agrometeorological information. However, the effectiveness of agrometeorological communication is determined, among other things, by the extent to which all persons involved in the communication transaction are competent in communicating and interpreting agrometeorological information (Mukhala, 2000).

This paper discusses technological advances that may be better used to communicate agrometeorological information. It is important to bear in mind that technological advances are only channels of communication that may be used to speed up the transference of information. The coding of the information, channelled through technological advances plays a major role in the communication process. To put the discussion into context, the paper begins by reviewing the definitions of communication to put the discussion into context.

II. DEFINITION OF COMMUNICATION

It is common to find the terms communication and dissemination being used inter-changeably. These terms do not mean the same thing. *What is communication then?* The definition of communication varies according to the theoretical frames of reference employed and stress placed upon certain aspects of the total process (Hill and Watson, 1997). However, most definitions include five fundamental factors, namely: an initiator (the Agrometeorologist), a recipient (the user or farmer), a mode or channel of message transfer (electronic and print media (technological advances)), the message (agrometeorological information) and effect (response to agrometeorological information). Several researchers have defined communication. Tubbs and Moss (1994) referred to human communication as the process in which meaning is established between two or more persons, while Marais (1979) stresses that the general aim of communication is to share meaning. Bittner (1985) defined communication as the action by means of which symbols are shared, while Wenburg and Wilmont (1973) refer to communication as any attempt to achieve understanding. The two terms that stand out in these definitions are: sharing and meaning. Therefore, in short, communication can be defined as the sharing of meaning. To put it in agrometeorological language, this implies delivery of agrometeorological information through a particular channel and that information being used for what it is intended. Dissemination is essentially the transfer of information from one place to another without minding whether the information will be understood or not. However, both communication and dissemination require modes or channels of message transfer.

From the definitions and concepts above, it is very evident that technological advances are only part of the communication process and can only be used effectively if agrometeorological information is coded in a manner that users can easily decode. One of the requirements for good encoding and decoding of messages or agrometeorological information is knowledge. Knowledge in this case refers to knowledge of another persons language (e.g. agrometeorological terms), knowledge of the subject matter (e.g. meteorology or agriculture) and general knowledge (Adey and Andrew, 1990). If the users or farmers have no knowledge of the subject matter, then encoding of agrometeorological information has to be done in such a way that it is not difficult for users to decode (understand) the information. There is no doubt that understanding of information will vary between the developed and the developing worlds.

Agricultural communication was defined by Terblance and Mulder (2000) as a communication transaction in which agricultural-related information is transmitted and interpreted with a view of sharing the

meaning thereof. Likewise, agrometeorological communication can be defined as communication transaction in which agrometeorological related information is transmitted and interpreted with a view of sharing the meaning. If agrometeorological information provided is not acted upon, there is a chance that communication has failed or the information is not relevant or too late for any action to be taken.

The main task of Agrometeorology is to provide services to the agricultural community. These services may differ from one country to another, according to the inherent agricultural and socio-economic systems, technological level, agricultural crops and the specific problems that the agriculture sector and the farmers are facing.

Main users of agrometeorological information in each country can be listed as follows:

- Ministry of Agriculture all departments, the agricultural organizations, agricultural settlements and the individual farmers.
- Water management authorities.
- Agricultural insurance companies, agricultural assessors.
- Faculties of agriculture and agricultural engineering, research institutes etc.
- Engineers, advocates, planners, advisors etc.

III. POTENTIAL USE OF AGROMETEOROLOGICAL INFORMATION

The potential use of agrometeorological information can be broadly broken down into three main categories:

- Agrometeorological information that leads to crop yield estimation for food security purposes especially in the developing world and for market/ price planning purposes in the developed world.
- Agrometeorological information for routine farm management practices in order to take the best decisions which may be planning for fertilisation, weeding, spraying, irrigation scheduling etc. in both the developed and developing world.
- Agrometeorological information reporting on adverse weather such as drought, frost, floods etc.

These three broad categories have clients that include decision makers, farmers and businessmen (Malachi, 2001). The potential use of the agrometeorological information will determine what channels are selected for use and the frequency of the updates of information. However, as indicated earlier, the decision to select the channel by which one can receive agrometeorological information depends on availability and accessibility of the technology. Agrometeorological information for farm management requires frequent updating while that leading to crop yield forecasting may be updated on decadal basis and still serve its purpose.

3.1. Technological advances for good service

To provide good service, both real time and long-term agrometeorological databases, should be available for all regions at which service providers have responsibility and for various agrometeorological parameters: rainfall, evaporation/evapotranspiration, temperature air and soil, heat and cold units, wind and relative humidity. The data should include averages, standard deviation, frequency distributions, probabilities and return periods, etc. Data on adverse weather, related to damage and disasters to agriculture, should always be available and updated regularly. Institutions need to have a robust and consistent monitoring and data collection system to be able to feed their clients. Specific Internet websites may be used as technological channels for dissemination of agrometeorological information and announcements. This is very possible in the developed world and some developing countries.

3.2. Agrometeorology and communication channels

Application of meteorological information for optimal agricultural production is what is referred to as "Agrometeorology". Agrometeorology is an applied discipline, and a "common language" is necessary for its application. There are several recognised channels that can be used to communicate agrometeorological information. These include: print and electronic media, internet, world wide web, telephone, faxes, special agricultural bulletins, seminars, symposia and conferences. These channels are available in many countries in the world although accessibility especially in developing countries is still a big challenge. The decision to select the channel by which one can receive agro meteorological information depends on availability and accessibility of the technology. The **print and electronic media** is extensively used in southern Africa to disseminate seasonal climate forecasts. Bembridge and Tshikolomo (1998) in a survey in South Africa found that among the respondents, 92 percent owned

radios, 52 percent owned television sets and 32 percent were connected to telephone facilities. With regard to television and telephone facilities, the survey results may not be representative of the situation in southern Africa given the relative economic advancements of South Africa. However, the survey provides basic information that target audiences in South Africa have access to electronic media. The number of Internet subscribers is continuously rising in Africa although this is linked to those who have telephone facilities. In Africa, the radio is the most commonly used channel for communication of meteorological information. However, peasant farmers have argued that the information transmitted on the radios is more generic than specific for particular applications. The same has been said about the print media. Nevertheless, millions of people are reached through these channels.

The **World Wide Web** is one of the channels that can be effectively used to communicate agrometeorological information to the various clients. An important role in communicating agrometeorological information should be played by the Internet, by providing access to specialized, near real-time agrometeorological information. However, the communication links should be fast, and of a two-way nature, enabling the farmer to take almost immediate advantage of researchers achievements, and providing valuable feedback to the researcher and the planner. However, this requires consistent data collection, analysis and updating of the web. While this approach may be feasible in the developed world, the developing world is still lagging behind, although the situation is improving.

The World Wide Web is now the most common means of providing information about institutions. Any serious organisation has a website. The contents of the website vary depending on the business in which the institution is involved. This covers most of the meteorological, agrometeorological, research and educational institutions (Table 1). The **telephone** is one of the oldest channels of communication of agrometeorological information. Farmers call the service provider to ask for specific climatic parameters for a specific place for their planning and management practices. The information may be provided, or if some further analysis is required, another channel of communication is then used and this is the **fax. Agrometeorological bulletins** have also served the farming community very well. These may be produced covering a particular region or the entire country depending on the application of the information contained.

3.3. Operational communication channels

The operational communications channels are pretty much universal irrespective of the development level of a country although some are easily accessible in some parts of the world than others. The common communications channels include: **newspapers, farming papers, radio, television, fax, email, mobile phones (sms) and Internet web site.** As part of technological advances, **mobile phones** are becoming increasingly useful in many parts of the world. In South Africa, they have become very popular among grape farmers where forecasts of minimum temperatures are disseminated through mobile phones 6 hours in advance. These are then later updated every 2 hours. This allows farmers to plan ahead and make decisions to irrigate to avoid damage to the crop. Usually the decision is by allowing some labour force to work over-time to irrigate the crop. This is a decision which would not be easily possible without mobile phone technology. Further, more and more **newspapers** and **magazines** are available on the **Internet**, which allows reading of the professional press without subscribing and selecting necessary information. In the future most information documents, including specialized agricultural ones, may be available through the Internet. According to the report on "IT Development Strategy" in Poland, recommendations say that, investing in information technology is costly in the short term but in the long term, the cost benefit ratio is worthwhile. However, when properly performed, it gives faster access to full and more reliable information, facilitating better decision-making and quicker fulfilling of social needs and service of economic entities. Moreover, the skill and habit of using information access techniques in everyday life are essential, since this leads to acceleration of individual development of man and also his functioning in modern society as a citizen and qualified worker.

The RANET project in Africa has been one of the success stories in terms of agrometeorological information dissemination. This programme started at ACMAD and has spread through western and southern Africa. This programme targets resource poor farmers by providing them with comprehensive climatic data for their management decisions. To obtain information for agricultural practices, the farmers use cheap

Table 1. Addresses of agrometeorological web sites in Europe and Africa.

Country	Institutions	Institutions
Austria	Research Institutions in Agrometeorology Federal Office and Research Centre for Agriculture University of Agricultural Sciences (BOKU)	Services in Agrometeorology Central Institute for Metorology&Geodynamics (ZAMG) Agrarnet Austria
	Education in Agrometeorology Institute for Meteorology and Geophysics, University Vienna Institute of Meteorology and Physics (BOKU)	
Belgium	Research Institutions in Agrometeorology Agricultural Research Centre Research Station of Gorsem	Education in Agrometeorology Gembloux Agricultural University (FUSAGx) Fondation Universitaire Luxembourgeoise (FUL) Université Catholique de Louvain (UCL) Katholieke Universiteit Leuven (KUL) Universiteit Gent (RUG)
	Services in Agrometeorology National Meteo Services Soil Service of Belgium a.s.b.l. PAMESEB	
Cyprus	Services in Agrometeorology Meteorological Service Agricultural Research Institute Agricultural Department	
Denmark	Research Institutions in Agrometeorology Danish Institute of Agricultural Science	
	Education in Agrometeorology School of Agriculture Services in Agrometeorology Danish Meteorological Institute Agricultural Advisory Center	
Finland	Research Institutions in Agrometeorology Agricultural Economics Research Institute Agricultural Research Centre of Finland, MTT Finnish Environment Institute Finnish Forest Research Institute Helsinki University of Technology, Water Resources Laboratory University of Helsinki - Department of Forest Ecology, SMEAR II University of Joensuu - Faculty of Forestry	Services in Agrometeorology Finnish Meteorological Institute The Information Centre of the Ministry of Agriculture and Forestry in Finland Rural advisory centres Maaseudun tulevaisuus
	Education in Agrometeorology University of Helsinki University of Helsinki - Faculty of Agriculture and Forestry	
France	Research Institutions in Agrometeorology INRA (Institut National de Recherche Agronomique) CIRAD (Centre de Coopération Internationale en Recherche Agronomique pour le Développement) CEMAGREF (Centre d'Etude du Machinisme Agricole du Génie Rural et des Eaux et Forêts)	Services in Agrometeorology METEO-FRANCE Ministere de l'Agriculture et de la Peche Education in Agrometeorology INA-PG (Institut National Agronomique de Paris-Grignon)

Table 1. continued...

Country	Institutions	Institutions
Germany	Research Institutions in Agrometeorology Bayerische Landesanstalt fur Bodenkultur und Pflanzenbau, Munich Federal Biological Research Centre for Agriculture and Forestry (BBA), Berlin and Braunschweig	Education in Agrometeorology Humboldt University, Faculty of Agricultur and Horticultur, Berlin Christian-Albrechts-University Kiel, Faculty of Agricultural and Nutritional Sciences, Kiel University Hannover, Faculty of Horticulture, Hannover University Rostock, Institute for Landscape planning and landscape ecology, Rostock Georg-August-University, Faculty for Agricultural Science, Goettingen Martin-Luther-University Halle, Faculty of Agriculture, Halle
	Services in Agrometeorology Irrisoft Data Base Deutscher Wetterdienst, Agrarmeteorologische Forschung Braunschweig Deutscher Wetterdienst, Geschäftsfeld Landwirtschaft, Außenstelle Geisenheim Bayerische Landesanstalt fur Bodenkultur und Pflanzenbau, Munich Landesanstalt fuer Pflanzenbau und Pflanzenschutz Rheinland-Pfalz, Mainz	
Ireland	Research Institutions in Agrometeorology University College Dublin (UCD)	Education in Agrometeorology Faculty of Agriculture (UCD)
	Services in Agrometeorology The Agmet Group	
Italy	Research Institutions in Agrometeorology Istituto per l'Agrometeorologia e l'Analisi Ambientale applicate all'Agricoltura (CNR-IATA) Istituto di Ecofisiologia delle Piante Arboree da Frutto (CNR-ISTEA) Istituto per il Monitoraggio degli Agroecosistemi (CNR-IMAES) Istituto di Scienze dell'Atmosfera e dell'Oceano (CNR-ISAO) Istituto per lo Studio dell'Inquinamento Atmosferico e l'Agrometeorologia (CNR-ISIATA) Università degli Studi di Bologna Education in Agrometeorology Università degli Studi di Bologna	Services in Agrometeorology Servizio Meteorologico dell'Aeronautica Militare Ufficio Centrale di Ecologia Agraria (UCEA) Laboratorio per la Meteorologia e la Modellistica Ambientale (LAMMA) ARPA - Servizio Agrometeorologico Regionale - Emilia-Romagna Servizio Agrometeorologico Regionale per la Sardegna Servizio Agrometeorologico della regione Toscana Centro Agrometeorologico S.Michele all'Adige Servizio Meteorologico Regionale Friuli Venezia-Giulia Associazione Italiana di Agrometeorologia
Norway	Research Institutions in Agrometeorology The Norwegian Crop Research Institute Institute of Geophysics at the University of Bergen Plant Protection Center VIPS (the warning system)	Services in Agrometeorology Norwegian Meteorological Institute (DNMI) Norwegian Crop Research Institute
	Education in Agrometeorology Institute of Geophysics at the University of Bergen Agricultural University of Norway	

Table 1. continued...

Romania	Research Institutions in Agrometeorology National Institute of Meteorology and Hydrology Research Institute for Cereals and Industrial Crops Ministry of Agriculture and Agriculture and Food	Services in Agrometeorology National Institute of Meteorology & Hydrology Education in Agrometeorology University of Bucharest, Faculty of Geography University of Craiova, Faculty of Agriculture
Spain	Research Institutions in Agrometeorology Escuela Técnica Superior de Ingenieros Agrónomos (Madrid) Escuela Técnica Superior de Ingenieros Agrónomos y de Montes (Córdoba) Escola Tècnica Superior d' Enginyeria Agrària (Lérida) Centro de Estudios y Experimentación Obras Públicas - CEDEX- (Ministerio de Fomento)	Services in Agrometeorology Instituto nacional de Meteorología - INM - (Ministerio de Fomento) Riegos de Navarra S.A. Servicio de Tecnologia del Riego Departament d'Agricultura, Ramaderia i Pesca Diputación de Albacete Red de Estaciones Agroclimáticas de Extremadura
	Education in Agrometeorology Universidad Politécnica de Madrid Universidad de Córdoba Universidad de Lérida (Lleida)	
United Kingdom	Research Institutions in Agrometeorology Institute of Arable Crops Research University of Birmingham Climate research unit, Norwich The Royal Meteorological Society	Education in Agrometeorology University of Birmingham Climatic Research Unit, University Of East Anglia Edinburgh University Meteorology Department Leeds University Atmospheric Field Studies Group Reading University Meteorology Department
	Services in Agrometeorology UK meteorological office Hadley Centre UK irrigation association Remote Sensing Society	
AFRICA	Services in Agrometeorology SADC Regional Remote Sensing Unit, Harare, Zimbabwe Agrhymet, Niamey, Niger	Education in Agrometeorology University of Free State, South Africa University of Natal, South Africa University of Zimbabwe, Zimbabwe

winding radios to produce energy to operate the **radios** which are distributed free of charge to communities. For developing countries, this technology is still valuable in this era of modern sophisticated technology. More information about RANET can be found at http://www.ranetproject.net/.

Agricultural users want to know not only what the weather will be like today, tomorrow and in the future, but also how the prices rule, or what the price tendencies are. Price information must be known not only for the purchased product, but also for means of production. In East Africa and the Horn of Africa, a web-based Regional Agricultural Trade Intelligence Network (RATIN) has been developed to provide information on commodity prices, production and weather to serve the agricultural and food security community (http://www.ratin.net). The farmer looks for information about growing methods and animal diseases, about technical innovations and where and what to buy. A similar approach such as carrying out bank transactions, selection of offers from travel agencies, ticket reservations or other services with which we are acquainted may also be applied to Agrometeorology in the future. Presently, such a system is directed at farmers in Great Britain. It is possible there to discuss by means of Internet subjects of direct importance to farmers. Much information is already accessible through the Internet which is developing rapidly with new users growing in number every day. Prices of computers and instrumentation often fall in the long run, so what today seems unreal will be accessible in the near future and farmers will

readily buy computer hardware. To make this happen, however, it is necessary to accustom agricultural school students to using the hardware. They will discover how useful the Internet is and will understand the necessity of having access to various data.

IV. INFORMATION COMMUNICATION CONSTRAINTS

Communication of agrometeorological information requires a substantial amount of resources, especially when sophisticated models have to be operated. In modelling, canopy or soil specific data are necessary to run the models over a particular time scale using historical data as well as making projections or yield forecasts using climatological data. Therefore, the type and extent of advisory is restricted by personal and financial resources. It brings in decision challenges and one has to decide between information concerning only the past (for instance to simulate plant diseases) or also the future, between common weather and special agrometeorological data.

The need to strengthen the research-extension-farmer relationship is obvious. The role of the agricultural meteorologist in this chain is of utmost importance. To successfully fulfil this role, a high level of education is required, with due consideration of the interdisciplinary nature of the agrometeorological information, and extension services. Another important challenge requiring attention is the teaching and training of communication courses to Agrometeorology students so that they are equipped to communicate agrometeorological information to the farmer and farming communities, with due consideration of the level of education, social and cultural background.

Unfortunately there is a widening gap between the developed and developing countries and countries with economies in transition. In the latter smallholder and subsistence farming is still prevalent, hampering or limiting the introduction of agrometeorological know-how and new advanced technologies. A significant step in this direction can be made by more extensive and knowledgeable use of agrometeorological information to the benefit of those that live in economies that are still in transition.

The paper has discussed a number of technological advances that currently exist and are being used for various functions. In order to make better use of this technology, it is important for those that will use this technology to understand how the technology works, not necessarily in detail, but to be able to operate the technology and obtain the data they need. While in the developed world the scenario is that children as young as 5 years old are able to operate a desktop computer and grow up knowing how to surf the internet, in the developing countries, there still exist old farmers who are yet to touch a computer keyboard. The developing world still needs training in the use of technology for it to be fully utilised.

There are a number of technological advances that can be used to communicate agrometeorological information. Some of them have existed for many years although they have evolved over time and become more sophisticated. The existing channels of communication can be listed as follows: print and electronic media (newspapers, farming papers, radio, television) internet, world wide web, telephone, faxes, special agricultural bulletins, seminars, symposia, conferences, and mobile phones (sms). These channels will help in quick dissemination of information, especially in the developing world as the developed world is well ahead already.

적 요

최근 선진국에서의 IT 기술발전은 매우 급속하여 현장활용을 위한 개발 활동이 채 따라가지 못할 정도이다. 첨단기술의 발전과 이의 응용을 위한 개발과의 격차는 농업기상분야에서도 마찬가지이다. 여기에서는 농업기상정보 교환을 위해 그 활용이 증대될 것으로 기대되는 기술들의 발전현황을 다루고 있다. 한가지 새겨두어야 할 점은 IT기술 발전은 단지 정보원에서 사용자에게로의 정보전달을 가속화하는데 사용되는 교환통로라는 점이다. 본 논문에서는 교환에 대한 정의 검토를 시도하였다. 결론적으로 여러 가지 논문 검토를 통해 살펴 본 바 교환은 "의미의 공유"라고 정의할 수 있다. 이들 논문에 의하면 실질적인 정보교환통로는 국가의 경제수준에 관계없이 매우 유사하였으며, 단지 차이가 있다면 일부 국가에서는 다른 나라에 비해 좀더 접근이 용이하다는 점 뿐이었다. 보편적인 교환통로로는 신문, 농민신문, 라디오, TV, 팩스, 전자우편, 휴대폰 및 인터넷 웹을 들 수 있다. 한편 통신기술이 발전함에 따라 전세계적으로 휴대폰의 유용성이 점차 높아지고 있다. 이러한 기술을 더욱 잘 활용하기 위해서는 이 기술을 이용할 사람들이 상세하지는 않더라도 최신기술을 운용하여 필요 자료를 획득하기 위한 기본적인 작동기술을 이해하는 것이 매우 중요하다. 첨단기

술활용의 장애요인으로는 농업기상정보교환이 원래 상당한 자원을 요구하고, 정교한 농업모의모형을 구동하기 위해서는 많은 비용이 든다는 점이다.

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