Improving Agrometeorological Bulletins
Perspectives from RA IV (North and Central America, and the Caribbean)

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Abstract

Routine agrometeorological information in the form of bulletins, advisories and press releases are important for farm management activities, and for implementing effective strategies at the policy maker level, in an effort to boost production, promote socio-economic development and enhance food security. Advance information and communication technologies (ICTs) can be utilized to provide more accurate and user-friendly agrometeorological bulletins to farmers and other agricultural interests. Agrometeorological information is part of a continuum that initiates with scientific knowledge and understanding of how the weather and climate influences agricultural production, and ends with the evaluation of the effectiveness of implementing the information to increase yields. This paper reviews the status of agrometeorological bulletins in Regional Association IV of the World Meteorological Organization, and makes some recommendations for improving this service to the farming community.

Introduction

The agricultural sector contributes significantly to the Gross Domestic Product (GDP) of many countries in North, South and Central America, including the Caribbean. In Belize, for example, its contribution to GDP was in the order of 21% in 2000 (Ministry of Agriculture and Fisheries, 2001).

A direct inter-dependence exists between the crop or forest, the weather and the soil. Although the influence of the weather on agricultural production is well understood, it is evident that seasonal and inter-annual

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climate variability has been, is, and will continue to be the principal source of fluctuation in global food production (WMO 2001)

Global food production is essential to enhance economic development and alleviate the scourge of poverty. The provision of timely, accurate and cost-effective agrometeorological forecasts and information has proven to be a useful resource base or tool which, when implemented, can help farmers make management decisions and guide policy-makers in adopting strategies that will promote food security.

It cannot be over-emphasized that agrometeorological information at adequate time intervals, and in a format friendly to users can go a long way in helping farmers make critical decisions such as for example applying for a loan to cultivate hot peppers or not, to spray or not to spray, to apply fertilizer or not to apply fertilizer, to deploy workers or not to deploy workers etc. This is only one level of users who can utilize agrometeorological bulletins operationally. Special bulletins for agricultural technicians and policy-makers for example, can provide guidance on the introduction a new variety of corn that can boost the socio-economic condition of a rural community; or it may help decision makers promote a new breed of livestock or a non native cash crop such as soybean, to help farmers in a diversification programme. The use for agrometeorological information is endless.

With the advent of new information and communication technologies (ICTs) such as: the Internet, Satellite Technology, and Geographic Information Systems (GIS), agrometeorological services now have sufficient data and data processing facilities at their disposal, to produce more streamed-lined and user-friendly bulletins that meet the diverse needs of the agricultural sector. In the past, and even today, the contents of agrometeorological bulletins lack coherence, because while they are generally intended for farmers, their scale and complexity is that for technicians and policy-makers. Therefore, providers of agrometeorological bulletins must recognize their users, the user's needs, and satisfy those needs within the context of agrometeorological bulletins and specialized advisories.

Current State of Agrometeorological Bulletins in RA-IV Countries

Questionnaires were sent to National Meteorological and Hydrological Services (NMHSs) of the 26 countries that make up the Regional Association IV (RA-IV) of WMO. Seven of these countries responded, namely: Belize, Dutch Antilles, Canada, Colombia, Cuba, Saint Lucia, and Venezuela. The authors also used information taken from the

proceedings of the Workshop on the *Use of Meteorological Information for More Efficient Agricultural Production*, held in Barbados in July 2000, from information downloaded from the INTERNET, from contacts with the Working Group on Agricultural Meteorology of RA-IV, and from personal communications.

Very few of the NMHSs of RA-IV have an independent Agrometeorological Service. Countries that can boast of such departments are Canada, Colombia, Cuba and the United States.

Few NMHSs of RA-IV produce specific agrometeorological bulletins; bulletins for Agriculture and Forestry, or agrometeorological warning and advisories. Among the few that do provide such agrometeorological products are Belize, Cuba, Saint Lucia, and Venezuela. In other countries of the region such as Canada, the United States and Mexico, the agrometeorological bulletins are produced by inter-institutional co-operation of the National Meteorological and Hydrological Services and other institutions that are concerned with crop production and diverse agricultural activities.

In general, the information collected by institutions that produce agrometeorological bulletins comes from different sources, namely: meteorological, agrometeorological, and hydrological observation network, and from institutions that provide information on the state of crops, forests, livestock and crop yields. The information is transmitted via the global telecommunication system to regional centres. The data is then channeled to national centres. Depending on what interests are served — local, national, or regional — this primary data is disseminated for different time period; e.g. daily, five-day, weekly, ten-day, or monthly.

The meteorological information collected is validated and later simple statistical methods are applied to compute statistical summary of averages, extreme values and other statistical information. Complex statistical methods are utilized for the analysis of anomalies and trends.

In some NMHSs the reference evapo-transpiration, water balance and the potential and estimated yields are calculated using established models and methods, and using tools such as Geographic Information Systems, to produce simple maps of meteorological events of interest that influence or can influence agricultural parameters considered in the bulletin.

Even the spatial distribution of some expected agrometeorological conditions are calculated; for example, the vegetative conditions of crops, the comfort of the farm animals, the presence and the evolution of agricultural drought, and the availability of water for plant growth and development.

All this information is processed by personal computer using word processors, electronic spreadsheets, and database management systems. Other applications that permit the use of models and Geographic Information Systems are used by some NMHS to obtain formats that will present more adequate information that farmers can easily interpret.

The frequency of delivery of bulletins depends upon national, regional and local interests. For example, daily deliveries are done in Canada and Mexico, weekly in the U.S. and Venezuela, five days in Colombia and Cuba, and monthly delivery in Saint Lucia.

The format and the contents of agrometeorological bulletins differ markedly from one country to another.

Generally, the content of bulletins comprises various subjects that can be grouped under different headings:

- Significant features of the past and present weather and climatic conditions at the national level, or at the regional and local levels. These are presented in the form of graphs, tables, drawings, maps, satellite imagery and text. Average and extreme values of meteorological, agrometeorological and hydrometeorological elements are also presented. These elements are important in agricultural production and decision-making.
- Existing agrometeorological conditions. Written text describes the state and the phases of development of agricultural crops, forest plantations and farm animals. In addition, comments are made on the soil-water regime, the state of agricultural drought, flooding, dangerous conditions of forest management, etc. All this information is complemented with maps, graphs, drawings and tables.
- Expected meteorological conditions — the weather and climate is analysed for the next time period that the bulletin will cover. This could be for the next twenty-four (24) hours, for the next forty-eight (48) to seventy-two (72) hours, for the next five (5) days, ten (10) days, month or for the entire cropping season.
- Expected agrometeorological conditions — the possible effects of expected weather and climate on cultivated crops, tree plantations and on farm animals at different stages of development and on their yields.

In general, agricultural researchers and extension agencies are the people who provide information on cultivation, state of crops and farm

animals, their phases of development and their yields. They also participate in one way or another in the preparation and publication of bulletins, as is the case with Canada, Cuba, the United States, Mexico and Belize. In other countries, for example, Colombia, the NMHSs does not depend on the support of agricultural researchers and extension agencies for the preparation of their agrometeorological bulletins.

The purpose of both the agrometeorological bulletins and agriculture meteorological bulletins is to satisfy the principal demands of a vast sector that is directly involved in crops and animal production, so that they may make appropriate decisions at different levels of production. For example, farmers want to know the date when the water regime in the soil will guarantee the beginning of the cropping season, so that they can apply for loans at the banks; prepare land for planting; insure their crops; apply additional water by irrigation; apply insecticide, herbicide and fertilizer; know the presence, evolution, and duration of drought, and know the optimum date when boreholes should be maintained, etc.

Bulletins reach the user by fax, electronic mail, Internet, telephone, radio programs, printed leaflets, personal delivery and other means that safeguard their opportune arrival for decision-making.

The services for agrometeorology and hydrology for agriculture use feedback information, consisting fundamentally of the results of research, cultivation, development phases and state of agricultural crops, farm animals and tree plantations. In general, there are no organized systematic forms of obtaining feedback from the users. However, even though in some cases it is continuous, it is not an established routine. In Cuba and Venezuela, at the end of the agricultural campaign period or termination of subscription, users are asked to express their opinion on the information provided. The responses have always been satisfactory and the users have asked that their subscription be renewed. This serves as an indirect way to assess the quality of the information given and the validity and accuracy of the forecast.

In most cases, yearly evaluation is conducted on the cost of preparing the bulletins. Some of the expenses considered are: the cost associated with the salaries of technicians and professionals that work in the production of the bulletins, the expense for material used in its production, the expense for its diffusion, and the depreciation of equipment and other epigraphs. In Canada, it is estimated that the benefit derived from the use weather information in relation to its production cost is a ratio that exceeds 6:1. In Cuba, the agrometeorological service is commercialised. This service includes agro-

meteorological bulletins and, even though a part of this information is offered as a public service, the agrometeorological activity is profitable, yielding a profit of 25% on the investment during the last few years.

In general, the meteorological services that produce bulletins for agriculture follow systematic guidelines when reporting meteorological and agrometeorological conditions. They use satellite imagery and ground truth (actual surface data); and if there is a danger that extreme weather and climatic changes are likely to occur, they relate this to the users by means of extraordinary bulletins, electronic mail, web pages and other means of divulging the information. When climatic conditions are extreme, warnings are sent out to inform farmers of the presence of these conditions. These warnings can be found in bulletins produced in Canada, Colombia, Cuba, the United States, Mexico, Nicaragua, Saint Lucia and Venezuela.

The models that simulate the growth of crops are used in just a few countries of the region. References about their use are found in bulletins produced in Canada, Costa Rica, Cuba and the United States. A similar situation but perhaps more critical is the use of Geographic Information Systems. References indicate that it is only used in Canada, Cuba and the United States, although in countries such as Colombia they are used in the preparation and extrapolation of maps.

Some Limitations in the Efficient Provision of Agrometeorological Bulletins and Information

Among the limitations that can be pointed out are the following:

- Lack of resources to develop and implement typical agrometeorological bulletins that are at par with the increase necessities of the user.
- The slow response to the needs of the farmer for useful agrometeorological information. At the present time, merely adding some agrometeorological information in the public meteorological bulletins cannot satisfy these.
- The arrival of the Internet has given the NMHSs an excellent source to obtain and diffuse agrometeorological information. But this technology is not easily accessible to, or usable by farmers.
- New techniques and methodologies in the analysis of agrometeorological data, and their presentation are not well known to many specialists who are engaged in the preparation of bulletins for the NMHSs.

It is necessary, therefore, to seek international and inter-institutional expertise that can provide technical assistance and training to agro-meteorologists, so that they can observe the experiences of other countries that have already been strengthen in this field, and so add a greater value to the bulletins. In this way they can make them user-friendlier to the farmers.

It will be necessary therefore, to increase the agrometeorological observations, the equipment and the specialized personnel to obtain a net increase in the rendering of information to farmers through agrometeorological bulletins and other relevant information. Today, the networks of meteorological and agrometeorological observing stations are not sufficient to cover all the areas of agricultural interests in most of the countries of Region.

Conclusion

The provision of timely and accurate agrometeorological information in the form of bulletins, advisories and press releases is indispensable for cost-effective crop management and food security. Agrometeorological information is part of a continuum that begins with scientific knowledge and understanding and ends with an evaluation of the information. The science transcends national borders, but the remaining components that have been the subject of this presentation differ from developed to developing countries. These differences are specifically a function of the availability of human, financial and natural resources. Whatever the setting, the information provided to farmers must be accurate, timely, and cost effective. The benefits gained by implementing agrometeorological information must outweigh the cost of processing and disseminating the information.

Recommendations

Some recommendations to improve agrometeorological bulletins and information to farmers and decision-makers in the agricultural sectors are as follow:

- Most agrometeorological units within NMHS of member countries require institutional strengthening in personnel and resources.
- Training should be aimed in advanced information and communication technologies (e.g. GIS, Agrometeorological Models, INTERNET, and Web Page design), so that agrometeorologists can provide the best possible advice to farmers.

- NMHS must devise strategies to foster inter-institutional collaboration for the preparation of agrometeorological bulletins.
- Providers of agrometeorological bulletins and information must keep in contact with users, know their needs, and meet those needs with accurate, timely, and cost-effective agrometeorological information.
- A concerted effort is required to improve agrometeorological network of observing stations.
- Member countries are encouraged to organize National Agrometeorological committees or councils.
- Member countries NMHS in collaboration with the agriculture agencies should encourage the development of phenological databases for the most important crops, fruit trees, pest and forest species.
- National Crop Calendar registers should be developed in collaboration with agriculture agencies to familiarize agrometeorologists with the agriculture activity in his district and country.
- Agrometeorologists and Agricultural personnel should be trained in risk management skills, and developing early warning systems for crop and livestock protection.

References

WMO. 2001. Background Document for the Inter-Regional Workshop on Improving Agrometeorological Bulletins. October 15-19, 2001, Bridgetown, Barbados. CAgM, World Meteorological Organization, Geneva.

WMO. 2000. Guide to Public Weather Services Practices. WMO-No.834. Second Edition. CAgM, World Meteorological Organization, Geneva

Garcia, S. 2001. CEO, Ministry of Agriculture, Fisheries and Co-operatives, Government of Belize. Personal Comm.

Weiss, A., L. Van Crowder and M. Bernardi. 1999. Communicating Agrometeorological Information to farming communities. *Agric. For. Meteor.* 103: 197-208.

Specimens of agrometeorological bulletins published in WMO Regional Association IV

Figure 1. Canada

This figure is from the Internet:
www.gov.mb.ca/agriculture/climate/waa_50500.html

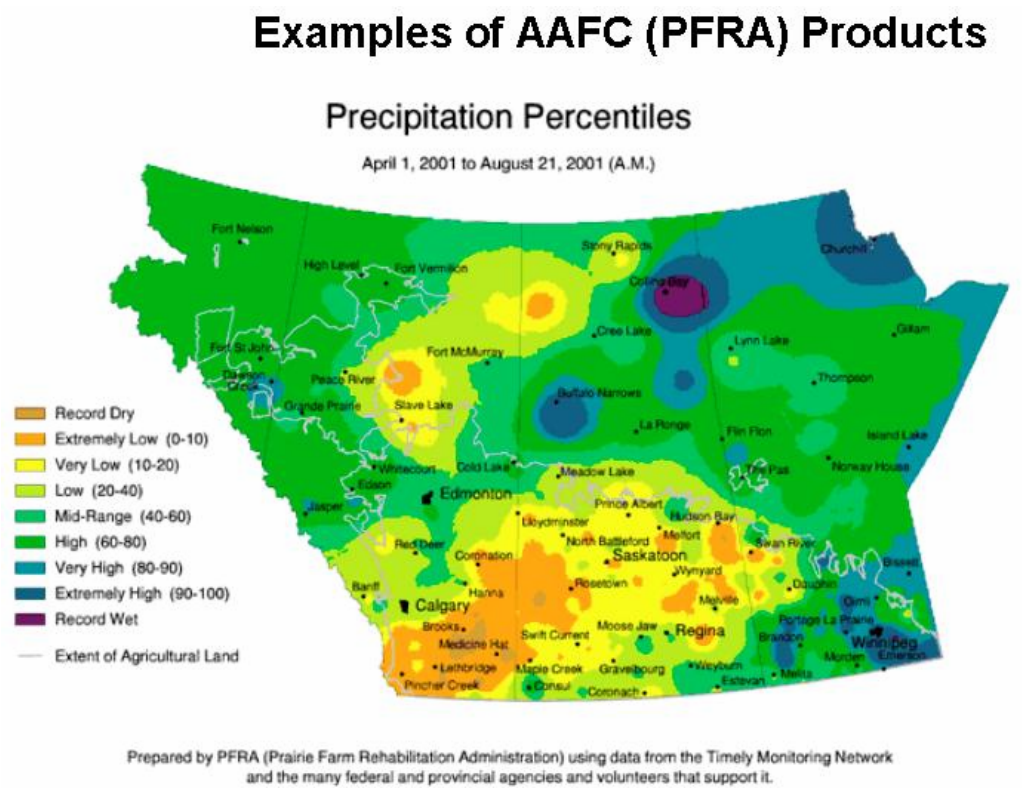

Figure 2: The Prairie Farm Rehabilitation Administration Product, Canada

This figure is from the Internet:

www.agr.gc.ca/pfra/maps/drprec1.htm

Accessibility of this Site

Back to JAWF Homepage

Weekly Weather & Crop Bulletin

Archives

National Summary

International Summary

General Information

About JAWF

Mission Statement

Contact Information

Publications

WWCB

World Crop Areas

Products

National Weather

International Weather

Weekly Weather and Crop Bulletin

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The Weekly Weather and Crop Bulletin is jointly prepared by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, and the U.S. Department of Agriculture. The bulletin is published weekly on Tuesday with the following summaries being officially released Tuesdays at noon eastern time:

The electronic version is posted Wednesdays by 5 p.m. eastern time.
(NOTE: When a federal holiday occurs on Monday the releasing of summaries and posting of the electronic version falls on Wednesday and Thursday, respectively.)

Table of Contents (PDF)

- Download the Entire PDF Document
- International Summaries by Region

- Color Crop Moisture Index
- Color Palmer Drought Index

Joint Agricultural Weather Facility, U.S. Department of Agriculture/U.S. Department of Commerce
Contact: bmorris@oce.usda.gov

Last updated on: 10/11/2001 08:30:44
URL: http://www.usda.gov/oce/waob/jawf/wwcb.html

Figure 3. Cover Page: Joint Agriculture and Weather Facility Bulletin, U.S. (Electronic Version)

This figure is from the Internet:

www.USDA.gov/oce/waob/jawf/wwcb.html

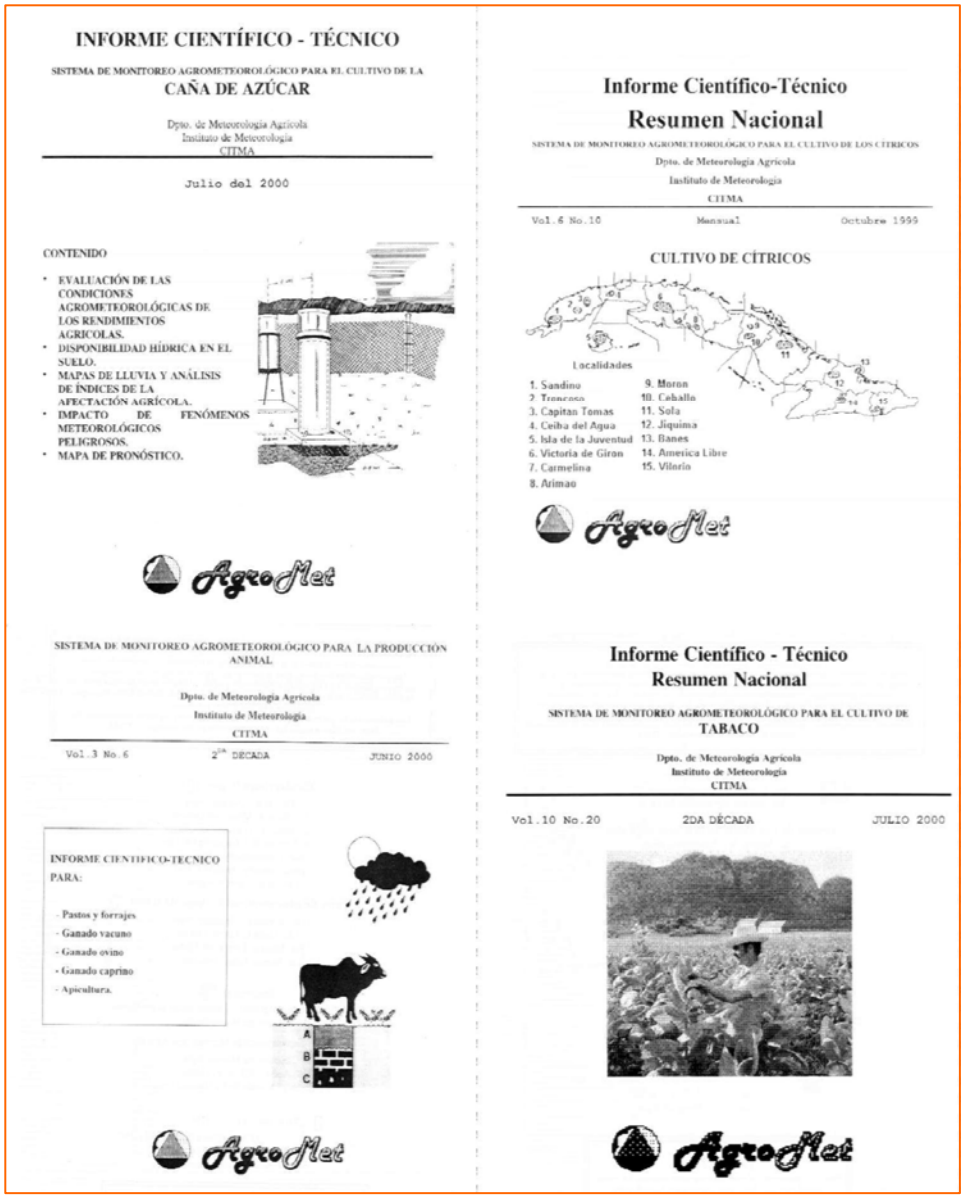

Figure 4. Agrometeorological Bulletin from Cuba

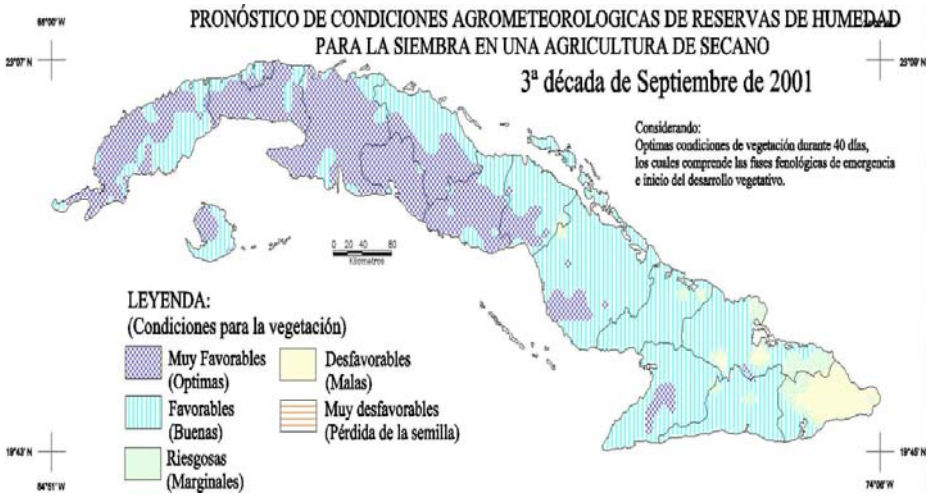

Figure 5. Cuba: Forecast of Soil Moisture Reserve for a Dry Season Crop.

Agrometeorological Forecast
for Farm Operations, Belize Central America
FARMS in: Stann Creek Valley / South Stann Creek / Toledo / Cayo and Belize Districts
Forecast Prepared ... Time: 10:00 am . Day: Friday Date: October 26, 2001
Updated Every Three Days...

Synopsis: A cold front will cross Belize by Saturday evening ahead of a broad cold airmass that will push cooler air over Belize through Tuesday of next week. A marked increase in rainfall will accompany the frontal passage beginning today, Friday through Sunday!

Chance that the 6th Pentad of October (i.e. Oct 26 - 31) will be WET or DRY is: Airport: WET 44% DRY 56% ; Belmopan: WET 52% DRY 47%; Central Farm: WET 47% DRY 53%; Pomona: WET 54% DRY 46%; Punta Gorda: WET 51% DRY 49%.

OUTLOOK :Cloudiness and Rainfall **(Next 48-72 hours): Cloudy with showery outbreaks increasing over the Northern, Central , and Southern Agricultural Zones through Sunday. Showers will decrease later on Sunday through Monday.** *Twelve (12) Tropical Storms expected this season, with seven (7) becoming Hurricanes and three (3) CAT III or stronger!*

One cold front expected over Belize in October.

Weather Parameter			Today... Fri 12 Oct.	Day 1 Sat 13 Oct	Day 2 Sun 14 Oct	Day 3 Mon 15 Oct
Relative Humidity (%)	Night 3am		90%	96%	94%	93%
	Morning 9am		99%	100%	99%	97%
	Afternoon 3pm		69%	65%	55%	50%
Rainfall (quantity, hrs)			15 - 25 mm/24h	20 - 30 mm/ 24h	20 - 25 mm /24h	10 to 15 mm / 24
Wind Onshore 5knots 25 mi Inland			E - NE 8 to 16	N - NW 15 to 25	N – NW 10 to 20	N - NE 8 to 16
Cloudiness : (sunny/clear, partly cloudy, cloudy, overcast)			Cloudy with some outbreaks of showers & TS	Cloudy to Overcast with scattered showers & rain	Cloudy to overcast with periods of rain	Cloudy at times with showers and rain over coast!
Sunshine hours			8 - 10 h	5 - 7 h	5 - 7 h	8 - 10 h
Temperature °C / °F Hills	Coast	Min	**25 / 77**	**24 / 75**	**22 / 72**	**19 / 67**
		Max	**31 / 87**	**29 / 85**	**29 / 84**	**30 / 86**
	Inland	Min	*23/73 (19/66Hill)*	*20/68 (19/67Hills)*	*18/65 (20/68 Hills)*	*15 /59 (19/67 Hills)*
		Max	**32 / 90**	**30 / 86**	**30 / 86**	**31/87**

FARMS in: Corozal and Orange Walk Districts

Forecast: Cloudiness, Rainfall & Wind (Next 36 - 48 Hours):

Cloudy to overcast today, Friday through Sunday with outbreaks of showers increasing!

Outlook: Cloudiness and Rainfall (Next 48-72 hours):

Showers diminishing as the cold front zone moves offshore.

No. *Next Update: 10:00 a.m., Monday, October 29, 2001*

Citrus Research and Education Institute (CREI) / Agroclimat Unit, National Met. Service.

Form revised 14/01/97. R. Fruitos (Agrometeorologist).

Figure 6. Three-day Agrometeorological Forecast from Belize

This figure is from Internet: www.hydromet.giv.bz/Agro_forecast.html

Figure 7. Agrometeorological Bulletin Web page from Belize

Belize Weekly Weather and Crop Bulletin

National Agricultural Summary

Vol.1 No.6 October 24-30, 2001

WklyWxCropBullPg1
Ten-day Rainfall Outlook
Seasonal Outlook
Agro-Hydrology
Home Page

Agricultural Summary provided by the Ministry of Agriculture, Fisheries and Cooperatives

HIGHLIGHTS

Wet weather is proving favorably to the newly planted crops and timber trees. The soybean crop that was planted in the Orange Walk District last week has germinated. The fertilizer applied at pre-planting is contributing to the vigorous vegetative growth. Similar scenario is being experienced in corn, rice, sugarcane root crops, fruit trees, pastures and timber trees. Whilst this type of weather has benefited the aforementioned crops, it has negatively impacted the hot pepper and vegetable crops. Heavy rains are damaging the quality of peppers by creating abrasions in the fruit while vegetable such as tomato and sweet pepper are more frequently being invaded by pests and disease.

The Importance of Irrigation in Coco yam

The coco yam (Xanthosoma sagittiiolum (L.) Schott) is one of the oldest domestic crops in Central and South America. Nevertheless, it remains in the category of being and under-exploited and poorly understood crops (O'Hair, 1999). In Belize the current acreage is estimated at 200 acres. The average yields obtained by producers are 16 tons per acre. Most of the crop is grown for home consumption with periodic exportations occurring from time to time.

The coco yam is a herbaceous plant, 3 – 6 ft in height that produces a cylindrical main corm at the base and 10 or more side corms, which are the edible portioned. White, pink and yellow cultivars are known.

List of Web-sites Related to Agrometeorological Information in RAIV

Belize

- http://bzewxcrop.iwarp.com
- http://hydromet.gov.bz

Canada

- Drought Watch
  http://www.agr.ca/pfra/drought.htm
- Government of Newfoundland and Labrador
  http://www.gov.nf.ca/agri/soils/agromet.htm
- Winnipeg Climate Center
  http://www.mb.ec.gc.ca/ENGLISH/AIR/WCC/agrom.htm
- Canadian Society of Agrometeorology
  http://www.oac.uoguelph.ca/~csam/
- Manitoba Agrometeorological Centre of Excellence
  http://www.gov.mb.ca/agriculture/news/ace/index.htm

United States

- USAID Famine Early Warning System
  http://www.info.usaid.gov/fews/fews.html
- The California Weather database
  http://www.imp.ucdavis/WEATHER/weather1.html
- Georgia Automated Environmental Monitoring Network
  http://www.griffin.peachnet.edu/bae/
- ICASA
  http://agrss.sherman.hawaii.edu/icasa
- AWIS Weather Services, Inc
  http://www.awis.com
- National Drought Mitigation Center
  http://enso.unl.edu/ndmc
- Washington Sate University (Public Agricultural Weather System)
  http://frost.prosser.wsu.edu
- Response Farming
  http://www.davis.com/~wharf
- Global Soil Moisture Data Bank
  http://climate.envsci.rytgers.edu/soil_moisture

- USDA-World Agriculture Outlook Board
  http://www.usda.gov/oce/waob/jawf/profiles/mwcacp2.htm
- University of Nebraska
  http://enso.unl.edu/agmet/
- New York State Agricultural Experiment Station
  http://www.nysaes.cornell.edu/pp/faculty/seem/magarey
- Pacific Northwest Cooperative Agricultural Weather Network
  http://mac1.pn.usbr.gov/agrimet
- Centre for Precision Farming
  http://www.silsoe.carnfield.ac.uk.cpf
- Oklahoma State University
  http://radar.metr.ou.edu/agwx.agwx.html

Others:

- FAO
  Remote sensing imagery, Agrometeorological data, tools and information
  http://metart.fao.org
- Agrometeorological crop forecasting
  http://www.fao.org/sd/EIdirect/agromet/forecast.htm

- WMO
  http://www.wmo.int/