

## **Perspectives from Regional Association IV (North and Central America)**

**Oscar Solano**

Agricultural Meteorology Department, Meteorological Institute  
Havana, Cuba

### **Abstract**

A questionnaire containing nine questions was circulated in Regional Association IV (RA-IV) of the World Meteorological Organization (WMO), as well as in the other regions. The original questionnaire suggested by the WMO Division for Agricultural Meteorology was sent to members of RA-IV Agricultural Meteorology Working Group. The region has 26 members and the RA-IV Agricultural Meteorology Working Group has 19 members. We received 14 answers from 13 countries, representing 74 percent of their active members. The evaluation of the answers was not easy because, from many countries, two to three answers were given instead of one short answer. The members were asked not only to answer the specific questionnaire but also submit examples. The total amount of the submitted materials, the answers, and the examples averaged more than 60 pages. The paper evaluates the information about the state-of-the-art of operational agrometeorological services at the national level in RA-IV, but it applies to only those parts of the region that provided survey answers.

### **Introduction**

Agriculture can be considered a big factory in the open air in which all the tasks depend on weather and climate. Agriculture is the world's single largest employer. Agriculture is one of the main sources of export earnings in North and Central America and the Caribbean countries. The importance of the agricultural sector is significant not only from the foreign exchange point of view but also for employment-generation capacity. From the World Meteorological Organization (2004) point of view, variations in weather and climate as well as their interaction with agricultural operations from sowing to harvesting have a significant impact on yield variations. Despite the advances made in our understanding of the influence of climate on agricultural production, climate variability has been, and continues to be, the principal source of fluctuations in global food production. Farmers, herders, foresters, and fishermen have to adapt to the range and frequency of shocks that climate variability brings, and they continue to try to use the available knowledge and information to develop coping strategies.

The countries of North America, Central America, and the Caribbean in RA-IV of the World Meteorological Organization include mountains, rainy areas, deserts, and tropical islands. With their associated variations in culture and biodiversity and the long period of human occupation, exploitation of natural resources, urbanization, industrialization, and economic development have led to land degradation and environmental pollution. Climate change and climate variations also represent future stress.

The major challenges to the development of the region include natural and environmental disasters, climate change, climate variability, water management, over-fishing of coastal and sea resources, freshwater resources management and development, land use and land degradation, energy availability, tourism management, poverty alleviation, and conservation

of biodiversity (Kamali and Lee 2002). Weather and climate observation and analysis are required to address these issues which are of relevance to the present social and economic conditions as well as for future generations.

A direct interdependence exists between the forest, crops, weather, and soil. Although the influence of the weather on agricultural production is well understood, it is evident that seasonal and inter-annual 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 (Solano and Frutos 2002).

## **Background**

The North America, Central America, and Caribbean Regional Association (RA-IV) comprises 26 countries: Antigua & Barbuda, Bahamas, Barbados, Belize, Canada, Costa Rica, Cuba, Dominican Republic, El Salvador, French Antilles, Grenada, Guatemala, Haiti, Honduras, Jamaica, Mexico, Netherlands Antilles & Aruba, Nicaragua, Panama, Saint Kitts-Nevis, Saint Lucia, Trinidad & Tobago, the United States, Colombia, Venezuela, and Guyana.

The RA-IV Working Group on Agricultural Meteorology of WMO has 19 members from 13 countries.

## **Methods and Materials**

A survey was carried out by sending a questionnaire via e-mail to all active members of the RA-IV Working Group on Agricultural Meteorology. Some problems were encountered in contacting Guatemala, Haiti, Jamaica, Barbados, Netherlands, Antilles, and Aruba, and hence, no answers were received.

As a consequence, not all the countries in RA-IV have been analyzed, and survey responses reflect the current condition of thirteen nations of Central America and the Caribbean (Antigua & Barbuda, Bahamas, Belize, Colombia, Costa Rica, Cuba, El Salvador, Guyana, Honduras, Nicaragua, Dominican Republic, Trinidad, Tobago, and Venezuela).

## **Operational Agrometeorological Services at the National Level**

As seen in Table 1, four of the countries have an independent Agrometeorological Service Unit.

Country	Answer	
	Yes	No
Antigua & Barbuda		X
Bahamas		X
Belize		X
Colombia		X
Costa Rica		X
Cuba	X	
Dominican Republic	X	
El Salvador		X
Guyana	X	
Honduras	X	
Nicaragua		X
Trinidad & Tobago		X
Venezuela	X	
TOTAL	5 (38%)	8 (62%)

Table 1. Existence of an independent Agrometeorological Service Unit in RA-IV countries.

Nevertheless, in the Bahamas, Belize, Colombia, El Salvador, and Nicaragua meteorological applications develop agrometeorological functions. The major customers for agrometeorological services in RA-IV are:

<b><u>Customers</u></b>	<b><u>Percent of countries total</u></b>
Ministry of Farmers	85
Farmers	46
Agricultural enterprises, cooperatives, and association of producers	38
Researchers	31
Advisors	23

### **Type of Operational Agrometeorological Services Provided by the National Meteorological and Hydrological Services**

With regard to type of services provided, 77 percent of the National Meteorological and Hydrological Services (NMHSs) issue regular agrometeorological bulletins and advisories (Table 2); 77 percent issue early warnings or alerts as appropriate (Table 3); 54 percent provide help with strategic studies (Table 4); and 77 percent evaluate the impact of extreme events.

Country	Answer	
	Yes	No
Antigua & Barbuda	X	
Bahamas		X
Belize	X	
Colombia	X	
Costa Rica		X
Cuba	X	
Dominican Republic	X	
El Salvador	X	
Guyana	X	
Honduras	X	
Nicaragua	X	
Trinidad & Tobago		X
Venezuela	X	
TOTAL	10 (77%)	3 (23%)

Table 2. Issuing regular agrometeorological bulletins and advisories.

Country	Answer	
	Yes	No
Antigua & Barbuda	X	
Bahamas		X
Belize	X	
Colombia	X	
Costa Rica	X	
Cuba	X	
Dominican Republic		X
El Salvador	X	
Guyana	X	
Honduras	X	
Nicaragua	X	
Trinidad & Tobago		X
Venezuela	X	
TOTAL	10 (77%)	3 (23%)

Table 3. Issuing early warning or alerts as appropriate.

Country	Answer	
	Yes	No
Antigua & Barbuda	X	
Bahamas		X
Belize	X	
Colombia	X	
Costa Rica		X
Cuba	X	
Dominican Republic		X
El Salvador		X
Guyana	X	
Honduras		X
Nicaragua	X	
Trinidad & Tobago		X
Venezuela	X	
TOTAL	7 (54%)	6 (46%)

Table 4. Helping with strategic studies.

Country	Answer	
	Yes	No
Antigua & Barbuda	X	
Bahamas		X
Belize	X	
Colombia		X
Costa Rica	X	
Cuba	X	
Dominican Republic	X	
El Salvador	X	
Guyana	X	
Honduras	X	
Nicaragua	X	
Trinidad & Tobago		X
Venezuela	X	
TOTAL	10 (77%)	3 (23%)

Table 5. Assessment of the extreme events impact.

Moreover, Belize, Costa Rica, Cuba, and Venezuela conduct agrometeorological studies on crops, early warning systems for forest fires and floods to farmers, assessment and meteorological tendency, climatological reports, and climatic risk.

### **Operational Services Provided**

As can be seen from Table 6, services to help reduce the impact of natural disasters, including pests and diseases, are provided by 46 percent of national meteorological and hydrological services; 69 percent have early warning and monitoring systems; seven countries provide short- and medium-range weather forecasting for agriculture; and all but three provide climate prediction and forecasting for agriculture. Only four provide services to help reduce the contribution of agricultural production to global warming.

Country	Answer	
	Yes	No
Antigua & Barbuda	X	
Bahamas		X
Belice	X	
Colombia		X
Costa Rica		X
Cuba	X	
Dominican Republic		X
El Salvador		X
Guyana	X	
Honduras	X	
Nicaragua	X	
Trinidad & Tobago		X
Venezuela		X
TOTAL	6 (46%)	7 (54%)

Table 6. Services to help reduce the impact of natural disasters, including pests and diseases.

Country	Answer	
	Yes	No
Antigua & Barbuda	X	
Bahamas		X
Belice	X	
Colombia	X	
Costa Rica		X
Cuba	X	
Dominican Republic		X
El Salvador	X	
Guyana	X	
Honduras	X	
Nicaragua	X	
Trinidad & Tobago		X
Venezuela	X	
TOTAL	9 (69%)	4 (31%)

Table 7. Early warning and monitoring systems.

Country	Answer	
	Yes	No
Antigua & Barbuda		X
Bahamas		X
Belize	X	
Colombia	X	
Costa Rica	X	
Cuba	X	
Dominican Republic		X
El Salvador		X
Guyana	X	
Honduras	X	
Nicaragua	X	
Trinidad & Tobago		X
Venezuela		X
TOTAL	7 (54%)	6 (46%)

Table 8. Countries that provided short- and medium-range weather forecasting for agriculture.

Country	Answer	
	Yes	No
Antigua & Barbuda	X	
Bahamas		X
Belize	X	
Colombia	X	
Costa Rica	X	
Cuba	X	
Dominican Republic		X
El Salvador	X	
Guyana	X	
Honduras	X	
Nicaragua	X	
Trinidad & Tobago		X
Venezuela	X	
TOTAL	10 (77%)	3 (23%)

Table 9. Climate prediction / forecasting for agriculture.

Country	Answer	
	Yes	No
Antigua & Barbuda		X
Bahamas		X
Belize	X	
Colombia		X
Costa Rica		X
Cuba		X
Dominican Republic		X
El Salvador		X
Guyana	X	
Honduras	X	
Nicaragua	X	
Trinidad & Tobago		X
Venezuela		X
TOTAL	4 (31%)	9 (69%)

Table 10. Services to help reduce the contributions of agricultural production to global warming.

#### **Shortcomings and Limitations in Regional Association IV:**

Current availability data:

- Insufficient spatial cover;
- Quality of the information;
- Difficult access to daily data; and,
- Small amount of information in electronic format.

Analytical tools:

- Few developments of forecast models to local scale;
- Low utilization of crops forecast models, etc;
- Insufficient number of personal computers; and,
- Low utilization of geographical information systems.

Methods of providing operational agrometeorological services:

- New techniques and methodologies in the analysis of agrometeorological data, and their presentation are not well known to many specialists engaged in the preparation of bulletins for the NMHSs.
- There is poor access to methodologies for analysis of soil water balance, monitoring of vegetation conditions, monitoring of drought, and potential danger conditions for forest fires.

It is necessary, therefore, to seek international and inter-institutional experts who can provide technical assistance and training to agrometeorologists. They could then observe the experiences of other countries strong in this field and add greater value to their operational agrometeorological services and become more user-friendly to farmers.



## Cooperation between Operational Agrometeorological Services and Agricultural Research and Extension Services

All but three countries reported that their operational agrometeorological services work with agricultural research and extension services (Table 11). However, only three countries reported interacting with research and extension services on a daily basis (Table 12).

Country	Answer	
	Yes	No
Antigua & Barbuda	X	
Bahamas	X	
Belice	X	
Colombia	X	
Costa Rica		X
Cuba	X	
Dominican Republic	X	
El Salvador	X	
Guyana	X	
Honduras	X	
Nicaragua	X	
Trinidad & Tobago		X
Venezuela		X
TOTAL	10 (77%)	3 (23%)

Table 11. Countries where agrometeorological services and agricultural research and extension services in Regional Association IV cooperate.

Country	Answer	
	Yes	No
Antigua & Barbuda		X
Bahamas		X
Belice	X	
Colombia	X	
Costa Rica		X
Cuba	X	
Dominican Republic		X
El Salvador		X
Guyana		X
Honduras		X
Nicaragua		X
Trinidad & Tobago		X
Venezuela		X
TOTAL	3 (23%)	10 (77%)

Table 12. Countries with daily interactions with agricultural research extension services.

As can be seen from Table 13, no countries reported weekly frequency of interactions with agricultural research and extension services. Some countries, like Cuba, provide agrometeorological information twice per week to term 5 days (the Monday, of the Monday to Friday; the Friday, of the Friday to Tuesday).

Country	Answer	
	Yes	No
Antigua & Barbuda		X
Bahamas		X
Belize		X
Colombia		X
Costa Rica		X
Cuba		X
Dominican Republic		X
El Salvador		X
Guyana		X
Honduras		X
Nicaragua		X
Trinidad & Tobago		X
Venezuela		X
TOTAL	- (0%)	13 (100%)

Table 13. Countries with weekly interactions with agricultural research extension services.

Five countries reported monthly interactions with agricultural research and extension services (Table 14). They are Cuba, Dominican Republic, El Salvador, Guyana, and Nicaragua. Three countries reported yearly interactions with agricultural research and extension services.

Country	Answer	
	Yes	No
Antigua & Barbuda		X
Bahamas		X
Belize		X
Colombia		X
Costa Rica		X
Cuba	X	
Dominican Republic	X	
El Salvador	X	
Guyana	X	
Honduras		X
Nicaragua	X	
Trinidad & Tobago		X
Venezuela		X
TOTAL	5 (38%)	8 (62%)

Table 14. Countries with monthly interactions with agricultural research extension services.

Country	Answer	
	Yes	No
Antigua & Barbuda		X
Bahamas		X
Belize		X
Colombia		X
Costa Rica		X
Cuba	X	
Dominican Republic		X
El Salvador		X
Guyana	X	
Honduras		X
Nicaragua	X	
Trinidad & Tobago		X
Venezuela		X
TOTAL	3 (23%)	10 (77%)

Table 15. Countries with yearly interactions with agricultural research extension services.

As seen in Table 16, eight countries provided agrometeorological information with irregular frequency.

Country	Answer	
	Yes	No
Antigua & Barbuda	X	
Bahamas	X	
Belize	X	
Colombia	X	
Costa Rica		X
Cuba	X	
Dominican Republic		X
El Salvador		X
Guyana	X	
Honduras	X	
Nicaragua	X	
Trinidad & Tobago		X
Venezuela		X
TOTAL	8 (62%)	5 (38%)

Table 16. Countries with irregular interactions with agricultural research extension services.

Regional Association IV operational agrometeorological services aware of the new requirements from the following international conventions and agreements:

Country	Answer	
	Yes	No
Antigua & Barbuda	X	
Bahamas	X	
Belize	X	
Colombia	X	
Costa Rica	X	
Cuba	X	
Dominican Republic	X	
El Salvador	X	
Guyana	X	
Honduras		X
Nicaragua	X	
Trinidad & Tobago	X	
Venezuela	X	
TOTAL	12 (92 %)	1 (8 %)

Table 17. United Nations Framework Convention on Climate Change.

Country	Answer	
	Yes	No
Antigua & Barbuda	X	
Bahamas	X	
Belize	X	
Colombia	X	
Costa Rica	X	
Cuba	X	
Dominican Republic	X	
El Salvador	X	
Guyana	X	
Honduras		X
Nicaragua	X	
Trinidad & Tobago	X	
Venezuela	X	
TOTAL	12 (92 %)	1 (8 %)

Table 18. United Nations Convention to Combat Desertification.

Country	Answer	
	Yes	No
Antigua & Barbuda	X	
Bahamas	X	
Belize	X	
Colombia		X
Costa Rica		X
Cuba	X	
Dominican Republic		X
El Salvador		X
Guyana	X	
Honduras		X
Nicaragua	X	
Trinidad & Tobago	X	
Venezuela	X	
TOTAL	8 (62%)	5 (38%)

Table 19. Convention on Biological Diversity.

Finally, only 38 percent of the countries reported they didn't know the new requirements from World Food Summit Plan of Action.

Country	Answer	
	Yes	No
Antigua & Barbuda	<b>X</b>	
Bahamas		X
Belize	X	
Colombia		<b>X</b>
Costa Rica		X
Cuba		X
Dominican Republic		X
El Salvador		X
Guyana	X	
Honduras		X
Nicaragua		X
Trinidad & Tobago	X	
Venezuela	X	
TOTAL	5 (38%)	8 (62%)

Table 20. Awareness of World Food Summit Plan of Action.

## **Methods and Tools to Improve Agrometeorological Services**

The survey asked for recommendations on how to improve operational agrometeorological services. The following methods and tools were suggested:

- Introducing or improving agrometeorological monitoring services and early warnings and alerts to help reduce the agricultural impact of extreme events (Bahamas, Cuba, Dominican Republic, El Salvador, Nicaragua, Guyana, Honduras, Trinidad & Tobago, and Venezuela);
- Improving observation networks and agrometeorological databases (Bahamas, Belize, Cuba, Dominican Republic, El Salvador, Guyana, Honduras, Nicaragua, and Venezuela);
- Training national meteorological and hydrological services technical staff and the extension-related agricultural sector (Bahamas, Belize, Cuba, Dominican Republic, Guyana, Honduras, Trinidad & Tobago, and Venezuela);
- Improving computer tools used to analyze agrometeorological data, for example, reference evapotranspiration estimation, soil water balance at the depth root, vegetation conditions; meteorological, hydrological, and agricultural drought; and potential forest fire danger (Bahamas, Colombia, Cuba, Dominican Republic, El Salvador, Nicaragua and Trinidad & Tobago);
- Using agrometeorological models to evaluate existing and expected conditions on different agricultural sectors--crops, livestock, forest, pests, and diseases (Belize, Cuba, Dominican Republic, El Salvador, Guyana, and Nicaragua);
- Creating capacity and apply operational GIS technology (Belize, Cuba, Honduras, Nicaragua, and Venezuela); and,
- Using high-resolution satellite images (vegetal cover, Normalized Difference Vegetation Index [NDVI], soil humidity, etc.) in the operational agrometeorological services (Colombia, Cuba, and El Salvador).

## **Strategies to Strengthen Operational Agrometeorological Services**

Respondents suggested the following capacity building strategies:

- Create capacity in the agricultural meteorology specialty, either NMHSs or agrometeorological information users (Bahamas, Belize, Cuba, Dominican Republic, Guyana, Nicaragua, and Venezuela);
- Identify funding sources and promote financial support to national agrometeorological services with users who guarantee to keep the agrometeorological services (Costa Rica, Cuba, Dominican Republic, El Salvador, Guyana, and Trinidad & Tobago); and,
- Create a National Technical Committee that promotes agrometeorological applications that meet the needs of the agricultural sector and coordinates this work among institutions and disciplines (Belize, Colombia, Costa Rica, Cuba, and Venezuela).

## References

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