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Meteorological Data Acquisition in Ecuador, South America: Problems and Solutions

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Abstract: The acquisition of meterological data for public use is often taken for granted. A recent consultation trip to Ecuador, South America demonstrated that this is not always true. Meteorological data acquistion in Ecuador is hindered by: 1) lack of meteorological expertise, 2) lack of media presentation, 3) lack of cooperation between existing weather stations, 4) an unwillingness of weather facilities to share data with the public and 5) a lack of dedication to data collection responsibilities. These hinderances are further compounded by lack of power and communication lines, power failures, civil unrest, and a slow, unreliable postal service. This report discusses these problems and how two communities are solving them. Short-range solutions lie in establishing small weather stations where they are needed the most. More long-range solutions lie with the introduction of weather data to radio broadcasts, and the establishment of the first provincial climate data center in Ecuador.

Introduction

Meteorological and climatological data have a variety of applications in our daily existence. Weather and climate affect the human body, clothing, architecture, transportation, industry, urban and regional planning among others (Oliver 1973; Mather 1974). The most obvious application lies between weather data and agriculture activities. According to the National Research Council (1982), it is clear that improvements in climatic information would be of great value to farmers to manage their resources, to optimize productivity, and to minimize losses.

Educated agriculturalists in Ecuador are beginning to realize the essential role meteorological data plays in agricultural activities. Their search for local weather and climate data leads Ecuadorian farmers to seek outside assistance. During January 1985, this author visited two areas in Ecuador as a consultant for the Kentucky-Ecuador Partners of the Americas. The purpose of the visit was to design and help establish a series of small weather stations in the two target areas. This article discusses some of the major problems confronting the acquisition of meteorological data in Ecuador and some solutions to these problems.

The Problem

The general Ecuadorian public is grossly unaquainted with meteorological and climatological concepts and processes. This problem is caused by a number of factors. The first is the lack of meteorological training. According to the admissions office of the Central University in Quito, no university in Ecuador offers a major curriculum in meteorology or climatology. Some universities and colegios (high schools) may offer an introductory course in meterology, but nothing beyond that. A student must travel to Columbia, Argentina, or the United States to study weather and climate (Central University in Quito, Admissions Office, Personal Communication, January 1985).

The second factor is the lack of mass media presentation of meteorological data. To date, no radio station in Ecuador broadcasts any weather information. Ecuadorian television stations read the newspaper's weather reports which consist of little more that the previous day's maximum and minimum temperatures and rainfall totals for Quito, Guayaquil, Miami, and New York. The forecasts are limited to the probability of rain based upon the presence or absence of cloud cover.

A third factor is the lack of cooperation and communication between existing meteorological facilities. Surprisingly enough, quite a number of weather stations already exist in Ecuador, some with data records of thirty and forty years in length. These stations however, are managed by a variety of agencies. Among them are: 1) INMAHI (Instituto Nacional de Meterologica y Hidrologia) the National Institute of Meteorology and Hydrology, 2) INIAP (Instituto Nacional de Investigaciones Agriculturas y Pecularias) National Institute of Agriculture and Livestock Investigations, 3) Ecuadorian Air Force, 4) MAG (Ministero de Agricultura) Ministry of Agriculture and 5) Some universities and colegios technicos (technical high schools). The problems lie in the fact that these stations are not aware of each other's location, status, or activities. They rarely, if ever, communicate with each other. Some stations report their daily data to INMAHI where monthly totals and means are presented in tabular format in a publication called *Boletin Climatologico*. According to Tomas Guerrero, Agricultural Program Manager for the Peace Coprs (Personal Communication, 1985), "The *Boletin Climatologico* is not sold or available at libraries, it is only found at the INAMHI office." The most recent issue contained only a fraction of the stations in Ecuador and presented no daily data at all (Boletin Climatologico 1984).

A fourth factor is the unwillingness of existing weather stations to share data with the general public. When trying to acquire copies of weather records, a very apparent "Catch-22"* situation appears. The general public hears very little about the weather and weather data. As a result, the public (especially the uneducated population) is grossly unaware of meteorological and climatological concepts. This lack of knowledge is then perceived by most of the agencies that operate the weather stations as an excellent reason not to release data to the general public, and the vicious cycle continues. This situation was best exemplified by an Ecuadorian Air Force officer at an airport weather station. When asked if they release data to the public he simply said, "Weather data are not for civilians."

According to an agricultural extension Peace Coprs volunteer, the poor and uneducated masses do not even understand the concept of measuring heat by degrees of temperature, (Fahrenheit or Celsius). The people comprehend relative terms such as hot, mild, cold, and frost, but a numerical representation is foreign to these people (Jack White, Personal Communication 1985).

Under the auspices of the Kentucky-Ecuador Partners of the Americas there are several experimental agricultural projects in Ecuador at the present time. With the help of US agricultural experts, these projects are run by young, educated, and enthusiastic Ecuadorian farmers. The proper planning and implimentation of these projects cannot proceed without some meteorological input; and these innovative agriculturalists are left to deal with this restrictive attitude toward cooperation and data sharing.

The final factor, one of indifference is encountered when trying to gather accurate and continous weather records. In general, everything proceeds rather slowly in Ecuador. Ecuadorians themselves often joke about the concept of "Ecuadorian Time." The following example will clarify. If a meeting is scheduled for 9:00 a.m. on any given day, people will begin to gather for the meeting between 9:30 and 9:45 a.m. and the meeting may begin somewhere between 10:00 and 10:15 a.m. Though frustrating at first, eventually visitors adapt to "Ecuadorian Time."

This attitude factor however is more serious than just a slow down of activities. It is not uncommon for weather stations housed at universities and colegio technicos to close during school vacation periods. It is also possible for stations to close for equipment failure, personnel illnesses and vacations, and national work strikes. Discontinuous data and long periods of missing values plague Ecuadorian weather data records. It is believed, this nonchalant attitude toward weather data collection may stem from lack of attention that weather information receives. If the Ecuadorian weather data could receive more visibility and publicity in applied research, perhaps in the future, this attitude of indifference would improve. In the interim, this nonchalant attitude coupled with sparsity of telecommunications lines and a slow, unreliable postal service present problems to be dealt with by environmental and agricultural project directors.

Solutions to the Problem

The solution most sought by the Ecuadorians is to supply weather data monitoring equipment for local use. Therein lies the purpose of this author's involvement with this issue. Two communities requested aid and guidance in designing some local weather facilities.

Case one: Santo Domingo de los Colorados

This city, with an estimated population of 250,000 people, is the fastest growing city in Ecuador (Velastequi 1983). This city in Pichincha Province lies in a tropical rainforest climate on the western foot slopes of the Andes. At a major cross-roads, this city is growing at an estimated 8% per year (Velastequi 1984). The infrastructure of the city is unable to keep pace with population growth. Lack of paved roads, potable water, power, and communication lines offer a myriad of community problems.

* Catch-22 is an American colloquial term meaning a "no win situation".

The people of this community see the importance of accurate local weather data for: agricultural projects, technical training (Santo Domingo has two high schools), tourist information, urban and regional planning, and introduction to the mass media.

Though all of the above reasons are important, the one dealing with the mass media has the greatest potential. The management of Radio Zaracay AM and FM located in Santo Domingo de Los Colorados is anxious to be the first radio station in Ecuador to broadcast local meteorological data on a daily basis. This author views this as a significant attack on the aforementioned Catch-22 situation. Radio Zaracay's FM band has a local listening area but its AM band can reach all of Ecuador. It is believed that this new concept of meteorological data broadcasts on radio will stir other competitative radio stations to seek local weather data for broadcasts. This may further stimulate Ecuadorian television and newspapers to augment and sharpen their meager weather reports.

Local problems and solutions for Santo Domingo de los Colorados

A number of concerned citizens of Santo Domingo de los Colorados have requested that a small but comprehensive weather station be established for community use. A grant was recently awarded by the National association of the Partners of the Alliance, Inc. (NAPA) for that purpose. This station will contain instrumentation to monitor local temperature (air and soil) precipitation, barometric pressure, relative humidity, wind velocity and direction, and solar radiation. This variety of equipment was chosen through a series of local civic meetings.

Location and management of the weather station

The station will be located at the CADE (Colegio Adventista Del Ecuador) Campus. This highly esteemed Adventist High School has both the facilities and expertise to take on the responsibility of a weather station. Two of CADE's science teachers (Physics and Biology) are from the United States but reside on the campus. These gentlemen know the importance of accurate and continuous weather records and have had experience handling delicate scientific instruments. These educators will also be able to introduce meteorological training and real time data into classroom curricula. It has already been agreed that the Colegio Technico Nacional (technical high school) located in downtown Santo Domingo will also incorporate the weather data into their curricula as well.

Cooperation and communication

An INAMHI weather station is located only 40km from the CADE campus. It is hoped that future cooperation and communication between the weather stations can be established. At present, the INAMHI station will not release copies of its data. In fact, few residents of Santo Domingo even know of the INAMHI station's existence.

The NAPA grant will allow funding for a telephone line to be installed which will connect the CADE campus to town. This new communication linkage will allow daily weather data to be telephoned in to Radio Zaracay AM/FM for broadcast throughout Ecuador.

Power failures

It is not uncommon for Santo Domingo de los Colorados to experience as many as two electrical power failures in a weeks time. These power failures affect more than just electrical equipment. Nonfunctional electric water and gasoline pumps strongly restrict water utilization and road transportation. For this reason, only meteorological instruments with battery powered and spring woud chart drives will be used in the proposed station.

Work attitudes and national strikes

The CADE station will be manned by what is essentially Adventist educators/missionaries. This is a non-political group which functions despite any national work strikes or protests. Because these people requested that the weather station be placed on their campus, it is assumed that the station will be operated with a greater dedication than that of the average weather station employee.

Case two: Ambato

This city, with an estimated population of 150,000 people is nested in a large basin between the Occidental (W) and Oriental (E) chains of the Andes Mountains (Robinson 1967). Located in the mountainous province of Tungurahua, Ambato is dominated by a myriad of microclimates. The Ambato Basin is surrounded by mountains some of which rise 5000 to 6000m ase (i.e. Mt. Chimborazo and Mt. Tungurahua, 6310 and 5700m ase, respectively). In addition, dissection by several rivers have cut deep canyons across the basin (i.e. Rio Cutuchi and Rio Ambato have cut canyons which are 1100 to 1200m in depth, respectively) (Robinson 1967). These canyons and mountain peaks create a complicated labyrinth through which the atmosphere circulates. Cold dry air may occupy a canyon adjacent to canyon with warm most air. The results of this complex air flow are apparent in the various climates which exist there. A 5km trek in any direction will likely encounter a different climate type.

With assistance from agricultural experts from the United States, a group of young energetic Ecuadorian agriculturalists have established a series of four model

farms (fincas modelas). Each finca is designed to initiate and develop modern farming techniques and experiment with different types of agriculture. With scheduled visits from groups of local farmers, these fincas modelas display new techniques and allow a hands-on learning experience to other regional farmers. The directors of the fincas modelas and the US agricultural advisors both agree that future experimentation and development cannot proceed without proper meteorological and climatological input.

Problems and solutions for Ambato

Concerned agriculturalists in Ambato have requested that weather stations be placed in the region for community use. The author has submitted a small grant proposal to NAPA for that purpose. Besides the problems that affect Ecuador nationwide, some local problems and their solutions are discussed below.

Location and management of the weather stations

It was generally agreed that a multi-station approach is the only way to compare and contest the variety of mico-climates in this mountainous region. Because the stations will assist with the operations of the fincas modelas, it was decided to place a small weather station at each model farm. These four fincas are scattered around the Ambato basin area at various elevations, and each represents a distinctive climate type (from warm and humid conditions found at the vegetable farm to cold dry conditions located at the dairy and pasture farm). Each station will contain instrumentation to monitor temperature (soil and air), relative humidity, rainfall, and wind direction and volocity. One station will monitor solar radiation and barometric pressure as well. Two stations will monitor evaporation.

The directors of the fincas modelas will be responsible for the management and operation of the weather station on their property. All the directors know how to collect and manipulate (statistically and graphically) numerical data, but lack any meteorological training and knowledge of data collection techniques. These problems can be eliminated by a short but intensive workshop in basic meteorological concepts and instrument orientation. The author will conduct such a workshop after the equipment is installed but before the stations are fully operational. This workshop is tentatively planned for December 1986.

Cooperation and communication

The four proposed weather stations will operate with a spirit of total cooperation and communication. The directors of the fincas modelas agree to place copies of their daily weather data and monthly summaries into a central file at the Centro Agricola (Farmers Cooperative Office) in Ambato. At this location, daily weather data will be accessible to all of the 4,000 members of the Centro Agricola.

During my stay in Ambato it was discovered that 5 (possibly 6) weather stations already exist in Tungurahua

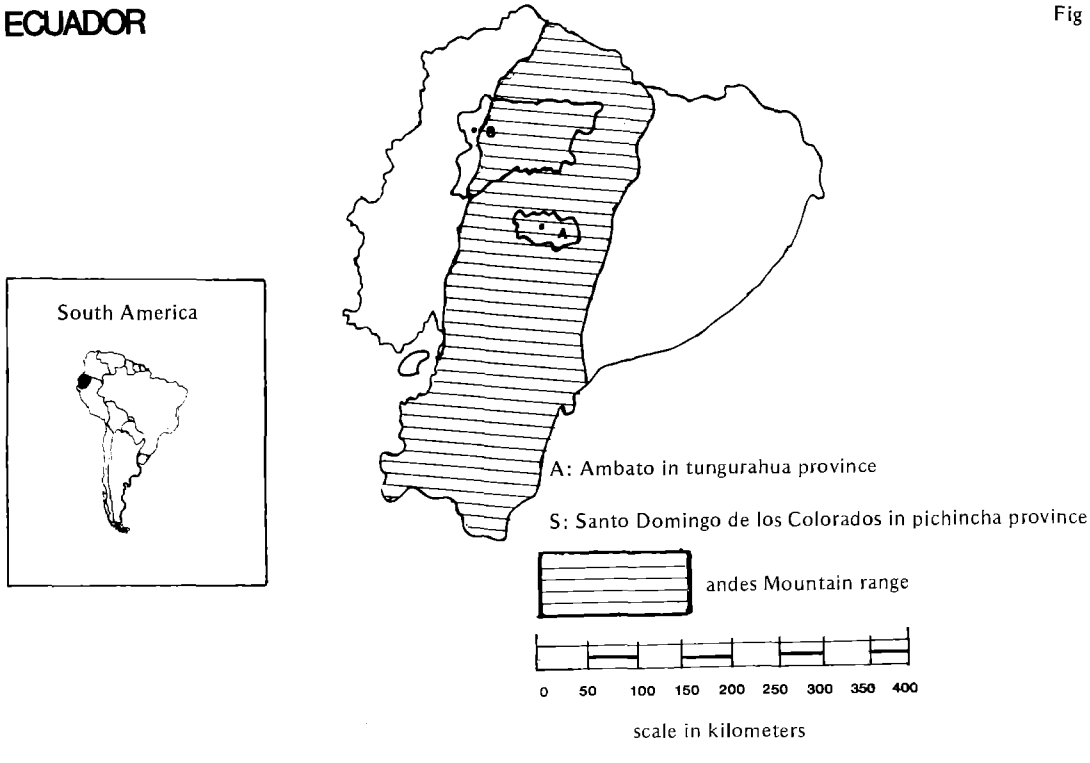

Fig 1 Study areas in Ecuador

Province; each station run by a different agency. As mentioned previously, none of the existing weather stations communicate and cooperate with each other. Initiated by this author, efforts are being made to contact all of the existing weather stations in Tungurahua Province and establish a data sharing agreement. In essence, each station will send one copy of the daily data and monthly summary sheet each month to the Centro Agricola.

The 4 proposed weather stations and the 5 or 6 already in existence will create a network of 9 or 10 weather stations in Tungurahua Province. This concept, though new to Ecuador, is simply modelled after our own concept of the State Climatologists Office. Each state's climatologist is responsible for gathering and archiving weather data from all the weather stations in the state. At the same time, the state climatologist is responsible for making weather and climate data available to citizens upon request.

This Tungurahua weather station network will create the first Provincial Climate Data Center in Ecuador. These data will be available to users on request. Initial users will most likely be agriculturalists, regional planners, and students (university and high school). It is hoped that this cooperative effort and data sharing philosophy will pave the way for similar efforts in other provinces. At least, it is another step toward eliminating the Catch-22 problem mentioned earlier.

Scarcity of power lines

Though the city of Ambato does not experience many power failures, there are few electrical power lines which reach farms on the outskirts of town and up the mountain slopes. For this reason, all equipment for the proposed weather stations will utilize battery powered or spring wound chart drives.

National work strikes and protests

Because the four proposed weather stations will be placed on the 4 privately owned model farms, outside the city limits, these stations will likely remain operational during any civil disturbance which may arise. Each model farm represents the livelihood of the director of that farm. Here, the spirit of free-enterprise and profit motive will assure a more constant and uninterrupted weather station operation.

Conclusions

The acquistion of meteorological data is plagued with a variety of problems. So much so that local residents tend to seek outside expertise to help acquire meteorological instruments to gather appropriate local weather data.

Obstacles to data acquistion on the national level include: 1) lack of meteorological expertise and meteorological training programs in Ecuador, 2) lack of media presentation of meteorological data, 3) lack of cooperation and communication between existing weather stations, 4) unwillingness of existing weather stations to share data with each other or the public and 5) lack of dedication toward continuous operation and maintenance of existing weather stations. These obstacles are compounded by a slow and unreliable postal service and occasional civil unrest (i.e. protests and work strikes).

On a local level, problems of data acquistions and weather station operations are often hindered by: 1) lack of electrical power lines, 2) electrical power line failures, and 3) lack of communication lines. These hinderances too are compounded by the poor postal service and civil unrest.

The key to some of these problems lies in the lack of awareness of the Ecuadorian public toward meteorological concepts, data, and applications. A temporary solution lies in establishing weather stations in specific locations for specific needs. At least then weather data can reach the people who utilize it and appreciate its importance. However, giving every user their own weather instruments is not the best answer.

A farther reaching solution entails the enlightenment of the Ecuadorian government agencies and general public. An appreciation for the importance and varied applications of weather and climate data will improve conditions in the future. This paper describes two efforts which are designed to uplift the awareness of Ecuadorian public toward weather and climate data. The first entails the introduction of weather data broadcasts on Ecuadorian radio. It is hoped that this first step will urge other advances in media presentation of weather data and concepts. The second endeavor deals with the establishment of the first Provincial Climate Data Center in Ecuador. This will initiate the first cooperative effort between private citizens and governmental agencies to make weather and climate data available to users on request. It is hoped that this effort will pave the way for other cooperative climate data centers in the future.

An increased awareness of the importance of meteorological and climatological data is the first step in circumventing some of the problems highlighted in this report. As the problems involved with meterological data acquistion are alleviated, a free cooperative exchange of atmospheric data will become a vital component in future environmental studies.

References

Mather, R.: Climatology. Fundamentals and Applications. McGraw-Hill, New York 1974.

Ministerio de Recursos Naturales y Energeticos: Boletin Climatologico, Instituto Nacional de Meteorologica y Hidrologica, 23, 270, 26 p. (1984).

National Research Council, 1982, Examples of the Utility of Climatic Services: Agriculture. Meeting the Challenge of Climate, Washington, DC, National Academy Press 1983.

Oliver, John E.: Climate and Man's Environment. John Wiley and Sons, New York 1972.

Robinson, Harry: Latin America. A Geographical Survey. Praeger, New York 1967.

Velastequi, Holger D.: Santo Domingo de Los Colorados. Santo Domingo de Los Colorados, Ecuador. Publicaciones Zaracay 1984.

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