

ESTABLISHMENT OF PRECIPITATION NETWORK  
WEST PAKISTAN AND ECUADOR

By

L. L. Cross, Jr., Hydrologist  
Chas. T. Main International, Inc.,

In September of 1959 Chas. T. Main, Inc., of Boston, a U.S. consulting firm, entered into a contract to do a feasibility study for a hydro project in West Pakistan.

As Project Hydrologist, I was given ten days in which to get myself and whatever I needed ready for the hydrologic sector of a preliminary reconnaissance. I must shamefacedly admit that my first effort was to find West Pakistan in my children's Atlas. Our particular project involved the study of the development of the Kinhar River and the Kaghan Valley, which together comprised one of the major tourist attractions in the Himalayan foothills.

The ten days passed altogether too quickly and much too frantically and soon we were on our way. There was a very enjoyable albeit all too brief a stopover in Paris which incidentally could provide the basis for a much more "listenable paper" and then on to storied Karachi on the flank of the Arabian Sea. A quick flight across the fabled Sind Desert brought us to the ancient university city of Lahore, the city that for decades has set athwart the Grand Trunk Road invasion route and cultural track to the Indian Sub Continent.

Here we talked to many government agencies and gathered the meager climatological and hydrologic data that was available for our study areas.

After several days we went on to Rawalpindi and here the "British Raj" effect was still very noticeable. Two days to lay on the necessary vehicles, food and equipment and then 80 miles and a 3,000-foot climb to Balakot entrance to the "glorious" Kaghan.

It was here that we were stopped to allow the down valley traffic to safely negotiate the narrow camel track, one jeep wide that labored, crept and clung tenaciously to 2,000-foot cliffs for 40 "nail biting", breath holding miles of the most startling scenery in the world.

Up until now I am sure that this has sounded much like a tour advertisement and not at all proper company for the excellent scientific paper we have all enjoyed to this point. My only reason for this is to try to set the scene so you will see our valley with Balakot at 2,000 feet at the downstream end and then 50 miles of narrow valley never more than three miles wide with Himalayan snow capped ramparts towering to 18,000 feet; to Barbusar Pass, 13,000 feet elevation. Here you can stand surrounded by the camel bones of countless caravan "drop outs" and view the mighty Karakorum Range home of seven glaciers and countless permanently snow capped peaks surrounding the lordly Nanga Parbat in all its 26,000-foot glory.

Here we were to spend two weeks measuring stream flow, selecting dam sites, laying out climatological stations and all the while keeping close watch on the snow line as it descended further down the crests of our surrounding ridges each night.

We found here, by talking with the native migratory herders, that snow usually accumulated to great depths, 8 to 10 feet here in the valley of the Kinhar and snow fields often remained until the following summer.

A scant five years of stream flow records at the downstream end of the valley and two years of precipitation data at the same site were the sole data available. We, therefore, had to lay on a program stream gauging precipitation measurement plus the dam site investigations and mapping for the following season on which to base our study.

The scene changes rapidly, it is July 1960 and we are in the valley with a crew of about 110 Pakistani surveyors and laborers and bearers of three expatriates. Our brief summer was busily spent in establishing staff gauges rating the stations and establishing three precipitation stations spaced up the valley.

One of the problems in this type of topography is trying to determine the extent of rainfall and the percentage of snow melt runoff.

The Pakistani had done very little in the way of data collection in this area so we set about to determine the extent of monsoon penetration. The NE-SW axis of the

valley made is susceptible to the June-September monsoon and we installed several "tin can" rain gauges which were nothing but No. 10 cans nailed to posts about four feet above the ground and read by a native or one of our people every day. This, coupled with such obvious evidence as distinct changes in the color of the river indicating marked increase in silt loads, allowed us to approximate the extent of monsoon penetration and to estimate the amount of runoff that came from rainfall.

The diurnal fluctuations of the upper reaches of the Kunhar coupled with our determination of the extent of monsoon rain made it most obvious that the bulk of the flow in this sector of the river was made up of snow melt water.

The Harza Engineering Company from Chicago had a contract to provide general consulting services to the Water and Power Development Authority and to set up surface water ground water and soil investigation group for the country. With the co-operation of Jim Ringenoldus and John Priest, Harza hydrologists, the government was convinced to set up snow courses and establish a snow survey for the Kaghan Valley.

Personnel from Harza, the Surface Water Circle of WAPDA and I established the first snow courses in Pakistan in the summer of 1960. Two sets of courses were set out, one about one-third the way up the valley with four courses ranging in elevation from 7,700 feet to 10,000 feet. The second set was established above Naran about two-thirds the way up the valley with four courses varying in elevation from 8,000 to 11,000 feet.

These courses were marked in the standard manner and each course had a precipitation storage gauge installed nearby.

Soil moisture indicators were buried at each course and all was in readiness for the actual measurement program to take place the following spring.

Unfortunately, by this time the particular assignment of Chas. T. Main, Inc. was completed and we left for Boston to work up our conclusions. However, the aforementioned John Priest of Harza took on the actual training and assisted on the first year's snow survey.



As with all hydrologic data, not enough time during which snow course measurements and concurrent stream flow data has been collected to establish any valid correlation. Nevertheless the program goes forward and the general feeling at this time is that not only will the program be of value on the Kinhar River, but will also have a great deal of use in the operation of the Indus Basin Scheme now being implemented by the World Bank in Pakistan.

The scene now changes from the semi-arid climate of West Pakistan to the equatorial climatic aspect of Ecuador.

Ecuador translates as equator and our first assignment in this South American country was the feasibility study of an irrigation project in the Guayas River Basin.

Our area of responsibility covered the basins of the Chimbo, Chanchan and Canar Rivers, all of which rise on the westerly slopes of the Andes and flow westward to the Guayas River.

We established ourselves in the steaming, thriving banana port of Guayaquil and set out to do a preliminary hydrologic and topographic reconnaissance of the basins. This was accomplished through the use of all manner of transportation from self-propelled rail cars all the way down the vehicular scale to horseback and foot.

We found fairly good coverage of the river basins with respect to water stage recorders, but we found that the longest period of record was on the order of two years. Precipitation records in the upper reaches of the basin were of roughly the same order of length and so, we were forced to make some rather long distance seasonal correlations to sites with longer periods of record.

From what climatological data was available, we found the project area broken up into what might be called "micro climates."

The steep slopes and deep valleys combined with the orographic process to produce alternating horizontal bands about 2,000 feet in height of lush tropical growth and arid climate vegetation such as cactus and yucca.

This alternation seemed to continue right up to the 12,000 to 14,000 foot peaks that marked the catchment limits.

Seasonal rainfall in the more remote areas of the basin were lacking and in November of 1965, we made an effort to "fill in" the data gap in these areas.

There was no time to arrange for the purchase and importation of standard storage rain gauges and so we designed a gauge that would store a season's worth of precipitation, and one that could be fabricated locally.

Twenty-five of these gauges were made and set out, not in time to get the whole winter season's "catch", but at least enough to fill in some holes in our precipitation data and allow us to plot seasonal isohytes with some degree of confidence.

As you can see from the drawing, the gauges are not pretty nor do they satisfy any desire for a "climatological status symbol", but they do work and they were easily and cheaply built. Of course, there were the usual problems that go along with putting this type of equipment out in the "boondocks", people using the gauges for water supply, all sorts of insect life using them for a home, and even having the gauges stolen to become household equipment for some of the natives.

At this writing the data from one season is still being analyzed and the program to read "tin can" gauges will continue through the coming rainy season. These will also be used in the future to test the efficacy of proposed rain gauge sites.

In both these instances, I have attempted to acquaint you with the hardware problems that confront the hydrologist who attempts to work in the developing countries. Basic data with ample periods of record that we take for granted here, are the exception in other areas. Equipment that we can purchase locally and repair if necessary with parts from the local hardware store is often too expensive or difficult to import. This leads to much improvising and "making do" with what is available.

In closing, let me say that these problems while at times assuming major proportions, do make the field fascinating and something of a challenge.

Thank you.