Sequía ЗАСУХА 干旱 Sécheresse

Drought Network News

June 1997

A Newsletter of the International Drought Information Center and the National Drought Mitigation Center

Volume 9 No. 2

From the Director

Drought policy continues to be a topic of much discussion in the United States. On June 12, the Western Drought Coordination Council (WDCC) met for the first time and adopted a work plan for 1997–98. The WDCC is committed to improving drought management in the western states through mitigation and preparedness. It is hoped that this Council, representing a partnership between federal, state, local, and tribal government, will serve as a model for other drought-prone regions of the United States. Four working groups (preparedness and mitigation; monitoring, assessment, and prediction; response; and communications) established by the Council will meet in late July to assign priority to action items identified by the Council as important to the WDCC's mission. The administrative leadership for the WDCC is housed at the National Drought Mitigation Center.

The WDCC was formed as a result of a memorandum of understanding (MOU) signed by the Western Governors' Association and federal agencies with primary programming responsibility in drought management and response. The initial federal agencies that signed this MOU were the U.S. Department of Agriculture, Department of Interior, Federal Emergency Management Agency, and Small Business Administration. The Department of Commerce recently signed the MOU and other federal agencies are likely to sign as well.

If you would like to know more about the Council or serve on one of the working groups, please let me know. We are creating a web site for the WDCC (http://enso.unl.edu/wdcc/), which should be online in early July. The WDCC web site will contain the annual work plan for the Council and the membership of the steering committee and the four working groups. (A discussion of the WDCC and its work plan is included in this issue of *Drought Network News*.)

The National Drought Mitigation Center is organizing a series of workshops on drought contingency planning under sponsorship of the Bureau of Reclamation. The first workshop is scheduled for July 28–30, 1997, in Albuquerque, New Mexico. At least four workshops are planned over the next two years for locations throughout the United States, and several organizations from regions throughout the country have expressed an interest in hosting these workshops. The purpose of these workshops is to train persons from local, tribal, state, and federal government in the mechanics of drought contingency planning. More information on the workshop series can be obtained by contacting our office.

In January 1997, Senator Pete Domenici (New Mexico) introduced the National Drought Policy Act in the U.S. Senate (S. 222). A hearing on this bill is scheduled for July 21, 1997. The bill notes that "Congress finds that, although the United States often suffers serious economic and environmental losses from severe regional droughts, there currently exists no coordinated Federal strategy to respond to these emergencies. . . . Therefore, the Congress finds that the President should appoint an advisory commission to provide advice and recommendations on the creation of an integrated, coordinated Federal policy designed to prepare for and respond to serious drought emergencies." Senate Bill 222 is currently being rewritten to include comments from various parties and has numerous sponsors in the Senate.

These and other changes in drought management in the United States are long overdue. These changes are largely the result of the devastating impacts of the 1996 drought, the acceptance of our current and increasing vulnerability to extended drought periods, the realization of the ineffectiveness of previous response efforts, and the political will of elected officials to finally address the policy issues associated with drought management.

Other countries are also striving to better monitor, respond to, and prepare for drought events. In May, I participated in the Workshop on Drought and Desertification in Bet-Dagan, Israel, sponsored by the World Meteorological Organization. Forty-four persons from Africa, Asia, the Middle East, and eastern Europe attended this event. A workshop summary report is included in this issue of *Drought Network News*, along with recommendations for future actions.

This issue of *Drought Network News* also contains articles about drought impacts in central India; impacts of weather on crop production in Kashmir, India; a case study of the Deficit Spell Index in the capital region of India; and a progress report on the North American Natural Hazards Map project.

Members of the drought network are encouraged to submit articles and reports for publication in *Drought Network News*. The feedback I receive at international meetings always serves to confirm the value of this information to the scientific and policy community. It is critical that we share information and lessons learned with others. **The deadline for receipt of articles for publication in the October issue of *Drought Network News* is September 1, 1997.**

Donald A. Wilhite

Contents

NDMC Conducting Regional Drought Planning Workshops

The National Drought Mitigation Center is conducting a series of regional workshops, “Planning for the Next Drought,” around the country in 1997 and 1998. The first workshop was in Albuquerque, New Mexico, July 28–30. Plans are underway to conduct similar workshops in other regions. A second workshop will probably be held in Salt Lake City in late 1997, followed by workshops in the Southeast and Midwest in 1998. Because the workshops are sponsored by the U.S. Bureau of Reclamation, there is no registration fee.

Workshop participants will learn how to develop a drought plan. Participants will also have the opportunity to discuss their specific planning needs with state and federal government officials and learn how others coped with recent droughts.

The objectives of the workshops are to:

- help people understand drought and the need for drought planning;
- teach natural resource managers, water utility managers, emergency managers, planners, and others how to develop drought contingency plans;
- help different levels and agencies of government coordinate drought-related programs.

Who should attend: Local, state, or federal officials; tribal representatives; people responsible for managing water and other natural resources; people in industries affected by drought, such as agriculture, energy, water utilities, recreation, and transportation; reporters; and others interested in reducing vulnerability to drought.

If you’re interested in learning more about the workshops, please contact the NDMC by writing to the NDMC, P.O. Box 830749, Lincoln, NE, 68583–0749, by calling (402) 472–6707, or by sending e-mail to ndmc@enso.unl.edu.

Workshop on Drought and Desertification

Report on the Workshop and Recommendations

The following article is paraphrased from a report on a workshop held in Bet Dagan, Israel, in May 1997.

The Workshop on Drought and Desertification was held in Israel from 26 to 30 May 1997. Forty-four participants from Africa, Asia, and Europe took part in the Workshop, which was sponsored by WMO. Three foreign experts provided in-depth analysis on drought and drought preparedness—Dr. O. Brunini (Campinas, Brazil), Prof. S. Mei (CAAS, Beijing, China), and Dr. D. Wilhite (University of Nebraska, USA), in addition to the Israeli lecturers.

Presentations by lecturers and discussions were conducted under the following four main headings:

1. Drought and Desertification Definitions.
2. Drought Causes and Management Response.
3. Drought Monitoring and Mitigation.
4. Assessing Drought Impact and the Development of a Rational Policy.

The methodologies of drought assessments (meteorological, hydrological, and agricultural) over a wide range of climatic conditions were presented and discussed, and recent lessons from the 1996 drought in the United States were presented. The possibility and economic consequences of alternative agricultural systems in semiarid climates were presented and numerous case studies of drought prediction, monitoring, impact assessment, and response efforts from Africa, Asia, the Middle East, and eastern Europe were discussed.

Two practical working sessions were held to present and analyze long-term annual rainfall time series demonstrating climatological data applications for the assessment of hydrological drought. Also, the analysis of rainfall-wheat yield relationships and the possibilities of such methodologies in the assessment of agricultural drought were demonstrated.

One day was spent on a field trip to the Jordan Rift Valley (rainfall cross section 250–400 mm), with demonstrations of runoff water harvesting, water use, and irrigation efficiency. The pumping station of the Israeli National Water Carrier was visited at the Sea of Galilee and a detailed discussion took place between the participants of the Workshop and National Water Carrier authorities on water management issues and economic implications.

The participants of the Workshop made the following recommendations:

1. Drought Monitoring Centres

The meeting recognized the broad scope and depth of work already undertaken by the DMCs in Nairobi and Harare, particularly in establishing subregional data bases and developing operational methodologies and schemes for drought monitoring and forecasting. The meeting therefore calls for links between the DMCs and the RMTCs, and the DMCs and national, regional, and other international organizations, for the development and implementation of drought programmes.

2. International Organizations

Noting the role drought plays in environmental degradation, the meeting recognized the role, work, and main thrusts of organizations such as WMO, UNDP, CILSS, FAO, ICRISAT, AGRHYMET, DMCs, and INCARDA in achieving future progress in matters (particularly in the areas of climate services) of sustainable development, impact assessment of drought, and response strategies to reduce vulnerability.

The meeting noted with regret the absence of the above organizations from the Workshop. The meeting therefore strongly recommends that the organizations participate in future Workshops so as to enrich the knowledge of participants and the results of the meetings.

3. Recommendations to the National Meteorological and Hydrological Services (NMHS)

The participants of the Workshop support the measures to be taken by WMO Members in implementing the UN Convention to combat desertification by NMHS.

(a) To strengthen and expand existing networks, and establish, where appropriate, new national and regional meteorological and hydrological observing networks, especially in areas prone to, or affected by, drought.

(b) To maintain close contact with the heads of the national coordinating bodies concerned with combating desertification and mitigating the effects of drought, so that NHMS requirements are largely taken into account in convention-related activities.

(c) To participate in the preparation and implementation of national and subregional action programmes and to improve existing programmes.

(d) To encourage and intensify research work on climate-drought interactions, and develop medium- and long-range climate prediction.

4. Recommendation to the Secretary General of WMO

The participants of the Workshop request the Secretary General of WMO to publish a technical note of the Workshop to be distributed to Members, after suitable synthesis of the papers presented and editing of the material. The Workshop established an editorial board consisting of Brunini (Brazil), Gundogdu (Turkey), Lomas (Israel), Mei (China), Wilhite (USA), and Yeves-Ruiz (WMO).

J. Lomas
Director, Regional Meteorological Training Centre
P.O. Box 25
Bet Dagan 50250, Israel

Western Drought Coordination Council:

Frequently Asked Questions

Dr. Donald A. Wilhite, director of the National Drought Mitigation Center, was a member of the Western Governors' Association Drought Task Force. This task force has been working on the development of the Annual Work Plan of the Western Drought Coordination Council. The Council approved the work plan at its first meeting on June 12, 1997, in Albuquerque, New Mexico. The first meeting of the Council's working groups was held July 30–31, 1997, in Albuquerque. The National Drought Mitigation Center provides administrative leadership for the WDCC.

Q What is the Western Drought Coordination Council (WDCC)?

A Formed under the auspices of the Western Governors' Association, the Council is a group of representatives of federal, state, local, regional, and tribal governments working together to coordinate drought mitigation, preparedness, and response in the western United States. The Council co-chairs are Gary E. Johnson, Governor of New Mexico; and Daniel Glickman, Secretary of the U.S. Department of Agriculture. The Council was officially created in February 1997 with a memorandum of understanding (MOU) signed in February 1997 by representatives of key government agencies. The MOU provides the framework for the creation of the Council. A regional council was recommended as a way to achieve that goal.

Q What prompted the formation of the Council?

A Severe drought gripped the southwestern United States in 1996. Both the Western Governors' Association (WGA) and the Federal Emergency Management Agency (FEMA) convened task forces to study how society can be better prepared for future droughts. Each recommended better coordination between government agencies and levels of government. Among those who kept the momentum going were elected officials from New Mexico—Governor Gary E. Johnson and Senator Pete Domenici—and the Western Governors' Association.

Q What does the WDCC hope to accomplish?

A Its general objectives, as stated in the 1997–98 Work Plan, are as follows:

- Encourage and help western states, local governments, and tribes to develop and implement drought preparedness and mitigation programs and plans by establishing and maintaining a clearinghouse of information on techniques and procedures for drought monitoring and prediction, response, planning, and mitigation.
- Identify and make recommendations on drought policy issues, legislation, and program implementation at the state, regional, and national levels.
- Improve information exchange and coordination at all levels of government by facilitating the development and implementation of an efficient drought monitoring and information delivery system.
- Heighten awareness and understanding of regional drought management and policy issues and promote the efficient use of water in the West.

Through a steering group, the Council will oversee and coordinate the work of several working groups. At their first meeting, working groups will establish priority for action items identified in the Council's Work Plan. So far, the Work Plan has established the following working groups and their goals and objectives:

Preparedness and Mitigation

This working group will concentrate on short- and long-term management and policy issues that are intended to reduce the economic, social, and environmental impacts (i.e., vulnerability) of drought in the West. The working group will identify preparedness actions, policies, and mitigation options that will facilitate this process and will work cooperatively with localities, states, Indian tribes, and federal agencies. The working group will build on the drought assessment, response, and planning experiences in western states, localities, and federal agencies, and will seek to identify new and innovative solutions to drought and water management issues. The working group will promote drought contingency planning, emphasizing a more proactive, anticipatory approach to drought management in the region.

For the purposes of the Work Plan, the term *mitigation* is defined as those specific measures, projects, and actions taken with the intent to save lives and reduce risk of future damage, hardship, or suffering from a drought.

Some general, ongoing goals of the Preparedness and Mitigation Working Group include:

- Developing recommendations to the Council for drought planning and management alternatives to mitigate short- and long-term impacts before, during, and after drought emergencies.
- Developing and maintaining an information clearinghouse on drought monitoring and prediction, response, mitigation, and preparedness for users throughout the region.
- Developing educational resources (e.g., booklets, reports, videos, drought simulations) that promote the concepts of drought planning and mitigation to a diverse audience.
- Interacting with local, state, tribal, and federal officials in the West and other regions to share experiences on drought planning and mitigation.

Action Items:

- *Review and analyze existing drought plans*. Analyze existing drought response plans adopted by localities, states, tribes, federal agencies, and other entities and identify the similarities and differences between plans, including characteristics such as organizational structures, monitoring systems, and response programs. This analysis will be shared with all interested parties.
- *Inventory and assess mitigation options*. Inventory all relevant mitigation options implemented in response to recent drought events, and assess their relative effectiveness in both the short and long term, noting any opportunities for improvement.
- *Identify a model to conduct vulnerability assessments*. Promote the development and use of vulnerability assessments to determine the potential economic, environmental, and social impacts of drought on specific geographic regions and economic sectors in the West. For example, vulnerability assessments could be conducted for local water supplies and forests to determine the probable impacts associated with droughts of various intensity and duration.
- *Develop an information clearinghouse*. An information clearinghouse on drought monitoring and prediction, response, mitigation, and preparedness will be developed for users throughout the region in association with the ongoing programs of the National Drought Mitigation Center (NDMC).
- *Conduct drought planning workshops*. Drought workshops will be organized and conducted to help local, state, tribal, and federal governments and others learn how to prepare drought contingency plans and evaluate mitigation options. The working group may work with the NDMC in the organization of these workshops in the western region.

Monitoring, Assessment, and Prediction

Despite advances made over the past decade in understanding the climate system, meteorologists and climatologists cannot predict the onset and end of a drought. Research will continue to improve our knowledge about climate systems and our capability to understand and predict climate anomalies such as drought, but there are no simple solutions in sight. Therefore, it is imperative to develop a drought monitoring system that provides timely recognition of the occurrence of drought to local, state, tribal, and federal officials responsible for implementing drought response measures. The goal of this working group will be to develop such a monitoring system.

Action Items—Monitoring:

- *Conduct a census of data networks*. The working group will conduct a census of federal, regional, state, local, and private remote and in situ hydrometeorological networks. The census will identify station or site location, environmental variables measured, instrumentation characteristics, and a comprehensive site history and other parameters of each network. Variables may include temperature, dew point, wind, snow, snow depth, snow water equivalent, streamflow, precipitation, reservoir storage, ground water, river stage, soil temperature, solar radiation, soil moisture, and evaporation. Initially, the working group will access data and products from the National Weather Service, Coop Network, USDA SNOTEL, and RAWS networks. The working group will access other networks later.
- *Develop a historical climate data base*. The working group will accumulate a historical data base for comparative analysis by initiating and maintaining a working relationship with current environmental archives including the National Climate Data Center (NCDC), the Regional Climate Centers, the Natural Resources Conservation Service's (NRCS) National Water and Climate Center, and the NRCS Soil Survey Center.
- *Link networks*. The working group will transform data from fragmented single-purpose networks into a multipurpose asset for management of renewable natural resources at a regional level by developing linkages of inventories and information from data networks and environmental archives.
- *Distribute climate-related information*. Once information from data networks are linked, the working group will make use of the Unified Climate Access Network (UCAN) to distribute climate-related products. UCAN is a national distribution network for climate-related products in an online climate data base format.

Action Items—Assessment:

- *Evaluate observed data*. The working group will conduct local, regional, and national evaluation of data, including mean, median, and variance, to highlight daily, weekly, monthly, seasonal, yearly, and historic anomalies.
- *Evaluate derived data*. The working group will monitor derived variables and indices for drought assessment, including the Palmer Drought Severity Index, Crop Moisture Index, Standardized Precipitation Index, Surface Water Supply Index, Crop Specific Indices, and Leaf Area Indices developed from the National Oceanic and Atmospheric Administration's (NOAA) Advanced Very High Resolution Radiometer (AVHRR) for the Normalized Difference Vegetation Index (NDVI).
- *Identify triggers for drought types*. The working group will make a determination of operational definitions and associated "triggers" and descriptive terms for meteorological, agricultural, and hydrological drought consistent with needs and activities of the Council. The working group will also determine appropriate indicators for assessing drought impact.
- *Regional drought assessment reports*. The Council believes a quarterly regional drought assessment report depicting current drought status in the region would be a useful tool for mitigating the impacts of drought. By identifying areas of future concern, a product of this type would enable the Council to be more proactive in its activities. The working group will develop content and format for such a report in the first year, possibly issuing several prototype releases in preparation for formal, scheduled releases in year two.

Action Items—Prediction:

- *Weather and climate predictions*. Monthly, seasonal, annual, and interannual forecasts will be monitored by the working group and interpreted for decision makers.
- *Forecast verification*. The working group will monitor the verification efforts for long-range forecasts to evaluate their suitability for use by decision makers involved in drought-related activities.

- *Drought prediction techniques*. The working group will monitor drought prediction techniques and technologies, including the application of soil moisture, evaporation, and atmospheric and global ocean circulation to support improved forecasting.

Response

This working group will concentrate on enhancing the drought response capability of states, promoting regional drought response mutual aid, strengthening intergovernmental response partnerships, and improving overall drought response management and customer service for future droughts by (1) identifying and cataloging drought assistance programs, resources, and points of contact; (2) aggregating western states' unmet needs in times of drought; (3) identifying drought response programmatic and policy issues; (4) developing action recommendations for issue resolution; (5) identifying potential drought response mitigation strategies, in cooperation with the Preparedness and Mitigation Working Group; and (6) publicizing drought response lessons learned, in cooperation with the Communications Working Group.

Action Items:

- *Review of drought reports*. Review WGA and FEMA drought reports on the recent southwestern drought; consolidate/receive action reports, including lessons learned; and recommend actions to resolve residual issues. Track and report status of issue resolution.
- *Assistance program catalog development*. In conjunction with the Communications Working Group, develop and disseminate a catalog of federal assistance programs, general eligibility criteria, funding availability, and points of contact for each program.
- *Historical responses and strategies*. Develop a list of historical state responses to typical short-term drought impacts and potential strategies for addressing these impacts.
- *Drought occurrence actions*. When a drought occurs, the working group will aggregate reports for the western states to identify unmet needs. In coordination with state drought response organizations, the working group will make action recommendations and facilitate response actions, mutual aid, and partnerships. Additionally, the working group will ensure that a regional post-drought report is completed for each drought.

Communications

The Communications Working Group's initial audience is identified as all parties interested in the objectives of the Council. The initial focus of this working group is to network with all parties interested in the mission of the Council and ensure that the proper means of communication are known, current, and widely distributed. The objectives of the working group are to (1) identify and use existing drought-related information networks and suggest complementary means of communication, where appropriate; (2) facilitate the exchange and dissemination of drought-related information, and act as a clearinghouse for those documents (where appropriate); (3) provide a forum for feedback and evaluation of information, programs, and services; and (4) provide an active communication outreach service for the Council through press releases and the preparation of articles for publication.

Action Items:

- *Prepare communication strategy*. Prepare, in cooperation with the co-chairs of the working groups and the steering group, a communication plan to implement the strategy for the Council and working groups. The plan will address communication and education products and their contents, as well as the dissemination of the information produced by working groups.
- *Prepare drought-related program directory*. Prepare and distribute a directory of federal drought-related programs and points of contact for each of these programs in conjunction with the Response Working Group.

- *Prepare organizational directory*. Prepare and distribute a directory, with the approval of the steering group, of state, local, and other organizations who are involved or interested in drought-related issues. This directory would also include contact points that could be used in the coordination of drought response activities.
- *Develop drought media briefing package*. Develop a generic western states drought media briefing package that can be modified and supplemented with geographic-specific materials.

Administrative leadership of the Council is through the National Drought Mitigation Center at University of Nebraska–Lincoln. The U.S. Bureau of Reclamation is loaning an employee to the Council for two years.

Q To whom does the WDCC report?

A The WDCC will prepare an annual statement of accomplishments for the WGA.

Q How do I get in touch with the Council?

A Call (402) 472–2731, or send e-mail to wdcc@enso.unl.edu. For more information, such as a copy of the Work Plan, please visit the WDCC web site: http://enso.unl.edu/wdcc/.

Localized Severe Drought during 1996 and Its Impact on Crop Production in Raipur District of Central India

In Raipur district, the onset of the monsoon occurred in the 25th standard meteorological week (June 18–24). But after the onset of monsoonal rains, there was a lull in the monsoon for about 2 consecutive weeks. In the 28th week (July 9–15), the district received 77.6 mm of rainfall. This was equal to the normal value for that week. In the following (29th) week, the district received 96.8 mm rainfall, 38.9% more than the normal rainfall for that week.

Thus, the rice, soybean, and other crops sown with the onset of the monsoon in the 25th week suffered from acute water shortage during the 26th and 27th weeks (June 25–July 8), and the germination of these crops was affected. Those farmers who had resown their crop received good rainfall during the 28th and 29th weeks (July 9–22). In the 32nd week, there was a total rainfall of 258.4 mm at Labhandi, Raipur, compared to the weekly normal of 77.1 mm. However, out of this, 222.0 mm of rainfall was received in only one day—July 31/August 1, 1996. Because the rice seedlings were very small at that stage, most farmers drained the water out of their fields.

Until the end of September 1996, there was a total rainfall of 1,016.2 mm rainfall at Raipur. The average value for this period is 1,192.5 mm, which shows that the rainfall received at Raipur was almost normal, with 15% deficiency. But the situation was not the same everywhere in the district. Due to the absence of any disturbance or cyclonic storm in the Bay of Bengal, there was no widespread rainfall in the district after the onset of the monsoon. Instead, there was scattered rainfall due to local thunderstorm activities and, as a result, there were large deficit rainfall conditions in some pockets of Raipur district.

The monthly rainfall for June–September at some stations in Raipur district is shown in Table 1.

There was deficit rainfall in all stations of Raipur district during June and July 1996. During August, the situation improved in many places, including Raipur. But in Abhanpur, Tilda, Baloda, Bazar, and Palari, the situation did not improve in August, and in these blocks the rainfall was deficient from June to August. Again in September, there was a deficit rainfall pattern in most of the stations. In Arang, Abhanpur, Tilda, Balodabazar, Palari, and Nagri

Block	June			July			Aug.			Sept.			Total		
	1996	Normal	D	1996	Normal	D	1996	Normal	D	1996	Normal	D	1996	Normal	D
Dharsiwa	93.8	177.5	-47	160.6	342.7	-53	493.7	348.7	+41	136.9	185.9	-26	885.0	1054.8	-16
Arang	43.6	242.6	-82	229.9	393.5	-42	355.8	389.6	-9	89.7	227.6	-61	719.0	1253.3	-43
Abhanpur	46.0	219.5	-73	264.0	370.8	-29	295.0	389.1	-24	111.0	213.1	-48	716.0	1192.5	-40
Tilda	97.3	87.5	-45	358.0	352.7	+4	223.4	358.7	-36	80.5	195.9	-57	759.2	1013.0	-24
Balodazabar	39.0	201.7	-81	258.7	388.6	-33	278.3	404.4	-31	53.0	195.1	-73	629.0	1189.8	-47
Bhatapara	45.0	177.5	-75	198.5	342.7	-42	394.2	348.7	+13	148.6	185.9	-20	786.3	1132.3	-30
Palari	68.5	219.5	-69	225.6	370.8	-39	255.7	389.1	-34	57.2	213.1	-73	607.0	1148.3	-42
Simga	45.5	177.5	-74	289.5	342.7	-16	407.7	348.7	+1	189.1	185.9	+2	931.8	1054.8	-12
Dhamtari	65.0	227.8	-71	283.7	390.7	-27	664.3	411.5	+61	182.7	225.5	-18	1195.7	1141.0	+4
Kurud	60.0	198.4	-70	338.0	341.1	-1	539.0	375.7	+43	109.0	194.1	-44	1046.0	1109.3	-6
Nagri	78.2	227.8	-66	259.2	390.7	-33	468.0	411.5	+13	110.6	225.5	-50	916.0	1141.0	-20
Labhandi (Raipur)	88.4	219.5	-60	263.1	370.8	-29	466.7	389.1	+20	198.0	213.0	-7	1016.2	1192.5	-15

D = Departure from normal (%)

Table 1. Monthly rainfall at different blocks of Raipur district during 1996 and their corresponding normal values and percentage departures.

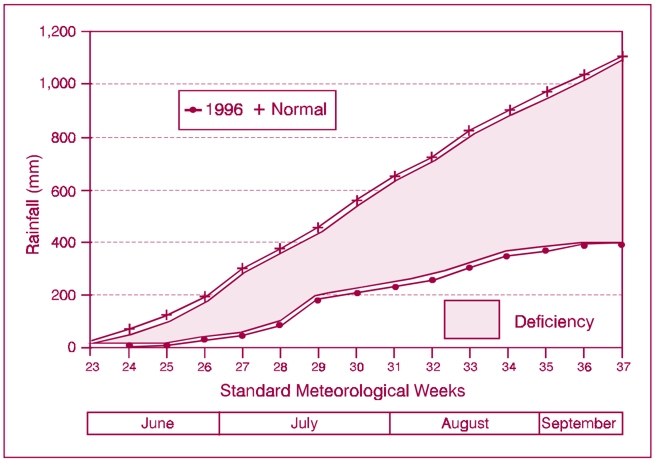

Figure 1. Cumulative weekly rainfall pattern during June 4–September 16, 1996, compared to normal values, at Mahasamund, India.

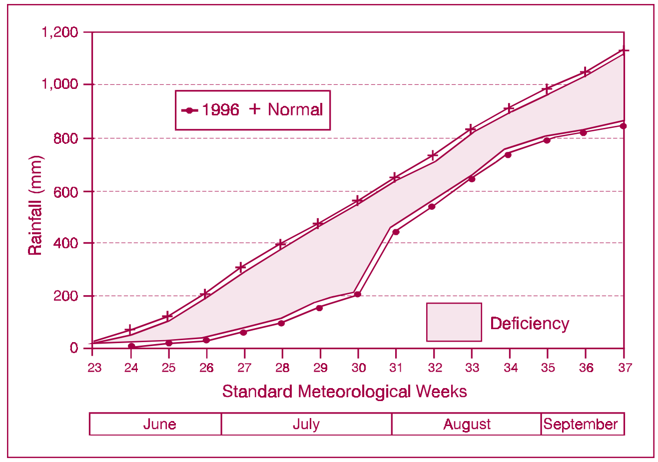

Figure 2. Cumulative weekly rainfall pattern during June 4–September 16, 1996, compared to normal values, at Fingeshwar, India.

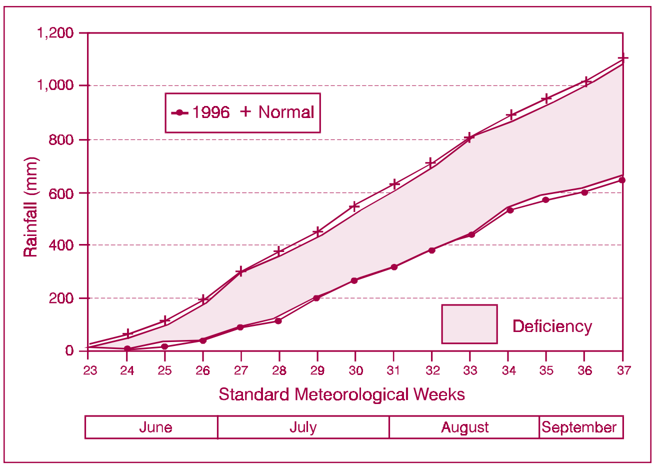

Figure 3. Cumulative weekly rainfall pattern during June 4–September 16, 1996, compared to normal values, at Kasdol, India.

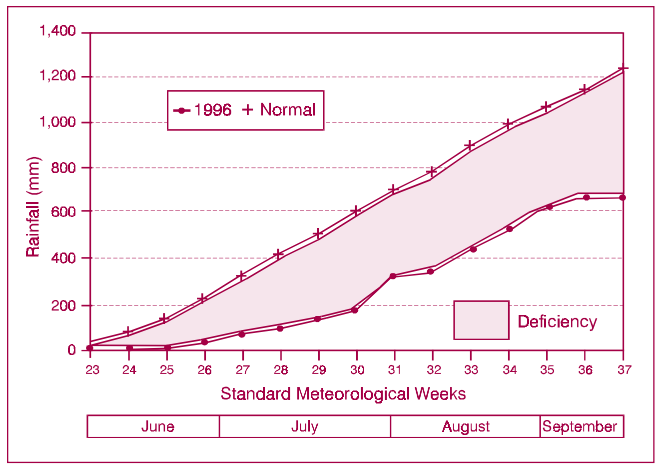

Figure 4. Cumulative weekly rainfall pattern during June 4–September 16, 1996, compared to normal values, at Chura, India.

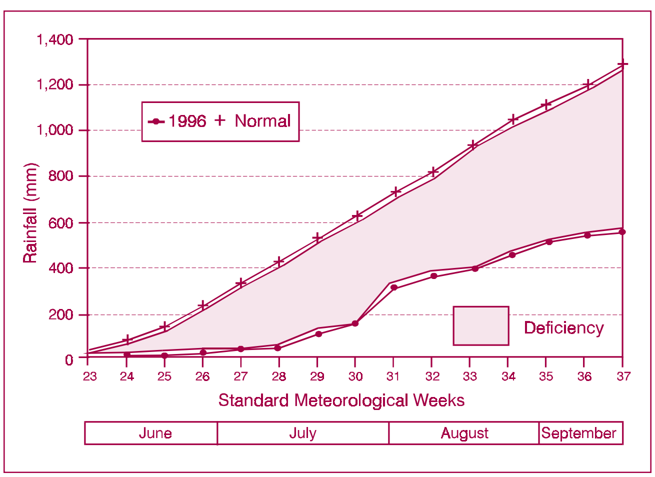

Figure 5. Cumulative weekly rainfall pattern during June 4–September 16, 1996, compared to normal values, at Gariyaband, India.

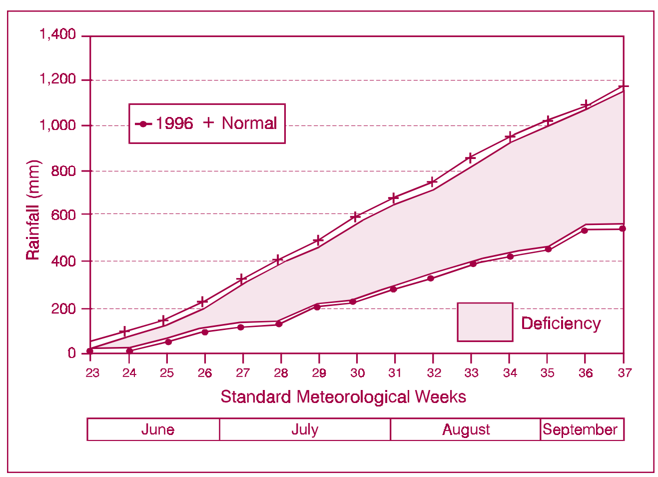

Figure 6. Cumulative weekly rainfall pattern during June 4–September 16, 1996, compared to normal values, at Bagbahra, India.

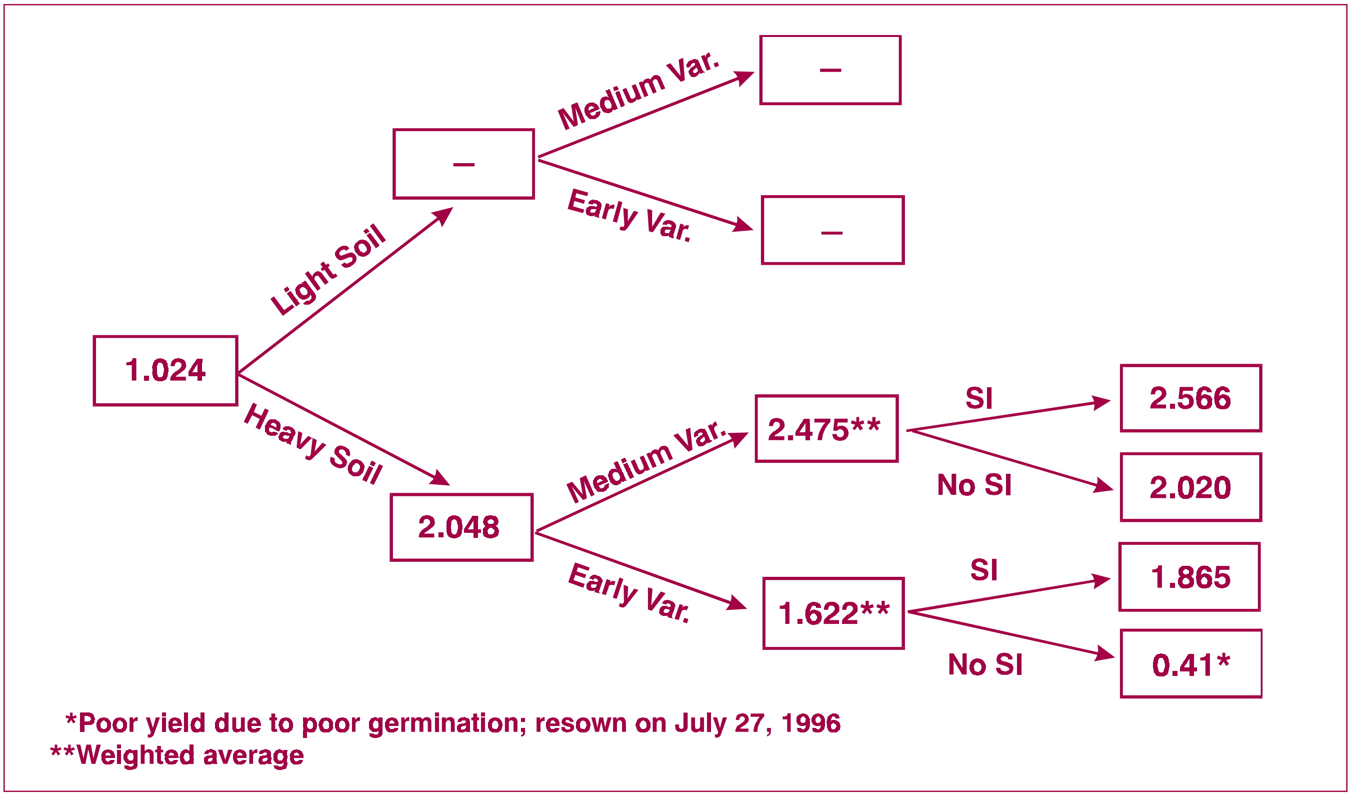

Figure 7. System analysis for productivity (t/ha) of early- and medium-duration rice varieties under severe drought conditions in two types of soil. SI = supplemental irrigation.

blocks, September rainfall was deficient by 48%–73%. Overall, from June to September in Arang, Abhanpur, Balodabazar, and Palari blocks, rainfall was less than 60% of normal. Considering ± 19% rainfall deviation as normal, the stations that received normal rainfall until September 1996 were Dharsiwa, Simga, Dhamtari, Kurud, and Raipur. Thus, out of 12 stations, only 5 received normal rainfall (± 19%) for June–September 1996. Cumulative rainfall and water deficit patterns for some stations for June–September are shown in Figures 1–6.

Rice Productivity

On-farm experiments in collaboration with the International Rice Research Institute (IRRI) under the International Fund for Agricultural Development (IFAD) program were conducted during the 1996 rainy season at Tarpongi Village (30 km. north of Raipur). Because of a severe, prevailing drought in the village, the rice fields were completely infested with weeds, and the majority of farmers left their fields unweeded. In the on-farm experimental fields, too, the rice crop failed in light soils. In heavier soils, the crop could withstand the drought conditions. A few farmers provided supplementary life-saving irrigation with water that accumulated in roadside ditches. This irrigation increased the yields of medium-duration varieties by up to 27%. But in the case of early-maturing varieties, the plant population was badly affected, and resown crops also experienced severe conditions; hence productivity further decreased in fields with no supplementary irrigation. The results of the experiments are shown in Figure 7.

J. S. Urkurkar, V. K. Koshta,
Diwakar Naidu, and A. S. R. A. S. Sastri
Indira Gandhi Agricultural University
Raipur (M.P.) — 492012
India

Agrometeorological Aspects of Crop Production in Temperate Kashmir

In our recent article on forecasting uncertain weather over temperate Kashmir (India) (*Drought Network News*, Vol. 9, No. 1, pp. 12–14), we tried to characterize the crop-growing environments by giving long-term means of various agrometeorological parameters (such as air temperature, relative humidity, precipitation, and hours of bright sunshine). Forecast analysis for changes in temperature and precipitation events indicated an overall reliability of about 50%. Changes in minimum temperature could be forecasted relatively more accurately than changes in maximum temperature. Precipitation events were more uncertain during summer (May to October), which happens to be an important season from the standpoint of crop production.

The present article focuses on the variability of Kashmir weather and its possible impact on summer and winter crops of the region. Historical weather data has been analyzed on a "weekly/monthly mean" basis to depict the ranges between which they might have fluctuated. The analysis is based on calculation of standard deviations. Results of one such analysis are depicted in Figure 1, which shows substantial variability in all weather elements. With the exception of one or two months, the parameters of precipitation and weekly duration of sunshine are quite inconsistent. A similar graph (Figure 2) has been prepared on a weekly mean basis wherein the means of air temperature (maximum and minimum) and weekly totals of precipitation/sunshine hours are depicted. The phenological stages of some important crops have also been worked out.

Figure 2 also shows the "gallery" formed after plotting values of the "mean ± standard deviations." The width of the gallery or path is directly proportional to the fluctuation observed in the past. The wider the path/gallery, the more variable the particular weather element. In the case of air temperature, we observed the width of path to be comparatively narrower for minimum temperatures. From this it can be assumed that changes in maximum temperatures over the growing season are more variable compared to changes in minimum temperatures. Maximum temperatures could become a decisive factor in crop production over temperate Kashmir. But the results of forecast analysis, wherein we had clearly indicated greater reliability in predicting changes in *minimum* temperatures, show that reliably forecasting changes

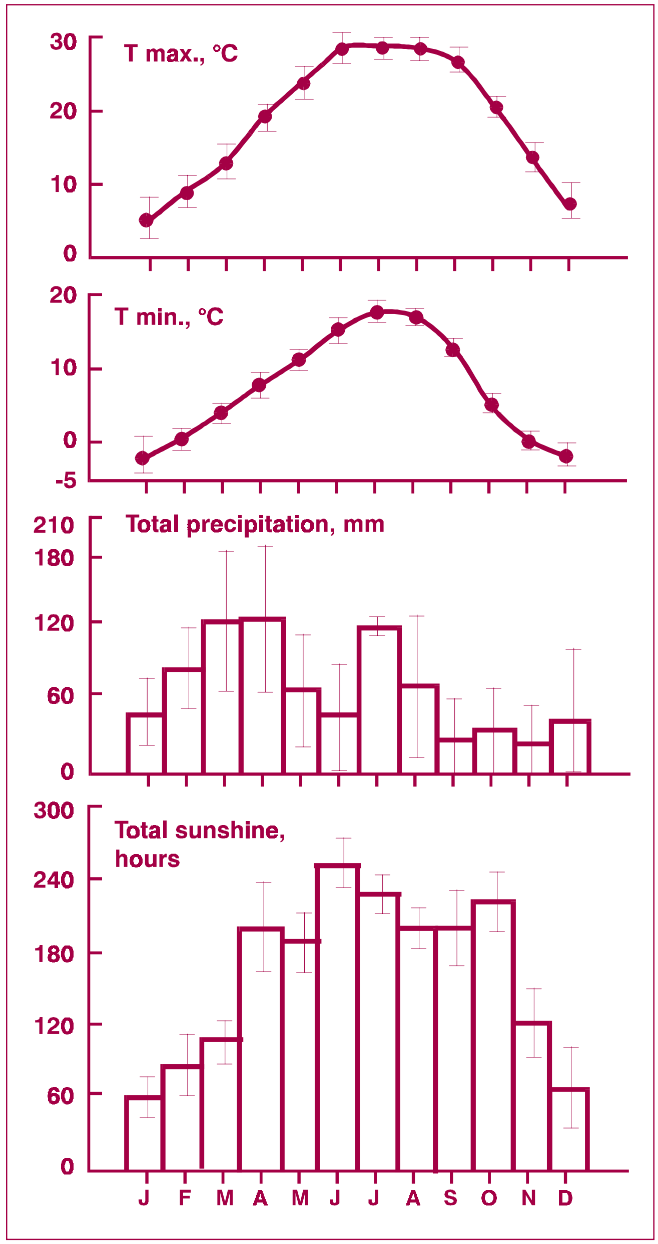

Figure 1. Monthly variability of weather, 1980–96.

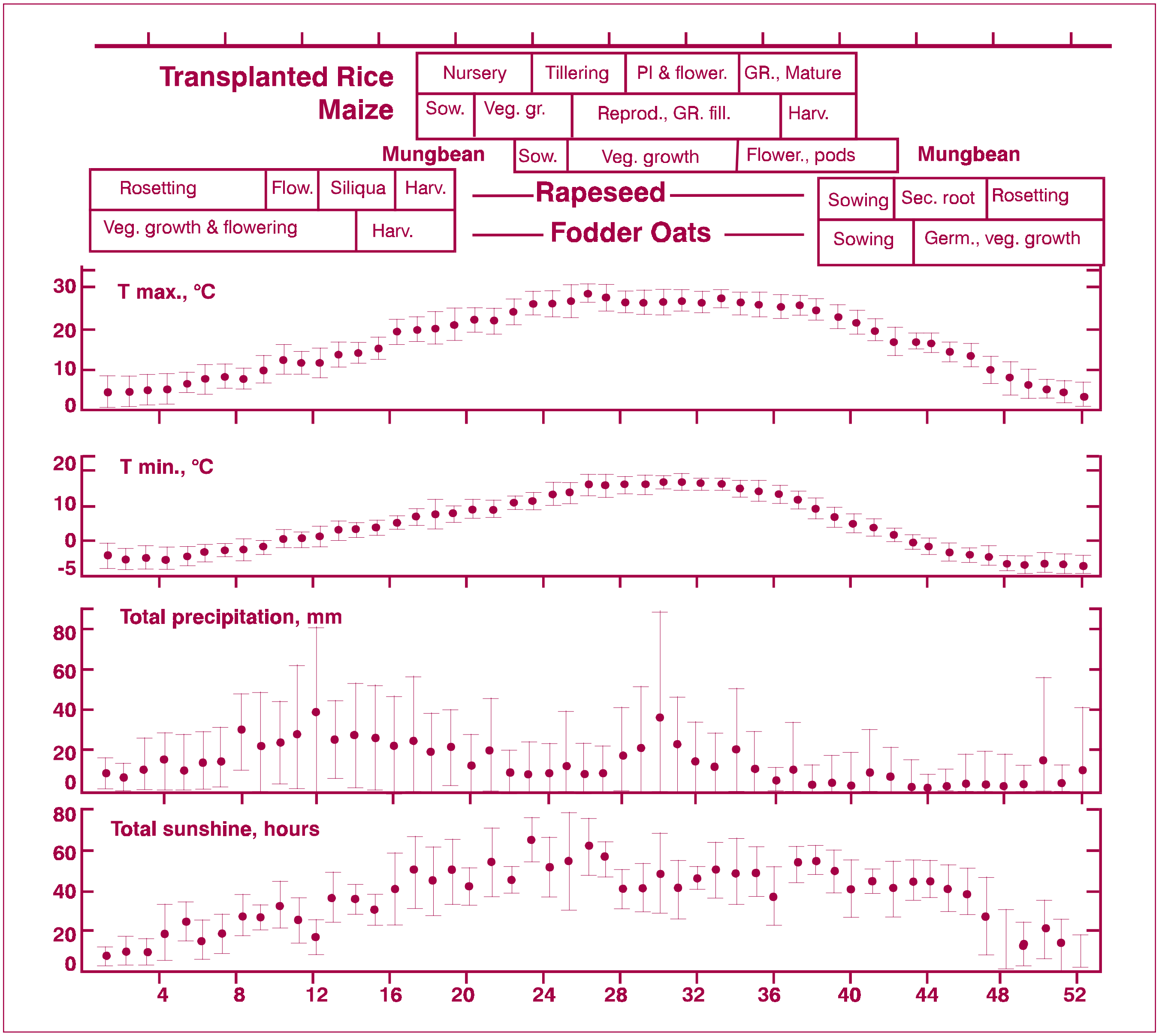

Figure 2. Crop weather relationships under variable conditions, 1980–96.

in *maximum* temperatures is a problem that remains to be tackled. In addition, a lot of fluctuation also exists for the remaining parameters (in particular, precipitation and sunshine hours), as is evident from the width of the gallery (Figure 2).

Active tillering and panicle initiation (PI) are critical crop-growth stages for rice. These stages fall between the 27th and 32nd meteorological weeks (Figure 2). Weather elements during this time period are quite unpredictable and variable and thus are likely to affect rice yields in temperate Kashmir.

Rapeseed and oats are winter season crops (October to May). The optimum seeding time for these crops is between the 38th and 43rd meteorological weeks (i.e., mid-September to the end of October). It is an established fact that winter tolerance of these two crops depends to a large extent on the amount of growth that takes place just before the onset of severe winter weather. Our crop weather calendar (Figure 2) shows a steep fall in mean temperatures from October on. A crop sown during the 38th to 43rd meteorological weeks that has gained sufficient growth will definitely be able to withstand the adversities of forthcoming winters (low-temperature tolerance).

As the winter season advances and spring arrives (March–April), temperatures increase. We observed continuous rains with significant variability (Figure 1). This period coincides with reactivation of winter crops, resulting in vegetative and reproductive growth. Top dressing and intercultural operations are performed. At this point, especially between the 10th and 19th meteorological weeks, rainfall variability adversely affects both vegetative and reproductive growth of the rapeseed crop and, at times, harvesting and threshing operations.

The weather of the region, with all its ramifications, severely limits agricultural choices. Summer crops suffer from uncertainties in temperature and rainfall while winter crops suffer losses due to low temperatures and weather-induced delays in cultural operations. The typical temperate climate of our region gives little opportunity for adjustments through variation in sowing dates. Delayed sowing has resulted in yield reductions of 50%.

Solving climate-related problems requires a lot of research and many developmental efforts in some important areas. The approaches should be interdisciplinary in nature and may encompass some of the following:

- Characterization of climate using historical weather data, and then evolving response farming strategies.
- Establishment of a data base management system for recording, retrieval, and analysis of weather data.
- Probability analysis of various weather elements (such as rainfall and temperature) will provide information to help crops withstand adversity at critical growth stages.
- Preparation of crop-weather calendars incorporating such information as agronomic practices and disease and pest occurrence under normal and late planting conditions. This will also help in forecasting pest/disease outbreaks and taking remedial measures.
- Use of standard models for crop-growth modeling in which both conventional and remotely sensed data can be used.
- Evolvement and strengthening of "Agrometeorological Field Advisory Units" (AMFUs) for advising farmers on their day-to-day agricultural operations.

Dr. Badrul Hasan
Division of Agronomy
S. K. University of Agricultural Sciences and Technology
Shalimar, Srinagar, Kashmir
India—191 121

A Case Study of the Deficit Spell Index for India's Semiarid Delhi Region

The Delhi region, the national capital region of India, is locked in by adjoining states like Uttar Pradesh and Haryana. Delhi has a characteristic continental type of climate, with extreme dryness, intensely hot summers, and dry cold winters. According to climatologists, this region is classified as semiarid tropical steppe. The monsoon rainfall is very erratic during June–September, which is the *kharif* crop-growing season. The monsoon breaks over the Delhi region between the first and second week of July and withdraws by the last week of September. The average annual rainfall is about 712.5 mm, of which 80% is contributed by the monsoon during *kharif* season.

With ever-increasing population in the Delhi region every year, there is a scarcity of drinking water, ground water levels are rapidly receding, usable land area is rapidly decreasing, and little agricultural activity is possible. Frequent droughts add to the misery. The frequency of droughts in the region is approximately 20–25%, with chronic drought experienced during 1918–19 and 1938–39.

Table 1 shows some recent drought years and good monsoon years that influenced the *kharif* crop yield. In the drought year of 1979, the paddy yield was only 10.9 q/ha. On the other hand, in 1990, a good monsoon year, the yield of paddy went up to 40.3 q/ha. Incidentally, rice is also a staple food along with wheat for Delhites; these crops are grown under both rainfed and irrigated conditions.

Year	Maize	Sorghum	Paddy
1979*	4.9	3.8	10.9
1987*	5.6	4.6	22.9
1988**	6.7	4.3	33.4
1989*	5.4	4.3	27.1
1990**	6.5	4.8	40.3

*** Drought year**
****Good monsoon year**

Table 1. Crop yield (q/ha) during good monsoon and drought years in the Delhi region.

It is the surplus and deficit rainfall over the crop-growing season, particularly in the *kharif* season, that needs study. A simple analysis of rainfall and potential evapotranspiration on a weekly basis gives us information like the Effective Precipitation Index (EPI) and deficit spells. From this, one can derive information about drought intensity and severity.

EPI is given as

$$\frac{P - PET}{Pa}$$

where **P** is the total precipitation for the week (in mm), **PET** is the total potential evapotranspiration for the week (in mm), and **Pa** is the total annual rainfall (in mm). To get rid of the negative sign when PET > P, the above equation can be rewritten as

$$EPI = \frac{P - PET}{Pa} + 1.0$$

This leads to three situations:

EPI > 1.0 (surplus)
EPI = 1.0 (balance)
EPI < 1.0 (deficit)

The third situation is the most important in rainfed agriculture. The actual depth of water can be derived from the equation

$$P - PET = (EPI \bullet Pa) - Pa$$

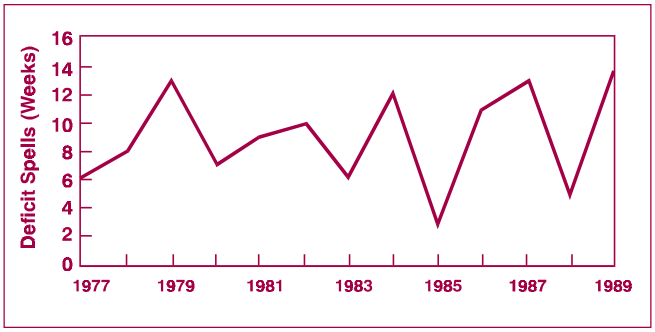

Figure 1. Deficit intensity (weeks), 1977–89.

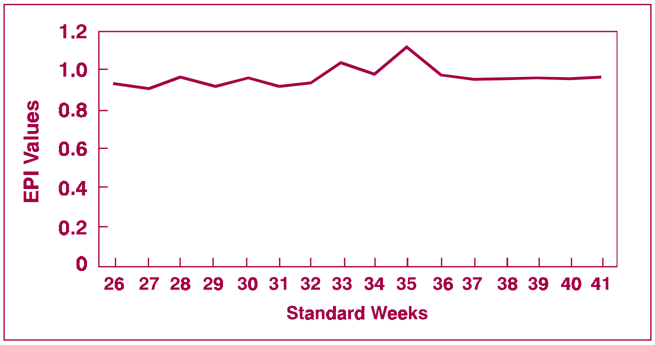

Figure 2. Effective Precipitation Index, 1987.

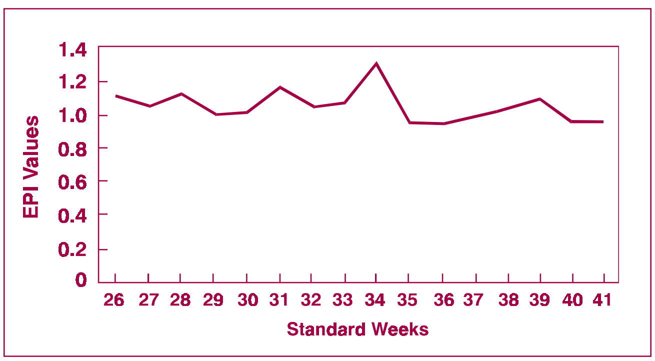

Figure 3. Effective Precipitation Index, 1988.

A case study of the EPI and deficit spells for the Delhi region has been made by analyzing the weekly values of precipitation and PET from the daily values for 1977–89 using the above conditions. Figure 1 shows the total deficit spell weeks in various years for the Delhi region. Drought years like 1989 have a maximum of 14 weeks of deficit spells, compared to a good monsoon year like 1985, which shows only a 3-week deficit spell.

As a case study for the region, the EPI was computed for a drought year (1987) and a good monsoon year (1988). Figures 2 and 3 depict the EPI for 1987 and 1988, respectively, on a weekly basis during *kharif* season. Figure 2 reveals that the EPI was below the threshold value of 1.0 during 13 weeks. But Figure 3 shows only 5 deficit weeks, reflecting good monsoon precipitation.

How these deficit spells are distributed or spread out in various phases is more important than the total amount of deficit spells in a particular season. This will help us to understand how the various phases of deficit spells influence the critical growth stages of *kharif* crops, particularly in a drought year. For example, if rainfed paddy suffers a deficit spell during critical growth stages like head development and flowering, its yield is affected. Similarly, sorghum and maize yield suffers during flowering and grain-filling stages because of deficit spells. Groundnut yield also is very much affected if deficit spells occur during its critical stages, like flowering and pod setting. Table 2 shows the distribution of these spells in different phases. The years 1984 and 1986 have three phases of deficit spells. On average, the first phase of a deficit spell lasts 4 weeks. But severe drought years like 1987 and 1989 contain 8 weeks of continuous dry spell in the first phase. Table 3 shows how much deficit the dry spell has created in various phases, during both bad and good monsoon years. This information is quite useful in agricultural activities like irrigation and water flow measurements. The drought years 1979 and 1987 have 13 deficit spell weeks in two phases with deficit amounts of 363.4 mm and 534.4 mm, respectively. In addition, most of

Year	Phase I (weeks)	Phase II (weeks)	Phase III (weeks)	Total
1977	2	4	-	6
1978	2	6	-	8
1979*	2	11	-	13
1980	2	5	-	7
1981	7	2	-	9
1982	3	7	-	10
1983	2	4	-	6
1984	3	4	5	12
1985	3	-	-	3
1986	4	5	2	11
1987*	7	6	-	13
1988	3	2	-	5
1989*	8	6	-	14

*** Drought year**

Table 2. Different phases of deficit rain spells (1977–89).

	Continuous deficit spells			Deficit amount (mm)			Period (Standard week)	
Year	**Ph.1**	**Ph. II**	**Total**	**Ph. 1**	**Ph. II**	**Total**	**Ph. I**	**Ph. II**
1979*	2	11	13	42.7	320.6	363.3	26-27	31-41
1987*	7	6	13	356.3	178.1	534.4	26-32	36-41
1989*	8	6	14	242.3	142.5	384.8	26-33	36-41
1985**	3	–	3	85.5	–	85.5	34-37	–
1988**	3	2	5	92.6	57.0	149.6	35-37	40-41

***Drought year**
****Good monsoon year**

Table 3. Deficit rain spells and amounts during good monsoon and drought years.

the deficit amount in these two years came in the first phase, between the 26th and 32nd standard weeks of the crop-growing period.

Table 4 shows the severity of the deficit spell in the form of an index called Index of Severity of Deficit Spell (ISDS). This is the ratio of the deficit gap of that week to the mean deficit gap computed with mean EPI values. Similarly, another index, the Index of Deficit Intensity (IDI), was computed by dividing ISDS by the number of deficit spells.

The 1989 drought in the Delhi region accounted for 87.5% of the total deficit spell, with an ISDS of 13.435. This is followed by the drought years of 1979 and 1987, in which 13-week deficit spells prevailed during the crop-growth period. The ISDSs for these years were 13.180 and 16.018, respectively. The IDI for 1987 was 1.232, compared to 1.011 for 1979. Although total deficit spells for both years were identical, their severity indices have different values, with 1987 values being greater.

These types of indices and analyses will serve as a guide to drought information for potential users of agriculture-related operations like water flow and reservoir management. In addition, EPI analysis has been applied to various aspects of catchment hydrology. These computed indices are amenable to probability analysis normally used in water resource programs.

K. K. Nathan
Senior Scientist
Water Technology Centre
I.A.R.I. New Delhi—110012
India

Year	Length of def. spells (weeks)	Percent of total	ISDS	IDI
1977	6	37.50	5.630	0.939
1978	8	50.00	6.540	0.817
1979*	13	81.25	13.180	1.011
1980	7	43.75	6.746	0.963
1981	9	56.25	9.817	1.090
1982*	10	62.50	10.610	1.061
1983	6	37.50	5.364	0.894
1984*	12	75.00	9.490	0.790
1985	3	18.75	2.819	0.939
1986*	11	68.75	13.341	1.212
1987*	13	81.25	16.018	1.232
1988	5	31.25	4.959	0.992
1989*	14	87.50	13.435	0.959

*** Drought year**

Table 4. Deficit spells and severity indices, 1979–89.

National Drought Mitigation Center Involved in Development of Natural Hazards Map

The National Drought Mitigation Center (NDMC) is involved in a project with several other agencies and organizations in Canada, Mexico, and the United States to develop a map of the major natural hazards that threaten North America. Work on the project began in February 1995. Since then, there have been three working group meetings, with the most recent meeting taking place in Guadalajara, Mexico, in February 1997. Project leaders include Dr. Chris Tucker (Emergency Preparedness Canada), Dr. Joe Golden (National Oceanic and Atmospheric Administration [NOAA]), Dr. Rosalind Helz (U.S. Geological Society [USGS]), and Dr. Mario Ordaz-Schroeder (Centro Nacional de Prevención de Desastres [CENAPRED]—National Center for Disaster Prevention).

Motivation for the project began when interest was expressed in constructing a map that would show both the disaster and vulnerability aspects of natural hazards. For example, the map would highlight the location of past earthquake disasters, yet also identify the potential risk-prone regions on the continent vulnerable to a major earthquake in the near future. Sixteen natural hazards affecting parts of North America are included in this project. These hazards include those with the highest economic impacts (floods and droughts), specific regional economic impacts (sea fog along the Canadian coasts), geological hazards (earthquakes, tsunamis, volcanos, and landslides), dramatic storms (hurricanes, tornadoes, and blizzards), and more general hazards (wildfires, lightning, cold, and heat). Besides specific elements that will be represented on the map, each hazard will have a brief description along with a discussion of past significant disasters.

The NDMC became a recent contributor to the project and is the working group leader in the project for drought. The Mexican representatives for the drought group are Fermin Garcia and Maria Teresa Vázquez Conde (CENAPRED), and Dr. David Phillips (Canadian Climate Centre) is the representative for Canada.

Most data for the project were submitted to the USGS lab in Golden, Colorado, by the end of April 1997. These will be compiled, and then a prototype map will be shown to interested sponsors to begin final production on the North American Natural Hazards Map. We will continue to provide updates on the progress of this project.

Michael Hayes
National Drought Mitigation Center

Announcements

Regenerative Agriculture for the 21st Century

The first of the Rodale Institute's Natural Resource Management Training Series, *Regenerative Agriculture for the 21st Century*, will be held October 28–31, 1997.

The purpose of this training is to familiarize emerging professionals in the fields of agriculture, international and community development, and natural resource management with concepts of regenerative agriculture technologies that recognize the interdependency between agriculture, human health, and environmental responsibility. Recognizing that many of the solutions to the world's health problems are linked to our agricultural production and distributions systems, a new agenda for food and agricultural development is needed, one for a "greener revolution" directed at increasing the production of nutritionally adequate food supplies in ways that protect and maintain community health, socioeconomic environments, and ecological sustainability.

The focus of the seminar will be on the use of regenerative technologies for enhancing soil fertility and managing natural resources, as well as on the relationship between soil health and human health. Using the case study approach, participants will have the opportunity to gain knowledge and practical experience directly from the expertise of the Rodale Institute's Regenerative Agriculture Research Centers staff, including such topics as Soil Conservation from Senegal, West Africa; Community Forest Concessions, Peten, Guatemala; and Composting and Soil Health from Rodale Institute's Experimental Farm in Kutztown, Pennsylvania. The seminar is designed to be participatory and will make the transition from scientific research to practical field experience.

The seminar should be particularly beneficial for NGOs, international development agencies, prospective or returned Peace Corps Volunteers, and students who plan to work in international development and project management.

For more information on the training seminar and how to register, please contact Jane Fisher at Rodale Institute, 611 Siegfriedale Road, Kutztown, PA 19530, USA; phone: (610) 683–1428, fax: (610) 683–8548, email: jfishe@rodaleinst.org.

4th International Symposium on Environmental Geotechnology and Global Sustainable Development—Call for Abstracts

The 4th International Symposium on Environmental Geotechnology and Global Sustainable Development will be held August 9–12, 1998, in Boston, Massachusetts. Sponsors of the meeting are the U.S. Environmental Protection Agency, Cold Regions Research and Engineering Laboratory, New England Water Environment Association, Battelle Pacific Northwest Laboratory, and National Institute for Standards and Technology. The host for the meeting is the Center for

Environmental Engineering, Science and Technology (CEEST) at the University of Massachusetts.

Several sessions will cover scientific, engineering, and policy advances in several cross-disciplinary geoenvironmental issues such as waste utilization, natural hazards, environmental impact assessment, mining and environment, oil pollution control, geohydrology, site remediation techniques, site characterization, and monitoring.

To submit an abstract, send three copies of one-page abstracts in English (typed, single-spaced) by November 15, 1997, to Dr. Vincent Ogunro, 4th Int. Geoenvironmental Symposium, Center for Environ. Engg., Sci. & Tech. (CEEST), University of Massachusetts (North Campus, Rm E-114), One University Avenue, Lowell, MA 01854, USA; phone: (508) 934–3185, fax: (508) 934–4014, email: ogunrov@woods.uml.edu.

Let Us Know . . .

If your address has changed or needs to be corrected, if you are receiving duplicate mailings, or if you're no longer interested in receiving ***Drought Network News****, would you please help us keep our mailing list up to date by filling out the form below and returning it to:*

IDIC/NDMC
239 L. W. Chase Hall
University of Nebraska
P.O. Box 830749
Lincoln, NE 68583–0749
USA
Telephone (402) 472–6707
Fax (402) 472–6614
e-mail ndmc@enso.unl.edu

If responding by conventional mail, please return this form with the mailing label still attached to the reverse side (non-U.S. members: please include the mailing label from the envelope). If responding by e-mail or fax, please include your old address as well as your new address.

____ Change/correction of address
____ Receiving duplicate mailings (please include mailing labels from all duplicates)
____ Delete my name from the *Drought Network News* mailing list

Name ____

Organization ____

New/Corrected Address ____

____

____

____

Telephone ____
Fax ____
e-mail ____

Drought Network News is published three times a year by the International Drought Information Center (IDIC) and National Drought Mitigation Center (NDMC). The IDIC and NDMC are part of the Department of Agricultural Meteorology at the University of Nebraska–Lincoln. Funding for the newsletter is provided by the International Activities Division, National Weather Service/NOAA, through their cooperative program with the World Meteorological Organization, Climate Prediction Center, National Weather Service/NOAA, and Cooperative State Research, Extension, and Education Service, U.S. Department of Agriculture.

Drought Network News encourages readers to submit information on current episodes of drought and its impacts; timely reports of response, mitigation, and planning actions of governments and international organizations (successes *and* failures); recent research results and new technologies that may advance the science of drought planning and management; recent publications; conference reports and news of forthcoming meetings; and editorials. If references accompany articles, please provide *full bibliographic citations*. All artwork *must* be *camera-ready*—please provide clear, sharp copies (in black/gray and white only—we are unable to reproduce color artwork) that can be photocopied/reduced without losing any detail. Correspondence should be addressed to

Drought Network News
IDIC/NDMC
239 L. W. Chase Hall
University of Nebraska
P.O. Box 830749
Lincoln, NE 68583–0749
USA

Telephone: (402) 472–6707
e-mail: ndmc@enso.unl.edu
WWW: http://enso.unl.edu/ndmc

Subscriptions to ***Drought Network News*** may be obtained, free of charge, by contacting Vicki Wilcox at the street or e-mail address or the telephone or fax number to the left.

Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln

IDIC/NDMC
239 L. W. Chase Hall
University of Nebraska
P.O. Box 830749
Lincoln, NE 68583–0749
USA