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Weather and Climate Extremes

journal homepage: www.elsevier.com/locate/wace

Monitoring the impacts of weather and climate extremes on global agricultural production



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ARTICLE INFO

Article history:

Received 13 October 2015

Received in revised form

2 November 2015

Accepted 2 November 2015

Available online 4 November 2015

Keywords:

Crop production

Yield forecast

Crop weather

Agricultural projections

WASDE

ABSTRACT

The World Agricultural Outlook Board (WAOB), under the direction of the Department of Agriculture's Office of the Chief Economist, employs a staff of agricultural meteorologists whose mission is to monitor and assess the impacts of weather and climate on crops in key growing areas throughout the world. The results of those analyses contribute to the deliberations conducted by the Interagency Commodity Estimates Committees (ICEC) led by analysts at the World Agricultural Outlook Board. The results of those deliberations can be found in the World Agricultural Supply and Demand Estimates (WASDE) report, one of the designated Principle Federal Economic Indicators issued monthly by the Federal Government (White House (Office of Management and Budget), 2015). The process used to develop those estimates each month requires the integration of an assessment of the current climatic conditions with knowledge of the agricultural practices and market conditions of a particular country. Weather and climate data are used in conjunction with information on when and where crops are planted, production practices including irrigation, which varieties are best suited for that particular climate, and what naturally occurring hazards can be expected in any given year. Being able to closely compare current conditions to historic observations of weather and realized output on a fine scale, temporally and geographically, is a key component of the international estimates in the WASDE process.

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1. Introduction

The Office of the Chief Economist (OCE) at the U.S. Department of Agriculture (USDA) coordinates and provides economic analysis of market conditions and policies that have a significant impact on the agricultural economy. To do so it houses the Climate Change Program Office, the Office of Risk Assessment and Cost Benefit Analysis, the Office of Energy Policy and New Uses, and the Office of Environmental Markets, the Director of Sustainable Development, and the Agricultural Labor Affairs Coordinator.

In addition, a key organization within the OCE is the World Agricultural Outlook Board (WAOB). The WAOB is comprised of agricultural economists and meteorologists who provide economic intelligence to the Chief Economist on commodity supply and demand. The WAOB responsibility, however, is to publish the monthly World Agricultural Supply and Demand Estimates, or WASDE report.

The WASDE represents the USDA's consensus view of foreign and domestic supply and demand for the major crop and animal

commodities for the current and previous market years as well as prices received by farmers. To develop that view the WASDE process involves compiling the best market intelligence of major producing and consuming regions from USDA analysts at home and abroad. The evaluation goes beyond the analysis of the US market as information on production in primary competitors and demand around the world are crucial to evaluating the US trade, stocks and price position. In evaluating US and foreign markets, the WAOB utilizes many USDA and external data sources to project production and consumption levels. In assessing domestic supply the WAOB utilizes field observations and farmer surveys on area, yield and stocks as well as information on livestock production as compiled and reported by the National Agricultural Statistics Service (NASS). Assessment of domestic demand uses a mix of recently established current agricultural industrial reports from NASS as well as industry surveys, customs estimates, or inferred quantities taken from other surveys.

In evaluating conditions outside the United States, other country's official reports on agricultural production and consumption, station and satellite observations of weather and vegetation provided by the National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics and Space Administration (NASA) are utilized. Additionally, local policy, market and

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growing condition observations are made by local staff of the Foreign Agricultural Service (FAS) stations out of their respective embassies.

The monthly assessment process is led by a WAOB commodity specialist who chairs an Interagency Commodity Estimates Committee (ICEC) consisting of experts from five USDA agencies to review each commodity. The World Agricultural Outlook Board chairs and organizes the ICECs with the participation and expertise of FAS, the Agricultural Marketing Service (AMS), the Economic Research Service (ERS); the Farm Service Agency (FSA). Each of the agencies brings unique datasets, research and market expertise to the committee. The crop committees assess US and foreign crop production, individual country supply and demand while simultaneously balancing world trade over the current and subsequent marketing year. The assessment of livestock markets focuses on domestic markets supported by those same agencies.

USDA has been in the business of providing unbiased economic information to the public since its inception by President Lincoln in 1862. Indeed USDA published its first statistical report on crop conditions during the Civil War in 1863 (Ajemian, 2012). Arguably one of the most valuable services that USDA provides the public is the regular release of unbiased analysis and data on supply and demand. Those unbiased estimates underlie innumerable market positions and risk management decisions by commodity traders, financial institutions, and other market participants, such as farmers, and agribusinesses who might not otherwise have access to similar information produced by private sector analysts. The timely and unbiased release of market information reduces market uncertainty and improves the symmetry of market information (Good and Irwin, 2005; Sanders and Manfredi, 2003).

In making those estimates, WAOB considers the likely impacts of weather on crop production. WAOB meteorologists make a crucial contribution in the provision of those weather analyses in key world growing regions during the growing season. The analyses conducted by WAOB meteorologists are incorporated into a variety of products, but particularly into USDA's monthly forecast of global agricultural supplies for the main agricultural commodities and published in the WASDE reports. The WASDE is one of the Principal Federal Economic Indicators for the United States (White House (Office of Management and Budget), 2015).

Each ICEC synthesizes those data along with contributions by collaborating agencies to project production in a forecasting cycle based on the local phenologic development and marketing year for each commodity. Several times per year, USDA's NASS forecasts domestic crop area in Prospective Plantings and Acreage reports. Domestic yield and production forecasts and estimates are provided in its monthly and annual Crop Production reports and Annual Small Grains report; available supplies are reported in the quarterly Grain Stocks and Rice Stocks reports. The ICEC incorporates those NASS forecasts and estimates into WASDE, creating a balance sheet of consensus estimates for each commodity, including the elements of supply and demand, as well as the season-average farm prices, released simultaneously each month with the Crop Production report.

2. Role of meteorology

As The WAOB employs a staff of agricultural meteorologists, who monitor and assess the impacts of weather and climate on crops in key growing areas throughout the world. Those meteorologists publish assessments regularly in various publications (Office of the Chief Economist (USDA), 2015). For example, WAOB meteorologists merge data obtained from the World Meteorological Organization (WMO) with climatological analyses and agronomic data to project the potential impact on agricultural

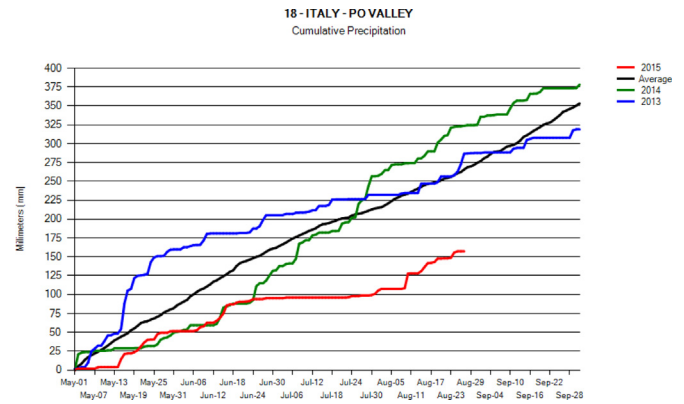


Fig. 1. Cumulative rainfall (in mm) averaged from 9 WMO stations in northern Italy's Po River Valley. Solid red line denotes 2015, with the core of the drought starting in late June. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

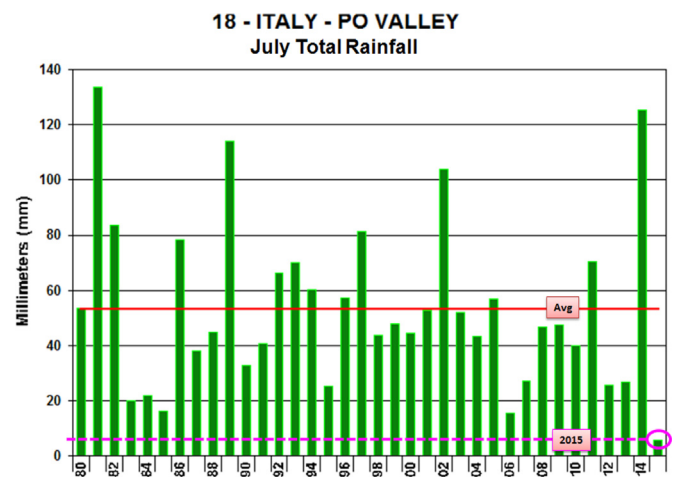


Fig. 2. The total July rainfall averaged over 9 WMO stations representing primary corn areas of northern Italy. July, 2015 was the driest going back to 1980.

yields of climate to date. Qualitative assessments of domestic and international agricultural weather conditions are then published in the Weekly Weather and Crop Bulletin, jointly produced by WAOB, NASS, and the National Oceanic and Atmospheric Agency/National Weather Service of the Department of Commerce.

Estimates of crop yield potentials are a key component to estimating international commodity supply in a particular region. Those potentials are a function of numerous agro-economic, weather- and climate-related variables. The WAOB meteorologists' estimates of those crop-yield potentials contribute to USDA's monthly foreign production estimates. The evaluation of a crop's yield response is based upon the cumulative effects of weather during crop development while understanding local production practices. A crop's estimated response to anomalous weather is a function of crop type and growth stages. Knowledge of historical climate data and production patterns in agricultural regions around the world is critical to those assessments of weather's potential impact on crop yields. Temperature, precipitation, and soil moisture are obviously important parameters to understand, but comparing those conditions, in combination with an assessment of crop stage development, to historic observations for those regions, including other components such as reservoir storage capacity, and crop progress are also important components of those estimates.

The meteorologists present the current growing conditions in a given country for a given crop in comparison previous seasons

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