Ag Decision Maker

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(last in a series)

Global warming - impact of climate change on global agriculture

by Eugene Takle, Professor of Atmospheric Science and Professor of Agricultural Meteorology, 515-294-9871, gstakle@iastate.edu and Don Hofstrand, value-added agriculture specialist, co-director AgMRC, Iowa State University Extension, 641-423-0844, dhof@iastate.edu

Our efforts to mitigate the effects of climate change, urgent as they are, will have little effect over the next 50 years. Changes during this period have already been set in motion by past greenhouse gas emissions.

Limiting greenhouse gas emissions will only affect climate change in the long-term (beyond 50 years). So we must learn to adapt to the changes in climate that will occur over the next 50 years.

In the previous article we listed several estimated changes we may expect to see in the Midwest and possible impacts on Midwest agriculture. In this article we will examine the rest of the world. We will identify expected changes in major agricultural regions around the world.

Suitability for rainfed agriculture

It takes large amounts of water to produce grain. But suitable soil and terrain also are necessary for successful agricultural production. Let's take a look at regions of the world that have a "high suitability for rainfed agriculture". This suitability factor depends on the amount of precipitation, the availability of soils suitable for agriculture, and terrain that allows for agricultural production.

An index of the suitability for rainfed agriculture is shown on the world map in Figure 1. The circled areas show a high suitability index.

From this we can see the regions of the world that are highly suitable for rainfed agriculture. They include the U.S. Midwest and Great Plains, Europe and European Russia, India, Southeast Asia, southern and eastern Brazil including the Pampas of Argentina, sub-saharan Africa, and the rim of Australia. These are the traditional agricultural producing regions of the world that have allowed human population to flourish and grow.

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Handbook updates

For those of you subscribing to the handbook, the following updates are included.

Replacement Strategies for Farm Machinery – A3-30 (7 pages)

Lease Supplement for Investing in Improvements on a Rented Farm – C2-07 (3 pages)

Lease Supplement for Obtaining Conservation Practices and Controlling Soil Loss – C2-08 (3 pages)

Table of Contents - Financial – C3-00 (1 page) Note: Files have been removed.

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IOWA STATE UNIVERSITY
University Extension

Ag Decision Maker is compiled by:
Don Hofstrand, dhof@iastate.edu
Extension Value-added Specialist and
Co-director of the Agricultural Marketing Resource Center

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The population density of various parts of the world is shown in Figure 2. In many instances, areas suitable for rainfed agriculture match the areas of high population density. This includes Europe, Eastern U.S., India, China, and Southeast Asia. Other regions, such as southern Mexico, the Middle East, parts of China, and regions bordering the Nile River, have high populations but low suitability for rainfed agriculture and therefore must rely on either irrigation or food imports. Changes in the suitability index for rainfed agriculture due to climate change can affect the ability of large areas of the world to feed themselves.

Projected precipitation changes

The latest International Panel on Climate Change (IPCC) report outlines potential changes in rainfall patterns over the 21st century. Although this represents the best available science, there still are uncertainties about the projections. However, considerable research currently is focused on this issue. So, more reliable estimates will be forthcoming.

By looking at the projected changes in precipitation due to climate change over the next hundred years (Figure 3), we see there will be winners and losers. The dark shaded areas show increased changes (either increase or decrease) in precipitation.

Since soils and terrain will not change, changes in the suitability index for rainfed agriculture depend on changes in rainfall during the growing season. The suitability index will increase in some areas and decrease in others. A decrease in precipitation will usually result in a decline in the suitability index. However, an increase in precipitation may or may not improve the suitability index. If the precipitation increase leads to more flooding or water-logging of soils, the suitability index will decline. Also, changes in precipitation will increase a region's suitability index only if it has suitable soils and terrain.

To help us focus on the areas with suitable soils and terrain, we have pointed out these areas in Figures 3 and 4. Areas with increased rainfall are marked with a square around them. Areas with decreased rainfall are circled.

The IPCC has not evaluated how the suitability index will change due to climate change rainfall projections. Discussions are underway to launch such an effort. However, we can at least make a simplistic estimate of the future of global agricultural production based on projected changes in precipitation.

Of the seven major regions with a high or moderate suitability index (Figure 1), we can see that:

1) The central U.S. will likely experience a modest decrease, particularly in the Great Plains,
2) Mexico and Central America will likely experience a significant decrease. This decline in precipitation

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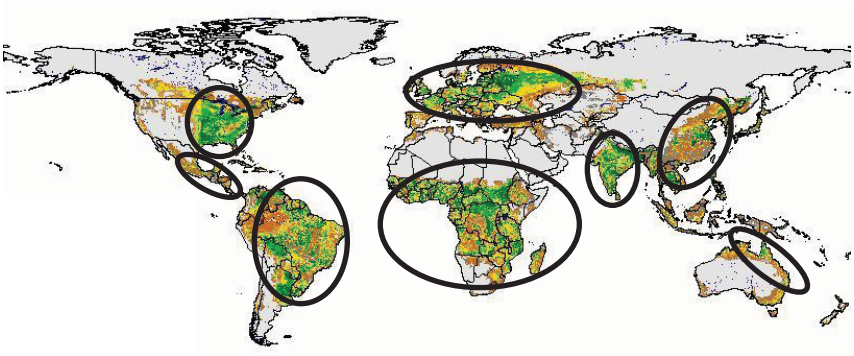
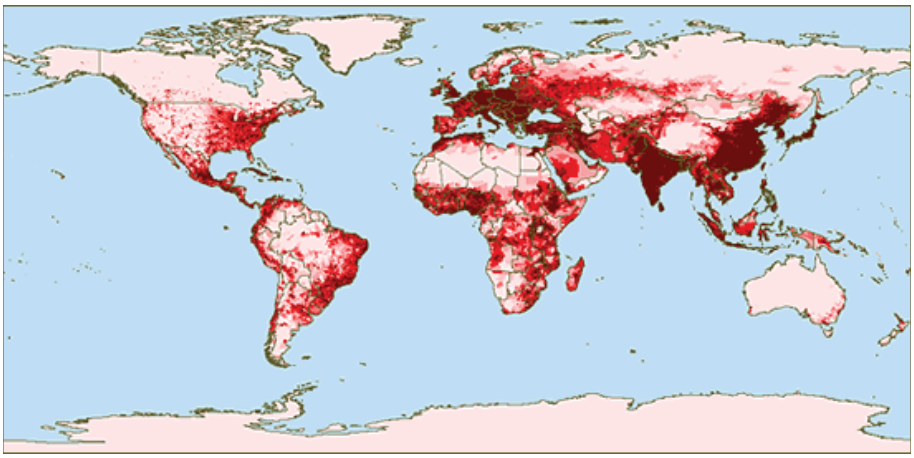
Figure 1. Suitability Index for rainfed agriculture



Source: (Fisher et al., 2001; IPCC, 2007b)

Figure 2. World Population Distribution



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is a feature of all global climate models. Because of the magnitude of this impact on our neighbors to the south, our U.S. national policy makers should monitor climate change over this region through the coming years.

3) Brazil, Uruguay, and Argentina might see an increase in rainfall that likely will be beneficial,

4) Southern and eastern Europe likely will see a substantial decrease,

5) Central Africa likely will see an increase and southern Africa a decrease,

6) India probably will experience an increase.

7) China and East Asia will probably experience an increase. However, the likelihood of extreme increases in precipitation in these areas may be detrimental to agricultural production.

8) Australia is projected to see an increase in the east and a decrease in the west. Regions with a long history of cereal production, such as Australia, are already facing new challenges (Reuters, 2008). Six continuous years of drought have reduced Australia's rice crop by 98 percent and has shut down processing plants (Bradsher, 2008).

Climate change also will lead to an increase in temperature that will affect agricultural production. However, it is difficult to evaluate whether temperature increases due to climate change will allow new regions such as northern Russia and Canada to expand production.

Adapt by using irrigation

Can we adapt to reduced rainfall by irrigating? Although irrigation can provide a short-term solution (a few decades), it does not provide a permanent or sustainable solution. A colleague made the observation that, of all former civilizations that depended on irrigated agriculture for their food supply, none have survived. In the modern world we see numerous regions with widespread irrigation facing challenges relating to water supply (e.g., aquifer depletion, competing uses for reservoir water) or salinization of land under long-term irrigation.

A recent example is Saudi Arabia (Elhadj, 2008), which, having an annual rainfall of only 3-4 inches, discovered in the early 1980s what was thought to be substantial groundwater reserves. By 1992 they were irrigating about 2.5 million acres and producing 4.1 million tons of wheat. But by 2000, the average cost of raising wheat in Saudi Arabia rose to $500 per ton – four times what it cost to buy it on the world market. On January 8, 2008, the Saudi government abandoned its food independence strategy and decided instead to import the country's entire wheat needs by 2016.

So, in the long-term, we will depend on rainfed agriculture. This means we must adapt our agricultural systems to the changes that a changing climate has in store for us.

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Figure 3. Projected precipitation changes between 1980-1999 and 2080-2099 for the Northern Hemisphere summer (June-July-August) (energy-conserving scenario of greenhouse gas emissions -- IPCC 2007a).

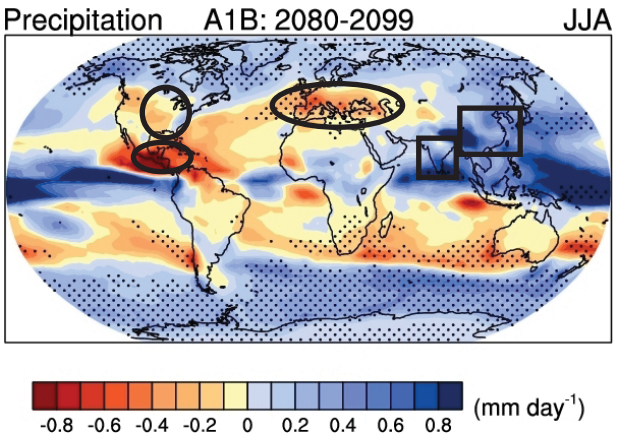
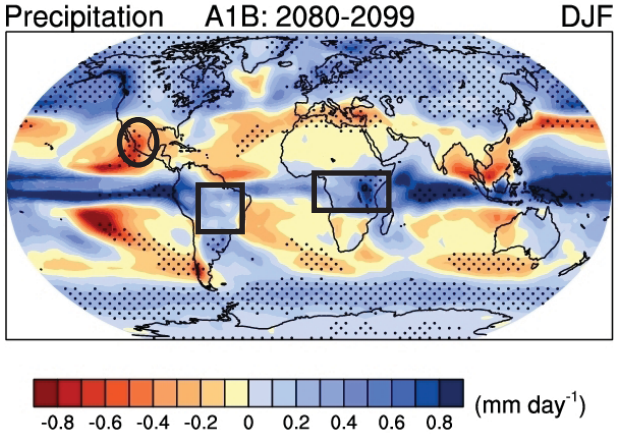


Figure 4. Projected precipitation changes between 1980-1999 and 2080-2099 for the Southern Hemisphere summer (December-January-February) (energy-conserving scenario of greenhouse gas emissions -- IPCC 2007a).



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Implications

We emphasize that, although the research summarized by the latest IPCC report represents the best available science, there are still uncertainties in the projections summarized here. However, climate change will have a significant impact on world agriculture regardless of the specific implications for various growing regions.

Because of the global nature of agricultural markets, agricultural trade patterns may shift. U.S. producers must address both the impact of climate change on their own operations and respond to market signals created by the impact of climate change on agricultural production around the world.

These projected changes in rainfall patterns and the resulting changes in the suitability index for rainfed agriculture provide us with a tool for anticipating the impact of climate change on various agricultural regions of the world. By focusing our attention on the regions of the world where climate change will negatively affect agricultural production, we can develop strategies for adapting to these changes that will help reduce the negative impact on food production in the coming decades.

These strategies must focus on agricultural research and development, including investment in new technologies that can reduce the impact of climate change. Although countries must make these investments individually, a need will arise for a worldwide collaboration to address these issues on a global basis.

References

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Average Crop Revenue Election (ACRE)

by William Edwards, extension economist, 515-294-6161, wedwards@iastate.edu

Under the new Food, Conservation, and Energy Act of 2008 producers of USDA program crops such as soybeans, wheat, and corn have the option to enroll in a new counter-cyclical revenue plan. The program is called Average Crop Revenue Election, or ACRE for short. It is being offered as an alternative to the counter-cyclical payment option under the 2003 farm bill, but is based on gross revenue (commodity price times yield) instead of price only.

ACRE uses a combination of state average yields, farm level yields, and the national marketing year price to determine levels of revenue guarantees and payments for each covered commodity. There are two revenue triggers that have to be met before any ACRE payments are generated, one at the state level and one at the farm level. To trigger a payment under ACRE the "actual" revenue for both the state and the farm must be less than their corresponding guarantees. The actual revenues

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are the current marketing year price multiplied by the state average yield and the actual farm level yield, respectively. If both triggers are reached, the payment to the farm will be the difference between the state guarantee and the state actual revenue.

Producers who sign up for ACRE will forfeit 20 percent of their current direct payments through 2012. They also will give up any potential price counter-cyclical payments, and the loan rate used to calculate their loan deficiency payments or marketing loans will be lowered by 30 percent. The loss of potential CCPs and LDPs may not be too critical, because if market prices fall enough to trigger those payments it is likely that the ACRE payment will be at least as large.

Although the ACRE program may resemble crop revenue insurance, there are some important differences. The ACRE guarantees are based on longer term average prices and yields, so they will not fluctuate as much from year to year as crop insurance guarantees. In fact, ACRE regulations state that the guarantees cannot increase nor decrease more than 10 percent each year. This helps accomplish the fundamental goal of ACRE, which is to stabilize gross revenues over the next 4 years.

On the other hand, one of the two ACRE guarantees and the size of the payment are based on state level yields, not farm yields like most crop insurance policies. ACRE does not protect a farmer who has a poor production year when the state as a whole does not. In addition, ACRE revenue uses the marketing year cash price to calculate actual revenue while crop revenue insurance uses futures prices at harvest time. So, while ACRE payments can be a useful risk management tool for sharply falling prices or widespread yield losses, they do not replace farm level crop insurance protection.

More information is available in Information File A1-45, Average Crop Revenue Election (ACRE). A Decision Tool is also available on Ag Decision Maker to help estimate ACRE payments.

Agricultural outlook & management seminar series

by Ann M. Johanns, extension program specialist, 641-732-5574, aholste@iastate.edu

Iowa State University Extension is offering Agricultural Outlook and Management seminars throughout November 2008 to address outlook and management issues.

These seminars are designed to provide agribusiness leaders with a concise evaluation of current market conditions, expected trends in crop and livestock income potential, and management implications. Participants also will receive an overview of the agricultural industry and learn how changes may affect Iowa producers.

Meeting registration begins at 8:30 a.m. for each location with the program beginning at 9:00 a.m. Most locations will conclude at approximately 3:00 p.m., though some sites may go longer.

The registration fee is $35.00 for most locations (Amana is $45.00). Registration includes lunch, refreshments, and materials at all locations. Pre-registration is required one week prior to the seminar.

Locations

November 12	**Fort Dodge** Best Western Starlight Village
November 13	**Waterloo** Hawkeye Community College - Tama Hall
November 14	**West Des Moines** DMACC West Campus
November 17	**Amana** Holiday Inn - I-80, Exit 225
November 19	**Cherokee** Western Iowa Tech Community College
November 21	**Atlantic** Cass County Community Building

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Program Highlights include:

- **Agricultural Industry Overview**
  - Bruce Babcock, Fort Dodge
  - Dermot Hayes, Waterloo, West Des Moines, & Cherokee
  - John Miranowski, Amana
- **Corn & Soybean Market Outlook Information & Management Considerations**
  - Chad Hart, extension grain marketing specialist
- **Swine & Beef Outlook Information & Management Considerations**
  - John Lawrence, extension livestock marketing specialist
- **Managing Crop Margins for 2009**
  - Area farm management field staff specialist
- **Legal Issues**
  - Steve Moline, Atlantic, Amana, Fort Dodge, & Cherokee

Attend a seminar to learn:

- Current market outlook information and management considerations for grain and livestock.
- An assessment of the effect of higher energy prices on profitability and discuss management considerations.

The seminars are open to anyone who wishes to attend. More information on meeting locations and registration is available at: www.extension.iastate.edu/agdm/info/meetings.html. For questions on registration, call (319) 433-1286.

Updates, continued from page 1

Energy Measurements and Conversions – C6-86 (2 pages)

Please add these files to your handbook and remove the out-of-date material.

Internet Updates

The following updates have been added to www.extension.iastate.edu/agdm.

Average Crop Revenue Election (ACRE) – A1-45 (3 pages)

Location, Location, Location—Value-added Processing/Manufacturing – C5-113 (2 pages)

Liquid Fuel Measurements and Conversions – C6-87 (4 pages)

Biomass Measurements and Conversions – C6-88 (1 page)

Natural Gas and Coal Measurements and Conversions – C6-89 (2 pages)

Current Profitability

The following profitability tools have been updated on www.extension.iastate.edu/agdm to reflect current price data.

Corn Profitability – A1-85

Soybean Profitability – A1-86

Ethanol Profitability – D1-10