# Farmweather - A Case Study in Agrometeorology

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## Abstract

In 1991, meteorological staff from the Australian Bureau of Meteorology toured the cotton growing areas of northern New South Wales, conducting interviews with cotton farmers and other farmers from surrounding areas. The combination of the expertise of the meteorologist and farmer resulted in the formation of the "Farmweather" service, which now provides weather forecast and agronomic advice to a large part of agricultural Australia. In 1996 and 1997, surveys were issued to a wide area of rural Australia to determine the impact of the "Farmweather" service and revealed that the economic benefits based on only the production of four main export crops (wheat, cotton, barley and sorghum) were about six times the cost of producing the services.

## Background

Operational and strategic use of weather and climate information is important for agricultural producers for the profitable production of many commodities. Intelligent use of such information, based on advance knowledge of weather events can also contribute towards the goal of sustainable agricultural production through optimal use of chemicals and water.

Advancements in the science of meteorology, and in the development of computer hardware and software, such as supercomputers, satellite and radar technologies have resulted in considerable improvements in global circulation models, the prediction of weather events, and the provision of meteorological and hydrological services such as locality specific weather services. In addition, the use of microcomputers, cable television, phone facsimile and global computer-based Internet information has greatly improved the accessibility of meteorological services, allowing more detail to be included in the forecast, as well as increased frequency of updates.

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In Australia, delivery of forecasts to rural areas has, until recent times, relied almost exclusively on the media. Originally, distribution was via the mainstream newspapers, and then radio became important from the 1920's, followed by television after 1956. This system of distribution largely controlled the style and information content of rural forecasts, with media restrictions on broadcast time and newspaper space always of paramount importance.

In November 1991, staff of the Australian Bureau of Meteorology conducted a tour of the cotton growing areas of New South Wales, during which numerous interviews were held with growers and farmers from the surrounding area. The idea was to gain feedback on how the existing rural forecast services could be improved, both in terms of forecast content and also mode of delivery.

The main issues raised in the meetings in priority order were:

1. More detail in the forecasts was requested, especially in the "further outlook" period from 48 to 120 hours ahead. A statement of forecast confidence was also requested, together with a quantitative estimate of precipitation amounts.
2. The preference for a "plain English" in normal conversational style was expressed. Phrases such as "mainly dry" or "becoming unsettled" are of only limited assistance in farm management strategies.
3. A graphic display of prognostic charts and expected rainfall distribution was requested to augment the text description of the forecast.
4. A more flexible method of forecast distribution was also asked for. An "on demand" service was considered ideal, rather than having to fit in with existing media programming schedules.

It was decided that these requests would be incorporated into a new forecasting service for the cotton growing regions of northern NSW, which we called "Cottonfields". Some additional agronomic advice involving evaporation trends and cotton degree-days was also to be included during the period when cotton was actually in the ground.

The design of the service therefore arose directly from a combination of the expertise of meteorologist and farmer, resulting in an integrated forecast system produced explicitly to assist with short term farm management strategies.

## Description of the Service

"Cottonfields" was designed to provide forecasts up to 7 days ahead, and consisted of three pages. These were a recent satellite photograph, a graphics page showing prognostic and rainfall predictions out to 4 days ahead, and a text page providing "expert opinion" commentary on the situation. This text page also contains information on forecast confidence, and quantitative rainfall predictions based on numerical model output.

In addressing the distribution problem, it was decided that this should be a non-media service, and a pollfax system was utilized. No national pollfax system existed at this time, so a local network was organized, centered on the fax machine located at the Namoi Cotton Cooperative offices.

The forecast information was prepared at the Sydney Offices of the Bureau of Meteorology and then faxed to the Namoi Cotton Co-operative machine.

Cotton growers could then poll the information as required, and records of the demand for the service were also available as output from the Namoi fax machine. The service became operational in October 1992, with the demand immediate and heavy, and growers complained of the extensive delays encountered because of line congestion.

Another issue that emerged very early was the way the demand quickly spread beyond the farm gate, with polling requests being received from rural businesses, banks, commodity traders, transport companies, local media and international sources, as well as the local growers it was designed to service. Numerous requests were also received from farmers in adjacent parts of New South Wales to begin a similar service for their area, and it soon became apparent that there was a national demand for this type of service. It was then decided to launch a national fax delivered rural service under the umbrella name of "Farmweather", and delivery of this was to be achieved through the just developed Infofax system operated by Australia's national telecommunications company, Telstra. "Farmweather" commenced in July 1993, and was subsequently extended to cover 21 agricultural areas around Australia.

## Growth of the Service

After about one year of operations, several usage patterns emerged. It became obvious that the demand for "Farmweather" was linked to three main factors, and these in total provided a measure of the level of rural activity around Australia. These factors are:

**Significant Weather Events**

Whenever significant weather events occur anywhere in Australia, there is immediately a peak in the demand for "Farmweather" services from the affected area. Weather such as tropical cyclones, scattered thunderstorms, or a widespread rain event will trigger such a situation.

**Seasonality**

Because of the climatic characteristics of Australia, agricultural activity is seasonal in many areas. In Western Australia, the main activity is centered around the winter wheat crop, which is a direct result of the winter maximum/summer minimum rainfall pattern across the area. In Queensland, the situation is reversed, with a summer rainfall maximum resulting in peak agricultural activity between December and March, and a minimum during the winter months. In NSW, dual rainfall peaks occur, one in summer and the other in winter, and this produces two periods of maximum activity in agriculture. These facts show clearly in the call numbers in “Farmweather” with the pattern very pronounced in Western Australia and Queensland, and even the double peak for NSW emerges.

So to a large extent, “Farmweather” call numbers produce a graph similar to the average rainfall pattern for the area in question.

**Awareness of the service**

For the first 4 years, “Farmweather” call numbers grew steadily, and then peaked during 1999. Typically we now receive about 17,000 to 20,000 calls per month and from survey evidence, awareness of the service is now very high across rural Australia.

**Example of a “Farmweather” Service**

(a) Sheet 1 contains “expert opinion” text referring to the local weather forecast for the next seven days ahead, percentage probability of rainfall, temperature and wind forecasts, and the last three months Southern Oscillation Index.

(b) Sheet 2 contains forecast temperature and evaporation trends, accumulated cotton degree-days compared with the same period last year and the rainfall across the local area over the previous 24 hours.

(c) Sheet 3 is a graphic representation of the prognostic and rainfall charts out to 4 days ahead based on an Australian numerical weather prediction model.

(d) Sheet 4 is a recent satellite photograph.

## Assessment of the Service

During 1996, a detailed survey study of user's evaluation of the "Cottonfields" weather service and its related benefits to the Australian economy was undertaken (Anaman and Lellyett, 1996a, 1996b). Some of the key results were that the users generally considered the service to be of high quality and useful for both their farming and non-farming activities. The benefits to the Australian economy in terms of aggregate producer benefits (producers surplus) was based on the estimated one percent reduction of costs of producing cotton determined from the survey.

This yielded a societal benefit-cost ratio of about 12:1 based on an increase in production of raw cotton (destined for export) resulting from the use of this service. However, with the advent of the "Farmweather" service, there was an obvious need to evaluate the national economic impact rather than just the effect on the cotton industry via the "Cottonfields" service. Consequently, in 1997, a survey was issued to a wide variety of farmers around Australia containing a large number of questions relating to the "Farmweather" service.

The survey consisted of a questionnaire addressing the following issues:

(a) General farm information
(b) Using weather information from the Cottonfields weather service.
(c) Benefits of the Cottonfields weather information service.
(d) Socio-economic characteristics of respondents.

The objective of this study was to analyse the use of "Farmweather" services and estimate the associated benefits to the Australian economy based on the production of several key export crops. The results of the survey were subject to standard economic regression analysis, and the associated economic theory and mathematical formulae can be found in Appendix 4 of the overall report: Assessment of the Australian Bureau of Meteorology's "Farmweather" Facsimile Services (Anaman 1997).

## Economic Benefits of Service and/or Policy Matters Served

The investigation revealed that the economic benefits of the services based on only the production of four main export crops (wheat, cotton, barley and sorghum) were about six times the cost of producing the services.

"Farmweather" is therefore an economically viable service to the Australian rural economy. However, the actual benefits from "Farmweather" are probably considerably higher, because the survey did not

include input from “beyond the farm gate” users, such as rural businesses, banks, commodity traders, transport companies and the media. It is reasonable to assume that these groups derive benefits similar to the farmers themselves.

## Other Important Issues

The promulgation of an “expert opinion” weather forecast service, linked to graphically presented forecast information and satellite imagery, and available on demand, was perceived to be a significant step forward by rural Australia, and many appreciative references were received from the users.

(a) One of the first noticeable effects was a reduction in telephone requests from cotton growers to the NSW Regional Forecasting Centre. These calls were originated because farmers had difficulty in building up a coherent weather picture from the traditional media presentations. With "Cottonfields" providing the required level of detail, the demand for personal telephone briefings by a meteorologist fell, thereby allowing the forecasting team to concentrate more on the evolving meteorological situation.

(b) We became aware of the strong educational benefits of the service, with many requests for further information being received from schools. Because of its easy accessibility and user-friendly style, “Farmweather” was used in school projects, and also increased community awareness of the capabilities of a modern weather service. This capability was often obscured in media presentations.

(c) “Farmweather” allowed us to quantify the demand for our rural weather forecast services, which is not possible through media delivery.

(d) Since the beginning of “Farmweather”, the Internet revolution has broken, and “Farmweather” will soon be available through this source, incorporating live radar, satellite photograph “loops”, and output from automatic weather stations. We now regard the fax machine as an intermediate step between the media and the Internet. Although the Internet is growing quickly in rural Australia, it is thought that demand for fax delivery will still be strong for the next two to three years.

(e) A possible advantage of “Farmweather” is that it can be useful in developing countries where Internet delivery is concentrated mainly

in the cities, but which have a fax infrastructure extending to the rural areas. For example, there may be a police station or government office with a fax machine in many rural villages, and these could act as distribution or display points for a “Farmweather” type service. Once again we could view this as an interim step before general provision through the Internet.

(f) There has been considerable speculation in meteorological circles that the provision of such information as live radar, recent satellite photography and automatic weather station information will reduce the demand for the services of a meteorologist, and that user groups will merely attempt their own forecasts. Our experience with “Farmweather” has led us to a different conclusion. We have found that the more information provided, the more the demand for an expert opinion to integrate the data is produced.

## Conclusion

The provision of a rural weather forecasting service covering the period out to one week ahead, incorporating the expert opinion of a meteorologist, computer graphics depicting model output, updated once per day, and including a recent satellite photograph, all available on demand, produces a quantifiable economic benefit to the rural activities of the host country. Delivery can be through pollfax or Internet.

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