1. Background

National weather forecasting is well resourced and the subject of much discussion. However it is only able to give indicative forecasts at broad scales and with a relative lack of detail.

To improve decision making farmers need to know what the weather will be doing on their properties in 2, 12, 22 or 32 hours time. Access to detailed 'customised' weather forecasting was expected to enhance cropping farmers' ability to optimise use of irrigation, agrochemicals and fertilisers and plan other farm operations.

Small weather stations have become increasingly affordable and the ability to transmit, process and share data is improving greatly. A network of stations and access to appropriate crop and disease models was anticipated to help farmers make the best practical and timely decisions on spraying, irrigating, and harvesting crops. Farmers would not all need their own weather stations, as they would be able to obtain property relevant predictions of the time of arrival of weather events or occurrence of infection periods via email, fax or phone messages or internet options.

The project investigated the opportunity to co-ordinate a regional weather station network, use computer modelling to predict disease risk, irrigation need, and crop yields. This would reduce unnecessary expenditure on hardware, reduce weather related risks, increase profitability and save farmers and the environment from wasteful application of chemicals and/or water.

We anticipated the outcomes from this project would be able to flow on to other cropping sectors, and to be extended geographically as well.

2. Project activities

This project involved co-ordination of three small groups of cropping farmers in Canterbury. Those involved had a commitment to developing much better site specific weather forecasts and taking advantage of related technologies to improve production efficiency and safeguard the environment.

An initial small workshop outlined the available technology options and explained how these are being applied in other sectors and regions in NZ.

Information and technology providers HortPlus (Trevor Atkins) outlined the existing uses of new weather and related prediction technologies for fruit industries, and potential for arable cropping in Canterbury. A number of growers and industry people described the roles they saw for such information.

Three existing weather stations operated by the Foundation for Arable Research were used to demonstrate the potential of already available forecast opportunities. The three FAR stations have potential to be included in a regional network providing data for on-farm decisions. Detailed site specific forecasts were generated by the Met Service and made available to focus group members by HortPlus MetWatch.

An attempt was made to record the locations of other weather stations that were potentially able to be incorporated in a regional network. Crop & Food Research and McCain Foods are known to have additional stations. A number of sites are operated by NIWA and through the National Rural Fire network, however these may not be in suitable locations or collecting sufficient data.

Surveys of participants were conducted at the beginning and end of the project to determine the uses to which weather and climate information is currently being used, and to document the benefits that accrue to those acting on the information provided. This also helped identify gaps and prioritise future development goals.

Information about weather stations and interpretation was prepared in fact sheet format. The material is predominantly derived from an earlier MAF SFF project, Research to Practice, use and interpretation of weather information (Manktelow and Porteous). This material is intended to increase the extent of awareness of the potential for these and related technologies.

We anticipate again interacting with the wider community through a series of workshops that present the results of the project, and generate ongoing adoption of suitable opportunities. This has not been completed as FAR are reviewing their portfolio of weather and crop model research and services for levy payers.

3. Weather station locations

3.1. Weather information requirements

The detailed forecasts used in this project are quite site specific. Therefore valued weather recording sites are located in or very near cropping districts.

In addition, specific information is required to generate MetWatch forecasts.

1. Minimum sensoring required for MetWatch

   Air temperature
   Rainfall
   Leaf wetness

2. Station Outputs

Output needs to include year, plus an output array for daily totals (usually 9am but midnight otherwise) for:

Rainfall total
Average, min, max air temperature
(plus Windrun if wind speed is recorded, and total radiation if recorded)

3.2. Weather stations used

Three weather stations were ultimately used as trial sites for this project – rather than one originally planned. This was assisted by Met Service making free forecasts available for this project. The contribution is gratefully acknowledged.

The sites were:

1. Methven at "The Glebe"
2. Chertesy at the "FAR Arable Site"
3. St Andrews at "Copperfields"

All three stations are operated by the Foundation for Arable Research.

3.3. Other weather stations identified

Approximately ninety potential weather stations were identified in Canterbury, Otago and Southland. After removing probable duplicates some seventy remain, although of these some are probably outside the main areas of interest.

The station names and known locations are presented in Appendix 7.2. A map is presented as Appendix 7.3.

Stations have been grouped according to ownership and probable utility. The weather factors measured by each is reported but has not been verified. Iin addition, there has been no checking of the quality or maintenance standards of these stations.

For reference, the requirements for inclusion in the National Rural Fire Association weather station network are presented in Appendix 7.4.

The collated list includes stations in the NFRA network, NIWA climate station network and stations operated for agronomy purposes by FAR, Crop& Food and McCain Foods.

Another group includes stations operated by councils, although some are located on buildings.

The remaining group includes private stations that are available for polling via internet links. Many of these are in Southland and more peripheral locations so may be of limited use.

Among the various groups are stations reportedly used by the NZ Meteorological Service.

The quality of data from the NFRA and NIWA networks and from Met Service stations and the agronomy stations can be assumed adequate for crop management purposes. Data quality from private on-line stations is unknown.

4. Weather forecasts

4.1. MetWatch forecasts

MetWatch weather station forecasts are detailed point forecasts generated by the New Zealand Meteorological Service. Key parameters are forecast on an hour by hour basis for up to 60 hours ahead.

Forecasting is refined through a feedback loop. Generated forecasts are compared to actual weather experienced at the site in question and the algorithms adjusted accordingly.

4.2. Accessing forecasts and data

MetWatch forecasts are made available to HortPlus subscribers by daily fax or email, and through website access. The members of focus groups in this project were provided with one year subscriptions by HortPlus at no charge.

An example of a daily forecast emailed to subscribers is given in Appendix 7.5. The HortPlus weather site can be viewed at http://www.hortplus2.com/mwol/

The Met Service generated and made available three weather forecasts, one for each FAR station. This increased coverage of the project from one to three sites. Three discussion groups were formed, one based around each weather station.

While many in the discussion groups were local to one or other of the sites, some were further a-field to help identify issues arising for farmers sited some distance from a local station.

4.3. Project weather forecasts

A number of problems were encountered during the establishment phase of this project. Early forecasts were notably incorrect – to the extent farmers rang to query the forecasts they received.

This problem was resolved quickly, but stayed in the minds of focus group farmers. The cause was an error in co-ordinate conversion. This error mis-located stations (Methven was apparently on Mt Hutt). All stations were some 10km out, and in areas with variable topographical (Methven and St Andrews) this was particularly significant.

On several occasions problems remotely accessing the three weather stations appeared to have been resolved but then resurfaced.

General station maintenance was completed and stations were reprogrammed to allow 24/7 remote login. Aerials were checked and changed but did not seem to cause the faults. It is possible a download software version conflict may have been the root cause.

5. Initial user survey

A postal survey of the focus group members receiving daily weather forecasts was undertaken near the start of the project. The survey form is presented in Appendix 7.6.1.

Unfortunately only a small number of users responded to the survey, even after repeated approaches.

5.1. Results of Initial Survey

Details are presented in Appendix 7.6.2.

Weather forecasting was generally regarded 'very important' for farm management. Half of the group checked forecasts daily, one quarter twice daily, and the others several times. Information was obtained from TV, radio and internet, and newspapers.

Forecast information was used for work planning and for protection from adverse weather such as frost. Spring and summer were predominantly named as the critical periods. Half of the respondents check weather forecasts several times a day at critical times. Responses to 'how often access was wanted' were generally the same as 'actual use'.

Wind speed and direction, rain information, maximum and minimum air temperatures and humidity were important to most of the group, while solar radiation was of interest to only 3 respondents.

Most farmers measured their rainfall, max and min temperatures and humidity. Less than half measured wind speed or direction and solar radiation. Rainfall was recorded by all but one respondent.

Soil temperature and disease pressure were the most highly sought related data (6/7), followed closely by soil moisture, leaf wetness and pest pressure. Ground air temperature was only wanted by three of the farmers.

Few were measuring all that they are seeking and even less were recording it.

6. Final user survey

At the end of the project, all focus group members were emailed seeking feedback on the service. A number of focus group members were also interviewed by telephone, interviews lasting for approximately half an hour.

6.1. Email survey

The email survey was 'informal' – an email with no leading questions sought quick responses. See Appendix 7.7.1.

A small number of growers replied (as with the first written mail survey at the start of the project). Further emails were exchanged with respondents, clarifying points raised. Of those who did not reply, later communications with some indicated they were "sorry but just too busy".

Details from email responses are presented in Appendix 7.7.2.

Responses varied from "not much use" to "excellent tool". In part this seems to be locality related, and in part it reflects early experiences and possibly attitude to new technologies. One grower felt the service was no better than other options and believed it to be highly inaccurate.

This response related to the initial incorrect grid reference given for the Methven station which resulted incorrect forecasts. It seems correcting this was not acknowledged, and perhaps the service was written off at this early stage.

Other growers were enthusiastic with one stating the forecasts were useful despite 'inaccuracy'. The information was still better than otherwise available.

The lack of 'add-on tools' for arable diseases was noted by several respondents.

6.2. Telephone Interviews

Interviewees included both farmers and consultant/contractors. Each person was referenced to one of the three FAR weather stations; four were based at Chertsey (two growers, one consultant, one process factory), two at Methven and two at St Andrews.

The interview template is attached as Appendix 7.7.3.

A range of responses was obtained, with overall opinions ranging from 'not much use' to 'extremely useful'. Details are presented in Appendix 7.7.4.

6.2.1. Summary

Most weather information users are seeking predictions and use multiple sources of information. They apply their own interpretations to whichever forecasts they receive.

TV news and weather is widely used to obtain an overview and a variety of other sources including websites and local newspapers used to obtain more localised detail.

There is some use of, but little emphasis on, access to historic weather data. The main identified use was for crop models such as Wheat Calculator, and Crop & Food provides updated information already. There is minor use of recent historic data by farmers for irrigation scheduling and some disease modelling by the process factory.

Some people are unable to adequately access web-based information due to poor infrastructure. However few of those involved in the project made extensive use of the information available on-line at HortPlus MetWatch anyway. There were notable exceptions.

Local accuracy differences from, and therefore usefulness of, the detailed forecasts were evident and seen to have significant effect further from the base station site. This was most noticeable away from the Methven and St Andrews stations.

The accuracy was generally considered much better around the Chertsey weather station. Suggested reasons are the more even topography and reduced influences from either sea or mountains. In the Chertsey area, the forecast was believed to be very accurate in an ellipse extending further north-south (15-20km) than east-west (8-12km).

All but one person found the HortPlus MetWatch forecasts very useful. The one who did not, discussed needing to learn to trust it, and thought that forecast was the best for wind prediction, a lot closer than TV or radio.

The prediction one to two days out was considered good by most. But beyond that it was less useful and often changed significantly as events neared.

The nature of inaccuracy was more in the wind and rain detail than an event occurring. Temperature predictions were perceived to be fairly good. The rainfall forecast was good on predicting timing of events, but not so accurate on depths. The wind forecast was good at predicting direction but not so accurate on strengths.

The ten day regional text forecast was seen to provide a useful overall picture but was not better than other sources. The TV news and midday radio forecasts were helpful for the 'big picture' because they covered adjoining regions and growers could track larger scale movements.

The detailed forecasts were valued for specific decision making. Crop spraying decisions were most commonly noted as needing detailed information and the hour by hour HortPlus forecast was regarded as best for that.

Some users were happy with a daily forecast, others rechecked at intervals during the day for particular reasons. Access to the on-line information was seen by some as very useful.

Two distinct approaches are evident – users do or don't go on-line. Those who do are usually seeking the most up to date information, maybe several times a day, or they want to find out about conditions away from their home station.

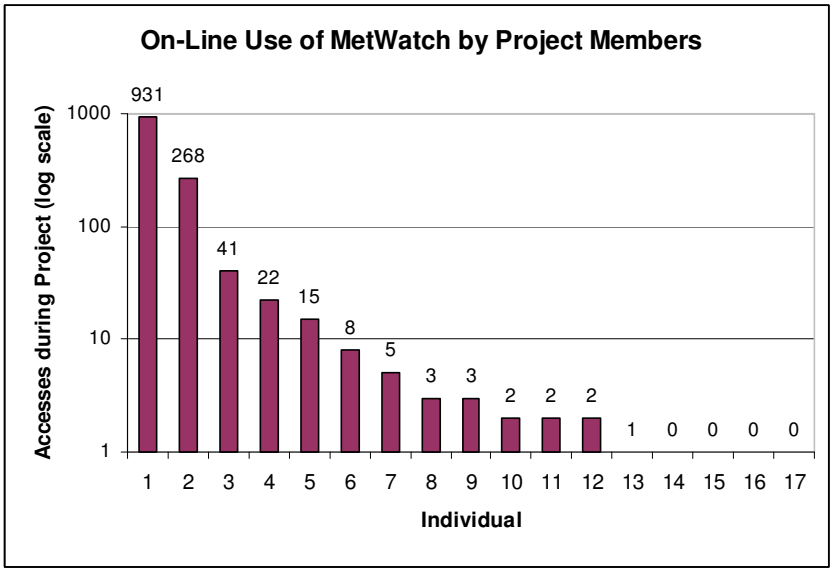

Figure 1: Graph of On-Line MetWatch use by individual members of the Project Focus groups showing extreme variation in number of accesses during the project, with a top usage of 931 accesses and a bottom of zero accesses.

The reason for not using the on-line service varies. In some cases internet connections are bad. In others, people are busy and do not perceive the time spent on-line gives sufficient extra benefit. It appears that individuals treat the weather site the same as any other on-line information. Web users also accessed weather.

The most common use of detailed forecasts was for spraying decisions. In this context, the lack of disease prediction tools was lamented.

Most users also recognised the information was helpful in making harvest decisions. Sometimes this meant delaying, other times hurrying and sometimes deciding which crop to harvest first. Similar use was made for cultivation and planting decisions.

Most users believed they had made only minor changes to their practices. Often they found it difficult to quantify change, but they thought they were doing things better. Timeliness of operations was the most reported factor. Most said they would make more significant changes if, for example, disease forecasting was integrated into the service.

All considered that use of Decision Support Tools would be integral to their business in the future. Those using Wheat Calculator noted that 'someone else' took care of updating the weather for them. They were aware that if they were downloading data for themselves they would need it to be in suitable format and easily loaded to the calculators with little room for mistakes.

Everyone interviewed saw the project as being very useful. The reasoning varied; any research adds to the pile of knowledge, showcasing current technology, making people aware of what could be done, and identifying that infrastructure problems prevented some people accessing the information.

Only a few thought the service in its current form merited paying a subscription. However, the integration of field crop disease models and forecasts into the suite would immediately provide justification for subscribing.

6.3. Application for decision support

The members of the focus groups were strongly supportive of development of predictive tools to enhance crop protection and for other management decision making purposes.

Several have been actively involved in the development of Wheat Calculator and similar tools. Some are making limited use of weather data to aid irrigation decisions.

Almost all were strongly supportive of the detailed hourly forecasts in assisting with spray application. Better knowledge of impending weather events – rain, dry, wind etc – allowed them to make better decisions regarding chemical type (mode of action) and to identify most appropriate spray windows.

The financial gain from using cheaper protectants was suggested sufficient to pay for the cost of obtaining the information. As such high priority should be placed on integrating suitable disease (and pest) models into the weather forecast service.

6.4. Application for environmental protection

The knowledge of wind speed and direction was seen as immensely valuable in directing work programmes. Managers were better able to plan spraying staff programmes, sending them to areas where weather conditions were likely to be suitable, or waiting until a weather gap saw suitable conditions on site. This was seen to reduce the risk of off-target impacts from spraying 'to get the job done'.