USING THE DEXCEL WHOLE FARM MODEL

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What is the Dexcel Whole Farm Model?

The Dexcel Whole Farm Model (WFM) is a computer model that simulates New Zealand dairy farms. The model is made up of components illustrated in Figure 1. The important parts of the model include weather, soil, pastures, paddocks, animals, decision rules and reporting.

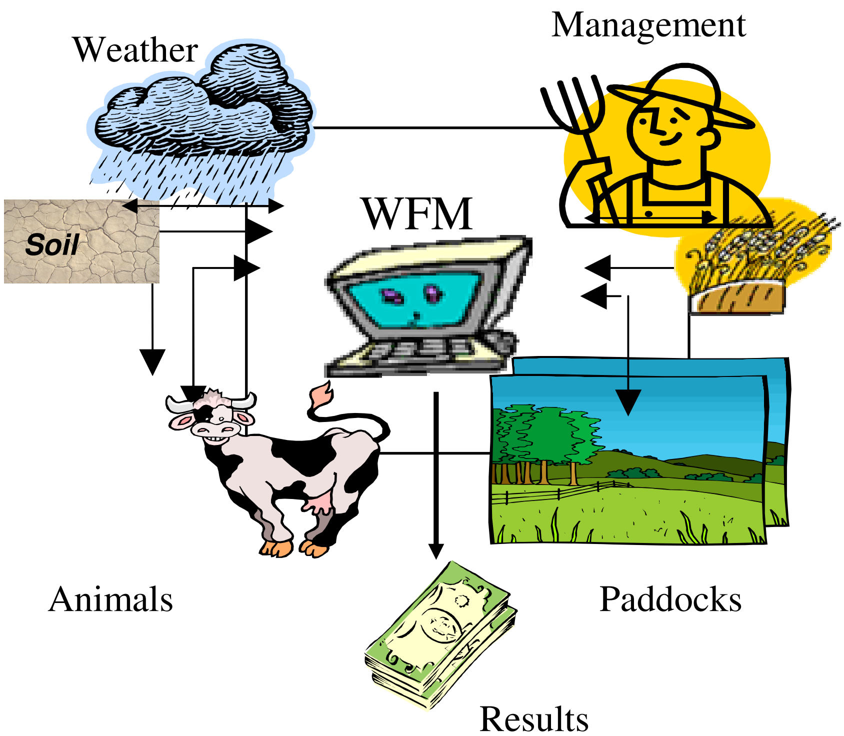

Figure 1: The Dexcel Whole Farm Model

Weather

Daily weather drives pasture growth and soil moisture status. Irrigation can be applied by the model and this increases soil moisture (and often drainage) allowing increased pasture yield.

Soil, pastures and paddocks

Pasture growth is modelled on weather and soil moisture, and influenced by soil fertility, the current pasture cover and recent grazing history. N fertiliser can be applied to individual paddocks, increasing pasture growth. Each paddock on a farm can be entered with a description of soil fertility, moisture holding capacity and initial pasture cover.

Animals

Each animal in the herd is entered individually, described in terms of genetic merit, age, calving date, initial liveweight and condition score.

Decision rules

The user can specify management regimes including (amongst many others) winter grazing, supplementary feeding decisions, irrigation and N fertiliser application, rotation length and pasture conservation rules.

Reporting

The model output includes physical performance measures such as milk production, pasture growth and cow liveweight. Economic summaries are also presented including income, Economic Farm Surplus (EFS) and Return on Assets (RoA).

What is unique about the Dexcel Whole Farm Model?

There are a number of computer models available for farmers, ranging from simple feed budgeting tools such as FeedPlan to detailed system models such as UDDER. The WFM has some unique features including:

- Pasture yield driven by weather, allowing pasture growth to be estimated independently of calculated intake. This also allows the effects of weather variability and irrigation scheduling to be modelled
- Multiple year runs are possible. We have run the model for up to 30 years to account for the variability in responses to irrigation restrictions and spring decision making caused by climate. This allows risk and variability to be assessed
- Carryover effects can be handled well. We have used the model to simulate the long-term trends in farm performance caused by incremental changes in cow reproductive performance. Pasture cover, feed reserves and cow condition also carry over to the next season ensuring that the sustainability of systems is assessed
- Detailed feed composition allows the WFM to consider protein effects on milk production as well as energy limitations.

How are farmers going to be able to use the Whole Farm Model?

The WFM was originally conceived as a research tool, allowing scientists to gather knowledge into a common format and predict the results of changes in farm management in association with farmlet trials. As the WFM has developed we have also used it to contribute to extension programmes and farm systems analysis for policy setting.

Benchmarking pasture yield

The amount of pasture eaten is a key driver of dairy farm performance and profit. The performance of the Lincoln University Dairy Farm (LUDF) in growing and feeding large amounts of quality pasture illustrates this point. However it is not possible to eat pasture that is not grown, and one of the challenges for dairy farmers in Canterbury is to benchmark themselves against the LUDF when they do not know how much pasture they actually grow. This difficulty is influenced by the wide variety of soil types and irrigation systems in Canterbury, variability in reliability of water supply between farms and the effects of different weather across the region on rainfall and temperature. While it is possible to calculate pasture eaten from animal performance, this doesn't give an accurate measure of pasture yield and potential to increase pasture harvested. Because the WFM pasture growth is driven by weather, soil type and irrigation it is possible to compare potential pasture yield between farms. This can allow farmers to interpret the performance of their farms against the LUDF with a better understanding of the effects of things they cannot change (weather, soil type), things that are difficult to change (irrigation system) and things that are easy to change (pasture management).

To do this we have compared the WFM predictions of pasture yield on the LUDF with pasture yield in the Winchmore area on two different soil types under border-dyke irrigation with two levels of water availability. The two soil types were a shallow Lismore type (67 mm available water storage) and a deeper Templeton type (90 mm AWS). The LUDF farm was simulated using the deeper Templeton type soil. The irrigation regime used for the LUDF was as applied in the 2002-03 season (585 mm) through the centre pivot. The two border-dyke systems were scheduled as in the Rangitata Scheme, but with different levels of water availability leading to a contrast between 936 and 454 mm being available. Pasture type and N fertiliser use were assumed to be the same on all farms. Thus any 'new-grass' effect of the regrassing programme on the LUDF is ignored in this simulation.

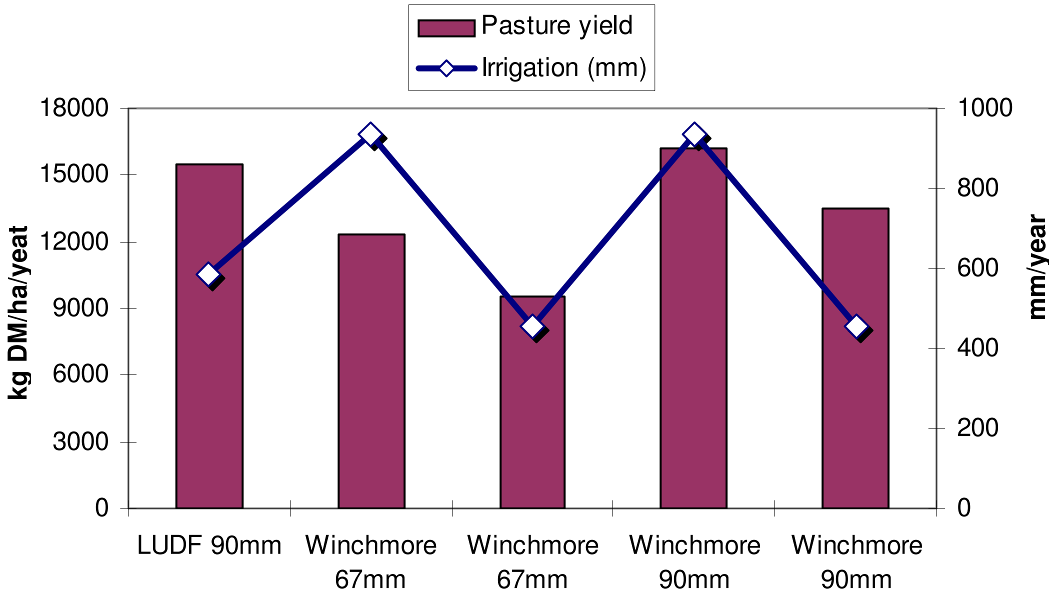

Figure 2: Potential pasture yield for the June1992-May 1999 period simulated by the WFM comparing soil depth, location and irrigation regime.

The results in Figure 2 show that the Winchmore site with the deeper soil and the greater volume of irrigation had a similar potential pasture yield to the LUDF. However, on the shallower soils and with less water, pasture yield drops away rapidly and the shallow soil with low water availability has a pasture yield that is only 61% of the LUDF. The greater potential efficiency of spray systems over border-dyke systems (especially on shallow soils) is also illustrated in Figure 2. The implications of this for benchmarking are clear; a farmer on a shallow soil with low water availability and mimicking the LUDF management system can only expect to be able to produce about 1000 kg MS/ha. These WFM simulations show that the range in potential pasture yield across Canterbury farms needs to be considered in extension of the LUDF results. The WFM provides a tool to do this.

Understanding the risks of pasture yield variability

Figure 2 shows that average pasture yield varies markedly with soil type, location and irrigation regime. More detailed analysis of the simulation results shows that the pattern of variability of pasture yield also differs. Figure 3 shows the results of 30-year simulations for the Winchmore shallow soil. The graph shows that as rainfall declines, the higher water availability farm (980 mm average) increases pasture yield as a result of warmer weather. On the lower water availability farm (439 mm average), the decrease in rainfall has a greater effect on pasture yield than the increase in temperature and pasture yield is positively related to rainfall. For farmers wanting to understand the risks of climate variability in a new dairying area such as Canterbury, the WFM provides a tool that can utilise long-term historical data to give an insight into the risks that farms face.

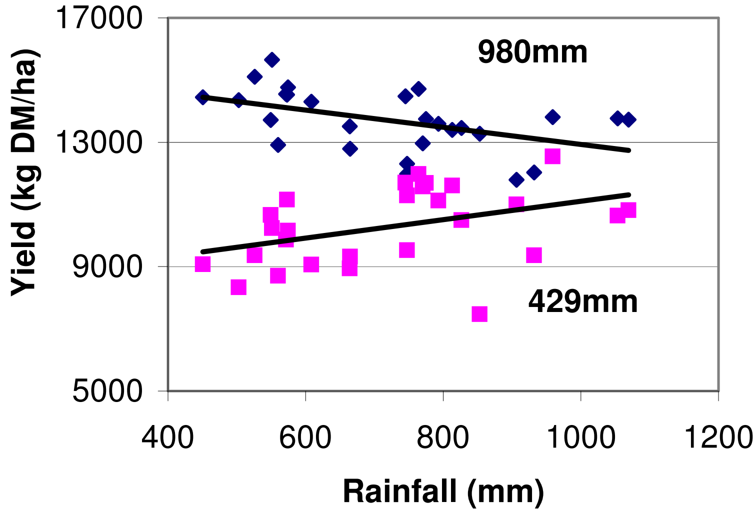

Figure 3: The relationship between rainfall and pasture yield for two border-dyke irrigation regimes at the Winchmore site.

These are just two examples of how the WFM has been used. Other work has looked at different scenarios for once-a-day (OAD) milking, the effects of different winter grazing and spring rotation options and the effects of different options for managing the transition away from inductions.

What are the benefits of the WFM going to be for the average farmer?

We see two areas of direct benefit to farmers. The first is in extension, where consultants using the WFM will be able to better relate the results of research trials and demonstration farms to the individual circumstances of each farmer. Benchmarking potential pasture yield, as above, is one example of this use of the WFM. This will help farmers to get more value from the research they are contributing to.

The second way we see farmers will benefit from the WFM is through direct access. Dexcel has been investigating making the power of the WFM available to farmers and consultants over the Internet through customised interfaces that will allow users to investigate options for their farms. Dairy InSight is funding an investigation of the potential for web-based tools in the 2005/06 financial year.

What other technologies are coming and how will they link with the WFM?

The options for the future are limited only by your imagination. Here are some possibilities:

- Your MINDA link updates the herd in the WFM on a monthly basis, allowing accurate estimates of feed demand. The effects of your breeding programme over the next 10 years are simulated to assess future trends in feed demand, production and fertility. This may provide early warning of undesirable trends.

- The Fonterra satellite automatically downloads an update of pasture cover on each paddock as it flies over. The WFM compares measured cover with the pasture target for the season and texts the result to your phone along with the comparison between target and actual milk yield downloaded to the WFM from Fonterra that morning.
- The NIWA climate forecast calculates the expected river flows and rainfall for the next two months and sends it to Environment Canterbury, who forecast rainfall and irrigation water availability for your farm and sends it to the WFM. The WFM calculates the pasture yield expected over this period and alerts you to any potential problems.
- Your OAD herd is showing a greater than expected decline in milk yield. The WFM knows this from the difference between individual cow yield from the farm dairy and the season forecast. Analysis of pasture cover and feed quality data (from hand-held NIR) by the model shows that the cereal silage you are feeding is causing milk yield to decline. The model analyses the choices and recommends that the TAD herd gets the cereal silage and the OAD herd goes onto higher quality pasture.