Quantum Market Research

MEAT & LIVESTOCK AUSTRALIA

Final report

Producer requirements for weather and seasonal climate forecasting

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Abstract

Interpretation of seasonal climate forecasting information (separate to one to seven-day forecasts) can significantly affect producer profitability and risk management. Therefore, there is substantial industry benefit from ensuring the forecasts are expressed in a way that equips producers with the optimal insight to inform their decision-making at critical junctures in business planning. This research project takes a 'needs first' approach to understanding use of seasonal climate forecasts and where producer knowledge or information gaps exists that would aid improved interpretation and on-farm decision making. The project findings will equip industry with information to determine the next best areas of investment to improve the interpretation of seasonal climate forecasts.

The project was carried out in line with the Market Research International Standard, AS ISO 20252.

Executive summary

Background

Climate is the biggest individual driver of production variability in agriculture and accounts for one-third to two-thirds of annual global crop yield variability.

Proper interpretation of forecasting information can significantly affect the profitability and risk management of a farming operation. As such, there is substantial industry benefit to be gained from ensuring that the forecasts are expressed in a way that equips producers with the optimal insight to inform their decision making at critical junctures.

Objectives

- Determine the current and future requirements of red meat, grains, dairy, sugar, rice and cotton producers for weather and seasonal climate forecasts.
- Determine what specific actions need to be taken to address requirements identified through market research.

These objectives were successfully met.

Methodology

Project initiation phase commenced with a visioning workshop with the stakeholder group to map out a clear and comprehensive list of existing hypotheses. Additional visioning sessions were also held with representatives of The Council of Rural RDCs (CRRDC), Grains Research and Development Corporation (GRDC) and the Bureau of Meteorology (BOM). Qualitative fieldwork was a series of one-on-one in-depth interviews with Australian producers. A disciplined approach was taken with recruitment to ensure research outcomes are a reliable reflection of the target audiences. The qualitative findings were used to assist in crafting the quantitative survey questionnaire. Statistical significance testing at 95% confidence was conducted on the quantitative data, between groups or against the total average as appropriate.

Results/key findings

Effectively the Seasonal Climate Forecast (SCF) enables producers to act more decisively on the medium to short-term information, rather than producers making firm plans or major commitments (like changing crop plans or selling livestock) based on the SCF. While the majority (82%) of producers surveyed are accessing a seasonal climate forecast, only half (59%) are using this information to make a decision on-farm.

Overall, two thirds (61%) of producers feel seasonal climate forecasts are too unreliable to pay attention to. So, while they are clearly in the habit of interacting with the forecasts, there is a gap in confidence.

But there is clear correlation between recognising improvement in the forecasts and active use of SCFs (of those who say they rely on SCFs, the majority (82%) agree the forecast has improved in the

last 20 years). Suggesting that if tangible improvements are made and communicated, it will encourage producers to take a fresh perspective on SCFs breaking their inertia and increasing use.

Two-thirds (65%) or producers are using the Bureau of Meteorology (BOM) for forecasting information, the highest usage of any one source, suggesting that (BOM) is the single largest stakeholder with the influence to positively affect how short-term and SCFs are used.

There are a number of areas that could be reviewed for improvement including a primary focus on rainfall with clarity on how the information should be read; the inclusion of straightforward interpretation of forecast information to reduce cognitive load and easy and digestible graphical representations of information.

Benefits to industry

Proper interpretation of forecasting information can significantly affect the profitability and risk management of a farming operation. As such, there is substantial industry benefit to be gained from ensuring that the forecasts are expressed in a way that equips farmers with the optimal insight to inform their decision-making at critical junctures. This research takes a 'needs first' approach to understanding farmers' existing use of services and where there are knowledge or information gaps.

Future research and recommendations

Producers offer a number of consistencies when asked what would improve the utility of short-term and SCFs from their perspective, including:

- Primary focus on rainfall presentation, including assurance that it is correctly interpreted. Rainfall likelihood and amount is overwhelmingly the most important aspect of any forecast, and its perceived reliability the biggest single factor in determining producers' propensity to utilise forecasts overall.
- Inclusion of straight-forward and accessible interpretation of forecast information, read in plain language.

To build on this research it would be useful to review specific product prototypes with producers, that bring to life the key areas of improvement identified within this report. User co-creation and testing would help to deliver the recommendations as outlined in this report.

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1. Background

Climate is the biggest individual driver of production variability in agriculture and accounts for one-third to two-thirds of annual global crop yield variability.

Proper interpretation of forecasting information can significantly affect the profitability and risk management of a farming operation. As such, there is substantial industry benefit to be gained from ensuring that the forecasts are expressed in a way that equips producers with the optimal insight to inform their decision-making at critical junctures. Forecast skill and accuracy has improved, as indicated by the figure below. But producers still indicate they would like a 'better' forecast.

1.1 Key Research Questions

To fulfil the objectives, the research:

- Explores current usage of seasonal climate information and weather forecasting.
- Explores how climate and weather data informs decision making in the daily, seasonal and annual planning cycles.
- Understands the information that is looked at and explores intention of use.
- Explores the ease and difficulty of understanding and acting on required data.
- Explores examples of effective and ineffective data content and presentation.
- Explores how producers read the information that is presented to them.
- Understands future needs from forecasting information and sources, with an exploration of how to better present information.

2. Objectives

The objectives of this project were to:

- Determine the current and future requirements of red meat, grains, dairy, sugar, rice and cotton producers for weather and seasonal climate forecasts.
- Determine what specific actions need to be taken to address requirements identified through market research.

These objectives were successfully met.

Outcomes from this research will equip MCV and stakeholders with a robust foundation of knowledge to determine the next best areas of investment in relation to seasonal climate forecasts.

3. Methodology

3.1 Overall project approach

A summary of the overall approach can be outlined as follows:

1

Project initiation phase commenced with a visioning workshop with the stakeholder group to map out a clear and comprehensive list of existing hypotheses. Additional visioning sessions were also held with representatives of The Council of Rural RDCs (CRRDC), Grains Research and Development Corporation (GRDC) and the Bureau of Meteorology (BOM).

As part of this initiation phase, Quantum undertook desk research by reviewing existing research and additional inputs from the MCV project team to ensure the project builds on existing knowledge.

2

Qualitative fieldwork was a series of one-on-one in-depth interviews with Australian producers. A disciplined approach was taken with recruitment to ensure research outcomes are reliable reflection of the target audiences.

Table 1 Qualitative methodology summary

Qualitative methodology summary	
	32 in-depth interviews: 9 face-to-face, 23 video conference or phone calls
	Interviews took place between 15 – 29th March 2021
	60 minute one-on-one discussion
	Each producer was provided a $150 giftpay card as a thank-you for their time

3

The qualitative findings were used to assist in crafting the quantitative survey questionnaire. The survey was administered predominantly via Computer Assisted Telephone Interviewing (CATI) with farmers drawn from purchased lists (n=406), with a small number of additional surveys (n=20) completed online through an email link sent via Sugar Research Australia and Cotton Research and Development Corporation (CRDC).

The average telephone interview length was approximately 18 minutes. Respondents were not offered an incentive for completion of the survey.

A total of n=426 interviews were completed, split by industry as per Table 2. The data was weighted to ABS statistics to ensure representativeness of the relevant industries; all results based on the 'total' reflect this weighted dataset.

Table 2. Sample profile

	Number of completed surveys	Unweighted percentage of sample	Weighted percentage of sample
Livestock	132	31.0%	58.1%
Mixed grain and livestock	101	23.7%	19.6%
Grain	79	18.5%	9.4%
Dairy	48	11.3%	8.3%
Sugar	25	5.9%	3.6%
Cotton	34	8.0%	0.8%
Rice	7	1.6%	0.2%
Total	426	100%	100%

Statistical significance testing at 95% confidence was conducted on the quantitative data, between groups or against the total average as appropriate. It should be noted that rice was represented by only a small number of interviews, and so results for this sector should be considered indicative only.

We have called out any statistically significant differences by sector or region in the results; where these have not been mentioned it should be assumed no such differences exist.

Findings from all phases of the study are included in this report.

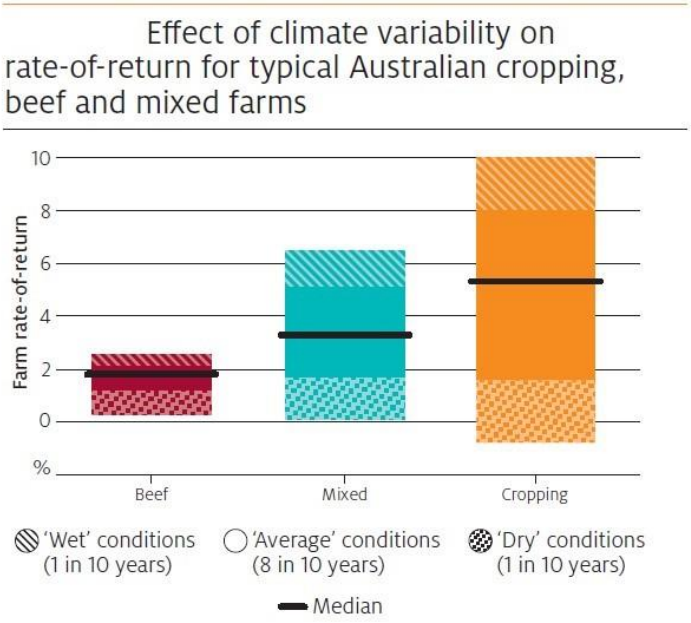
4. Results

4.1 Seasonal Climate Forecasting

4.1.1 Use of seasonal climate forecasting

As outlined in the ABARES insights report[i] the effects of climate on farms are complex and can vary greatly across locations and farm types. The ABARES report shows that cropping farms generally face greater climate risk than beef farms, while mixed-cropping livestock farms sit in-between these extremes (below). There is a trade-off between risk and return: cropping farms face higher risk but also generate higher average returns. It is suggested that improved use of seasonal climate forecasting can help producers improve their planning and in doing so improve output / stability of output, whilst reducing risk.

Figure 1. ABARES report, effect of climate variability on rate-of-return for typical Australian cropping, beef and mixed farms. (ABARES, 2019)



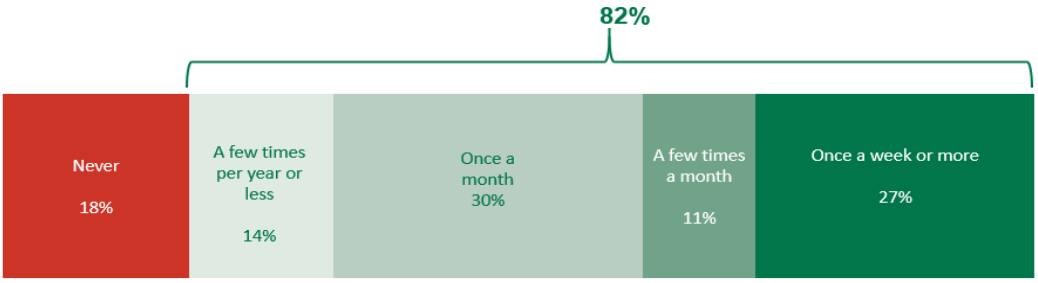
Notes: Farm rate of return is defined as profit at full equity (farm business profit less financing costs) relative to total capital holdings. Farm business profit is calculated at market prices for all inputs and outputs, including unpaid family labour, as well as changes in the value of stocks. Results are for average cropping specialist, mixed-cropping livestock and beef farms (farms with average characteristics: land area, capital holdings etc. for their industry). Based on model simulation results for current Australian farms and current commodity prices (2015–16 to 2017–18) and historical climate conditions (1949–50 to 2018–19).
Source: ABARES *farmpredict*

This study shows that four out of five Australian producers (82%) use a seasonal climate forecast, with most (65%) looking at least once a month.

Figure 2. Use of 3-month seasonal climate forecast

Q.9. How often do you look at the following types of weather forecast? (3-month climate forecast)

(Base: All respondents, n=426)



However, qualitatively, it is clear that use of and familiarity with seasonal climate forecasting terminology and associated weather events like La Niña is inconsistent across producers. Some producers can talk knowledgably about the different models and sources and to some degree the implications of these, others less so.

There is an opportunity to help producers maximise the value they get from forecasts. As most (82%) are already engaging with a seasonal climate forecast, the job to be done is not increasing awareness and driving 'traffic', but rather ensuring producers get value from the interactions they are having.

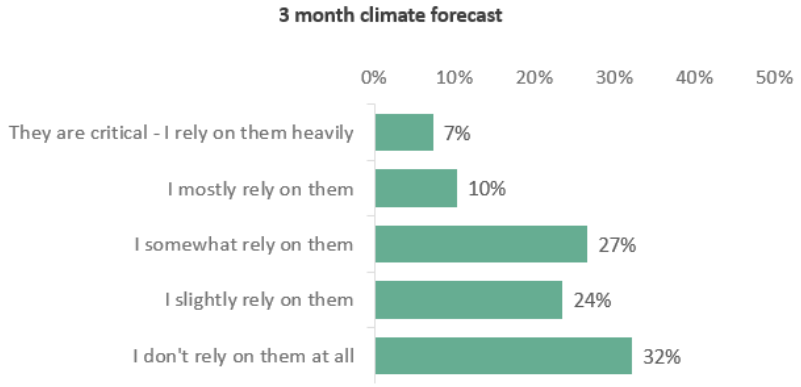
4.1.2 Reliance on Seasonal Climate Forecasting

At an overall level, there is a gap in the perceived reliability of seasonal climate forecast (SCF) information, with one in five (20%), feeling they are not at all reliable, and most (42%), feeling they are only slightly reliable. Moreover, in terms of usefulness and utility, one in three (32%) say they don't rely on the SCF at all.

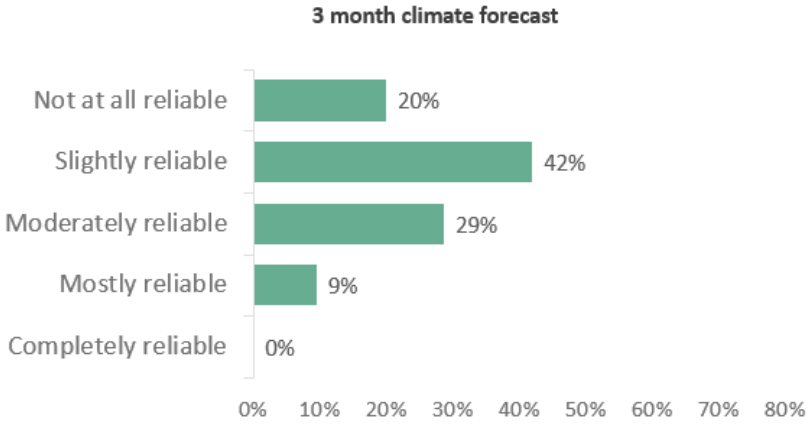
(Ways of improving confidence and utility of forecast is explored in following sections).

Figure 3. Use of SCF v perceptions of reliability

Q.11. In general, how useful do you feel the forecasts you look at are to you? (3 month climate forecast)
(Base: All respondents, n=426)



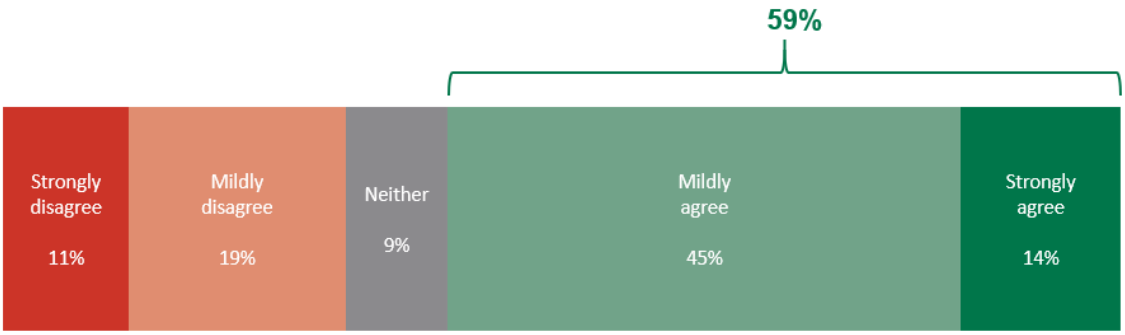
Q.12. And overall, how reliable do you feel the following types of weather forecasts are? (3 month climate forecast)
(Base: Respondents who have ever used each of the forecast types, n=355)



Encouragingly though, three in five (59%) of producers agree that seasonal climate forecasting has improved over the last twenty years.

Figure 4. % Agree seasonal climate forecast has improved in the last twenty years

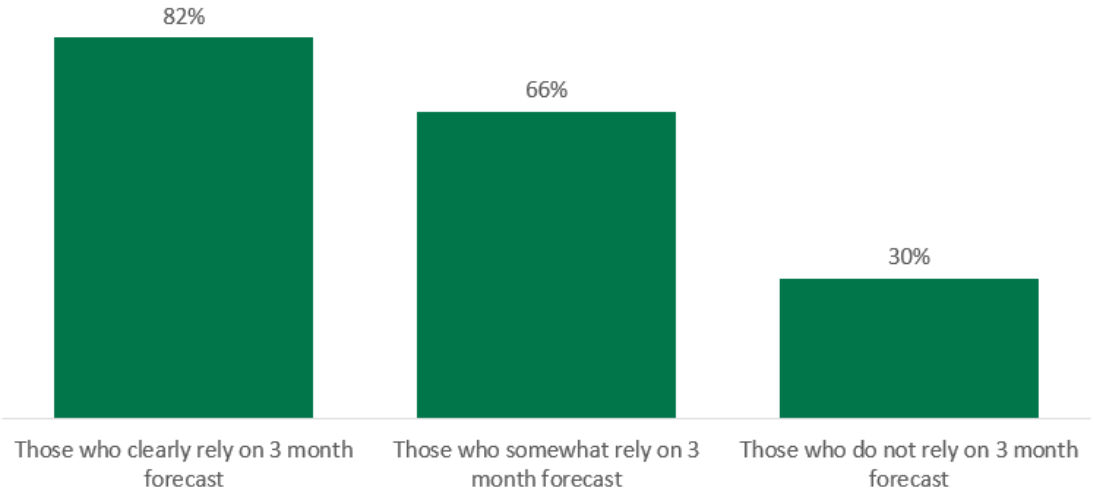
Q.7. To what extent do you agree… "Seasonal climate forecasts have improved a lot over the last 20 years"? (Base: All respondents, n=426)



Producers' perceptions of seasonal climate forecast improvement correlate with the extent to which they rely on the forecasts to inform their decision making.

Figure 5. Usefulness of forecasts

Q.11. In general, how useful do you feel the forecasts you look at are to you? (3 month climate forecast)



Perceptions of improvement in the forecast lead to greater use and utility for producers. Demonstrating continuous improvement not only improves utility, but builds producer confidence in the SCF, and confidence has a key role to play in making use of the information provided.

4.1.3 Seasonal Climate Forecasting decision-making impact

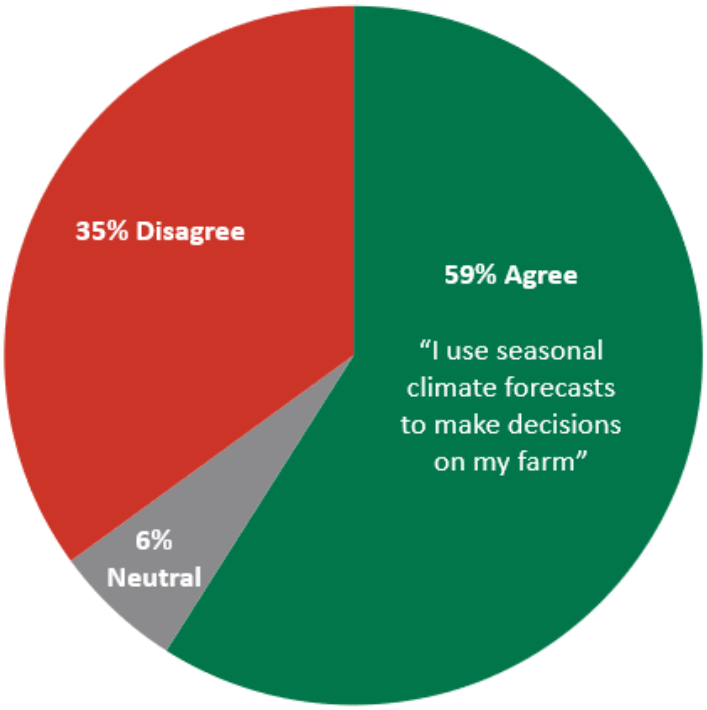
While the majority (82%) of producers are accessing a seasonal climate forecast, only half (59%) are using this information to make a decision on-farm. It is the higher turnover farms who are indicatively more likely to agree that they are using the SCF to make decisions. All the farms with a turnover >$25million included in this study (n=4) agreed they are using SCF to make decisions.

How to engage smaller farms with SCF is an important consideration, as the ABARES report shows, it is small farms that are much more likely to experience low cash income and negative profits in drought years. Larger farms are, by comparison, more resilient.

Figure 6. Use of seasonal climate forecasts

Q.7. To what extent do you agree… "I use seasonal climate forecasts to make decisions on my farm"?

(Base: All respondents, n=426)

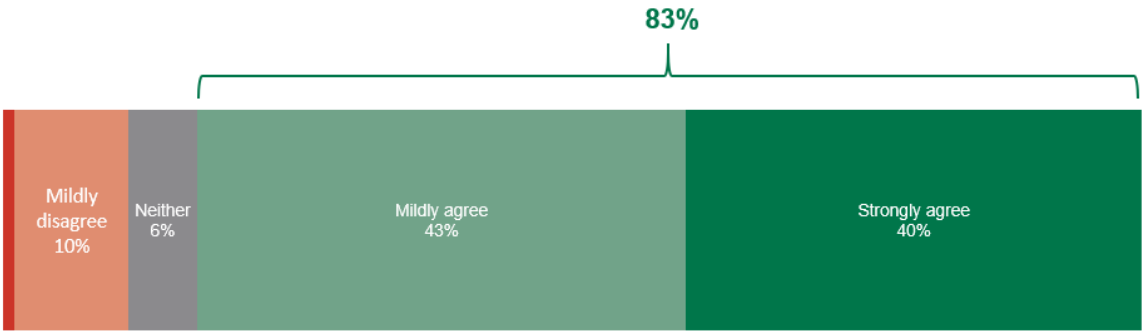


While producers may *review* the SCF, measures closer to home like soil moisture profile, water levels and short-term forecasts are the triggers for significant decisions. The majority (83%) of producers agree that current conditions have a '*greater impact on my decision making than do seasonal climate forecasts'.*

Figure 7. Current conditions have a greater impact on decision making

Q.7. To what extent do you agree… "The current conditions on my farm (e.g. soil moisture, water levels, etc.) have a greater impact on my decision making than do seasonal climate forecasts"

(Base: All respondents, n=426)



"Forecasts are like reading the news. You take it on-board… but decisions are made in real-time with other information to hand."

Grain producer, WA

"Seasonal forecast chat pops up everywhere. It may be things that would be of value – like what is the % rain increase over normal. But when you get burned a few years through drought -it's hard to put your eggs in that basket. I'm now making decisions on my soil moisture profile. Do I take their word for it that it will be another wet summer? Or do I take the bird in hand and plant winter? Bird in the hand.**"**

Cotton producer, Northern NSW

"We have moisture monitoring probes. We set them up in the driest part so it gives you a definite start date. You know how many days it will take you to get to that point and you can work backwards. That is what is helping us plan, not any forecast."

Sugar producer, Coastal QLD

With a sense of increased unpredictability in the patterns of the year, and with innovations in other areas of farming, it appears producers are conservative when it comes to making changes based on predicted climate conditions. They are instead focusing on areas they can more easily measure and control as levers for increasing yield and profitability. For example, crop types, diversification of revenue, and investing in on-farm measurements such as soil profiles.

Qualitatively, it seems *direct* decisions from SCF information are limited. SCF acts as something of a confidence booster. Producers will make lower-risk or 'partial' decisions based on the information. A producer may bring forward a decided upon action or start the preparation for a course of action in readiness for more near-term information to 'pull the trigger'.

> "Climate forecast is a confirmation for a decision I've already taken based on banked moisture."
>
> ***Grain producer, Northern NSW***

(It should be noted that at the time of interviewing, most producers were coming out of good season, anticipating another good season, so reflections on the SCF tended to be about what changes in a year with good rainfall).

Examples of preparation informed by SCF

- A rice producer prepares the maximum number of rice paddocks for crop planting expecting a heavier rain season. However, final planting decisions will only be made with more near-term information. Preparations have been made with SCF in the back of their mind, but major commitment (to plant) is only taken if medium to near term forecast supports this.

- A cotton producer maintains plans to plant at less than full soil moisture profile, this is always the default position and unlikely to change based on SCF. However, the producer feels more confident in the decision to plant, given a La Niña year prediction.

- A grain producer brings forward the purchase of an extra harvester with the prediction of a La Niña year in order to get crop off more quickly.

> "We didn't want to lose the crop so we purchase extra equipment a bit earlier than planned. If it's a wet harvest you need to maximise the efficiency of harvest. Anything that impacts on the speed is beneficial."
>
> ***Grain producer, North West VIC***

Examples of early action informed by SCF

There are instances across some sectors where action needs to be taken earlier than desired. When that is the case, producers feel they are taking a 'gamble' on what to do. And like gambling, sometimes this pays off, other times not. This need to take 'a punt', as one describes it, is more prevalent in sectors such as grain and sugar where there are some commitments that need to be made early.

Examples given:

- A grain producer must commit to a chemical purchase. However, the risk is managed by purchasing expensive chemical in a year when more rainfall is forecast. Cheaper chemical mixes are on-hand for 'bad years'.

> "When there's more rain forecast we go a more expensive chemical group to ensure we can then use cheaper mixes in a bad year without building resistance. Likewise, we scale fertiliser input costs up / down depending on what we think is coming."
>
> ***Grain producer, WA***

- A sugar producer needs to commit to a harvest schedule that enables them to access all fields. If heavy rain comes, then fields that are prone to flooding need to be harvested first, however this compromises yield.

> "We have to look at the forecast for June to December to make a harvest plan. We need to be harvesting in wettest part of fields first to get ahead of the rain. But sometimes that means it's the right time to harvest field but not the right time for the crops that are there. This can impact yield negatively, but we have to make the plans based on the info we have."
>
> ***Sugar producer, Coastal QLD***

Effectively the SCF enables producers to act more decisively on the medium to short-term information, rather than producers making firm plans or major commitments (like changing crop plans or selling livestock) based on the SCF. (See Appendix for an outline of the major decisions made by sector).

4.1.4 Producer relationship with Seasonal Climate Forecasting

Confidence, risk-taking and caution

Producers who have been in severe and prolonged drought (e.g. Northern NSW, parts of QLD) are increasingly sensitive about forecasts, particularly longer-term ones. There is an emotional toll taken watching forecasts when they don't see anything positive on the horizon. And an even greater emotional toll of the promise of things on the horizon that do not eventuate.

An act of self-preservation, there is less inclination to rely on the forecasts, particularly longer-term ones. For some this has even meant reducing their exposure to the forecasts.

Even if the forecasts indicate positive trends (i.e. rain), these producers describe an increased aversion to risk and a lack of confidence in the information. There is a tension here given the pressure they feel to maximise the good years to make up for losses over the last 4-5 years.

There is reflection from some producers that had they acted on La Niña they may have been able to get an extra crop rotation in (winter cereals). But the potential risk (financial and emotional) outweighs the reward. This trend is countered by others who are glad they didn't act on the expectation of more rainfall, finding the rain came too late or too light to be of impact.

Additionally, producers have a long memory when it comes to decisions taken based on forecasts that didn't work out. Negative experiences linger longer than positive ones, and shape future choices. There is reduced confidence to act on forecast information regardless of being informed of any accuracy improvements.

Overall, two thirds (61%) of producers feel seasonal climate forecasts are too unreliable to pay attention to. So, while they clearly in the habit of interacting with the forecasts, there is a gap in confidence.

Figure 8. % Agree SCF are too unreliable

Q.7. To what extent do you agree… "Seasonal climate forecasts are too unreliable to pay attention to"

(Base: All respondents, n=426*)*

Three quarters (77%) of those who disagreed that they use seasonal climate forecasts to make decisions on their farm, also went on to agree that forecasts are too unreliable to pay attention to. The livestock sector is significantly less likely to agree that seasonal climate forecasts are too unreliable to pay attention to (54% agree overall; 56% beef / 37% sheep, compared to 70% of those across other sectors). This may be due to the sector's lower risk profile (see figure 2).

> "Given the rain we've had, I could have put in the extra crop. But what if the rain hadn't come and we'd planted? That would have been worse. I'm not inclined to take those risks now, we've been through too much."
>
> ***Cotton producer, Northern NSW***

> "There was so much talk of La Niña and how much rain we were going to get. But I didn't change anything. And I'm glad I didn't take notice because we didn't get that much rain, and what we did get was too late to make a difference."
>
> ***Sugar producer, Coastal QLD***

> "We tried using the long-range forecast to inform decisions, but we stopped doing that 10 years ago after too many disheartening outcomes. Instead we make conservative decisions like choosing crops which are more forgiving to poorer seasons. For example, using short season wheat which allows me to wait until the season has already banked some rain."
>
> ***Mixed (Livestock and Grain) Producer, WA***

> "Last year they said we'd have spring rain, so we put out our nitrogen in August but the rain didn't come until October which was too late. So, we used all that chemical unnecessarily… it does make you question whether you should bother with the forecast again."
>
> ***Grain Producer, North West VIC***

Increasing number of sources

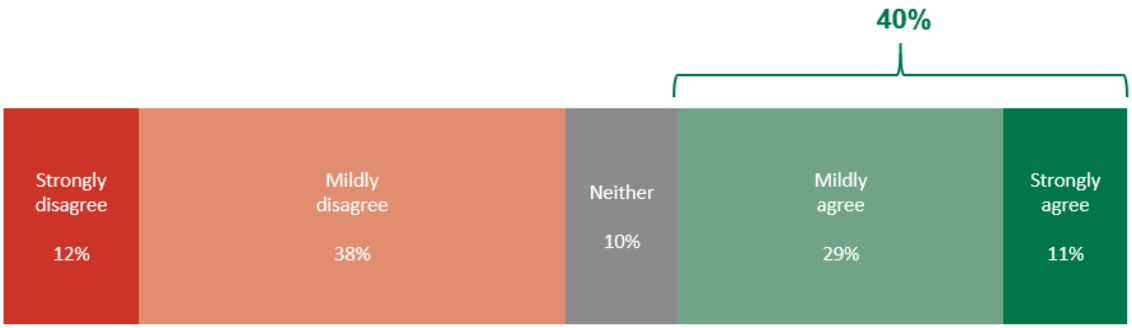
Producers feel they have had increasing access to forecasting information with what feels like a proliferation of weather apps, alerts and websites. These digital sources build on existing sources such as news reports and also intensify industry chatter and conversations with neighbours, suppliers, and peers. Thinking broadly about forecasting sources (both seasonal and short-term), on average producers are looking at 3.6 separate sources across all forecast types; the highest number of sources used by any one producer being 17.

While looking at weather has become habitual (sometimes productive, sometimes not), some are starting to feel overwhelmed by the information available. **Grain producers are more likely than other sectors that they feel overwhelmed by the range of different sources (44% agree they are overwhelmed, compared to 36% with a livestock operation).** Our observations suggest that those who feel more at-risk can get in the habit of looking at more information in search of helpful or positive information.

Figure 1. % Agree they feel overwhelmed by the volume of SCF available

Q.7. To what extent do you agree… "There are so many different sources of seasonal climate forecasts I get overwhelmed"

(Base: All respondents, n=426)



> "You do get hooked on looking but there is nothing worse than thinking rain will come and it doesn't. So I just discount the forecasts now. We are conservative after the years we've had... and it seems to me that the long-range forecasts are not helpful with our planning."
>
> ***Grain Producer, Northern NSW***

Misinformation and mistrust

With the proliferation of sources and increased access to weather information, there is room for misinformation to spread. This is particularly the case for those who have less reliance on forecasting, as there is less impetus and need to unpick information (i.e. they can afford to be frivolous about unsubstantiated theory).

Compounding this is the potential for misinterpreting the information. All these factors can lead producers to feel they are experiencing increased instances of 'inaccurate' or 'incorrect' forecasts.

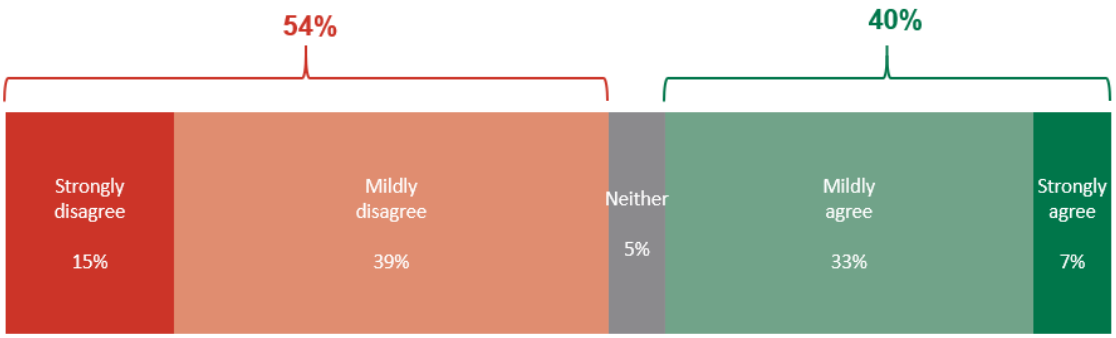
Passive accumulation

SCF information can be passively accumulated by producers through "chatter" with other local producers, their agronomist or consultants, as well as through industry specific programs and literature such as *Landline* on the ABC, or magazines such as *Australian Grain*. Most producers have an understanding of the ENSO weather patterns but generally frame such information as something which is "subconscious" or at the back of their minds rather than a determinant of various decisions.

However, just over half (54%) *disagree* that they *don't* have to make an effort to get SCF information. Indicating that it is important to note that even though there is 'chatter', there are some producers information seeking is a dedicated task. **Creating sources that easily and usefully convey the needed information would reduce the load on producers.**

Figure 20. % Agree SCF is something heard about without having to make too much effort

Q.7. To what extent do you agree "Climate forecasting is something I don't need to look for – I hear/read enough about it without having to make an effort" (Base: All respondents, n=426)



"We consistently get 550-750mm and there's never been a drought here in my life. The long-range forecast doesn't have much to offer me… I look at it mainly for interests' sake. To some extent, you can't avoid it. The SCF comes up on TV and in passing conversation."

Livestock producer, WA

"I have sources that I turn to… ones I will look up."

Grain producer, North-West, Vic

Checking and double checking

Despite this "subconscious" framing about the type of weather pattern they are in, producers continuously check the seasonal forecast *for* key periods of the year where they may find a "glimmer of hope" if the forecast is favourable. (This should not be confused with *when* producers are checking. E.g. if summer is an important time in their annual cycle, throughout the year they will be keeping an eye on the summer months forecast. See key months by sector in the appendixes.)

If producers see something of interest in their preferred weather report or application, this will prompt a pattern of checking against multiple sources. Astute producers will be consciously checking various models, less astute will simply be checking multiple sources (or even just raising their awareness to sources which are received passively such as chat between neighbours).

Given the cautious nature of producers (which has been reinforced over the drought years), there is a need for reassurance, which they fulfil by checking multiple sources for patterns of consistency. Almost 9 in 10 (87%) say they don't put too much faith in any one forecast, and 7 in 10 (68%) are looking at multiple sources to figure out the weather for the coming 3 months.

Figure 3 % Agree that faith is not put in one SCF alone

Q.7. To what extent do you agree… "When it comes to seasonal climate forecasting, I don't put too much faith in any one forecast" (Base: All respondents, n=426)

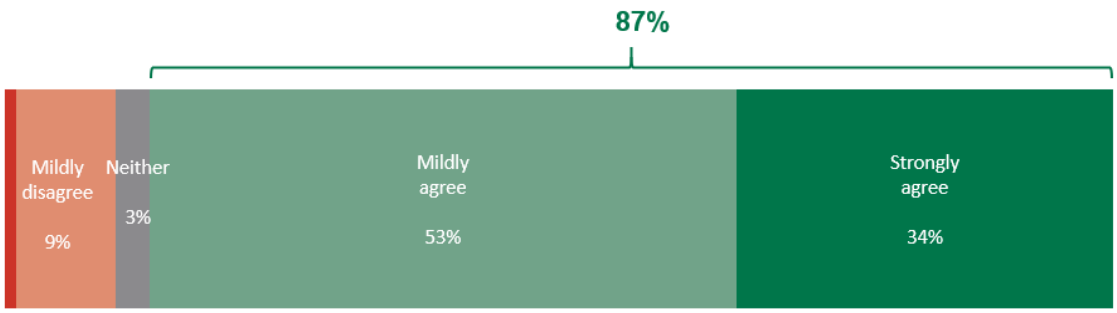


Figure 4. % Agree they check multiple SCF sources

Q.7. To what extent do you agree… "I look at multiple sources of seasonal climate forecasts to work out what the weather over the next 3 months is likely to be" (Base: All respondents, n=426)

Highlighting the importance of water, and hence producer focus on rainfall, it is those in low rainfall areas who are most in the habit of not relying on any one forecast. They are significantly more likely to agree they don't put too much faith in any one forecast (94%, compared with 77% of those in high rainfall areas). Those with irrigated operations are also less likely to agree with this sentiment (71% of those completely irrigated).

> "I take in as many different information sources as I can – it only takes 5 minutes to check multiple sites, but I'm basing big decisions off it. There's up to $5k of feed being cut, so it's very important to get it right. It doesn't hurt to get a second opinion."
>
> ***Dairy producer, NSW***

Producers have a complex relationship with SCF. Weather plays such an important role for producers, but it is not a lever that is within their control. Additionally, there is concern about the reliability of SCF. However, producers are using what is available to them to help reinforce confidence in their choices or look for positive news. To counter concerns of reliability, producers are turning to multiple sources looking for consistencies or contradictions. This though can lead to feeling overwhelmed and can create inertia with producers sticking to the status quo rather than having confidence in the SCF for decision-making.

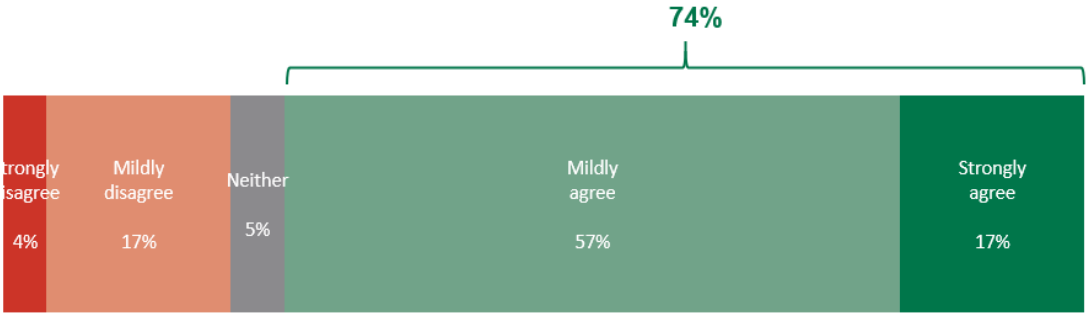
4.1.5 What producers need from an SCF

The value of interpretation

Producers fill many roles in their daily work. From market monitoring and animal management to sales and accounting. The ability to self-educate on the topic of forecasting to a point of sophisticated interpretation of the information is limited, and as one points out, "unlikely to be the best use of my time." **For this reason, producers value sources which distil the available information into relevant insights.**

Figure 13. % Agree SCF interpretation is helpful

Q.7. To what extent do you agree… "A written or verbal interpretation of the seasonal climate forecast is helpful to me" (Base: All respondents, n=426)



"As a farmer I don't need to be a climate scientist, but I need the scientist to tell me what to expect and what this means for me."
Grain producer, North-West VIC

"La Niña and El Niño- it wouldn't hurt to have more interpretation of what these weather indicators mean for me. I think I heard someone say that La Niña meant above average rainfall 60% of the time in the winter months, but I'm not sure. I like Roger Stone he does the climate and long-range forecasting. He has been pretty accurate. He breaks down what the forecast means for our specific area."

Sugar producer, Coastal QLD

Transparency

Producers value matter-of-fact honest voices when it comes to all parts of their business. It makes sense that this is also valued in seasonal climate forecasting, which all producers see as currently impossible to accurately predict. For this reason, there is value in weather sources which don't just present forecasts that could be either accurate or inaccurate, but also deliver commentary about the forecast which are framed as estimations and suggestions.

Producers prefer transparency over what they perceive to be presentations of 'false accuracy'. Information that is presented with clear caveats such as 'this suggests' or probability of accuracy are preferred.

> "Karl Ljirndis does the weather on news. He just says it how it is. He uses phrases like 'wide range'. And he is matter-of-fact about the flack."
>
> ***Livestock producer, South West VIC***

Long-term patterns

In an ideal situation, producers would have an understanding of when prolonged and continued years of dry/ changed conditions are ahead. While forecasts that look so far ahead are not an expectation as producers appreciate that there are limitations (and hence it is not something they request), it is clear that long-term weather trends do impact on major decisions such as land investment, succession planning and even choice of sector.

Producers talk about how 'usual' or 'regular' patterns have shifted or cannot be relied on as they once were. There is a sense that agribusinesses can make it through a short period (i.e. one to two years) of 'off' conditions, but past this, poor seasonal weather has much broader implications.

> "My dad's generation used to plant 1st March. Now often the soil temperatures are too warm to plant until April. It's something we have to monitor."
>
> ***Dairy producer, NSW***

> "This year has been better, but we are only just making up for the four years of drought. You have to think we are due for some good years, but it's hard to know these days if it will be good."
>
> ***Cotton producer, Northern NSW***

Significant changes in local weather

For some producers, there is value in the SCF, whether it is showing anticipated patterns or not. Producers who agree they are using SCF to make decisions are more likely to disagree that the information is only useful when it suggests a significant change, reflecting that these producers are finding value in the SCF in a way that those who are as yet less engaged are not (47% disagree that climate forecasts are only of use when they suggest a significant change).

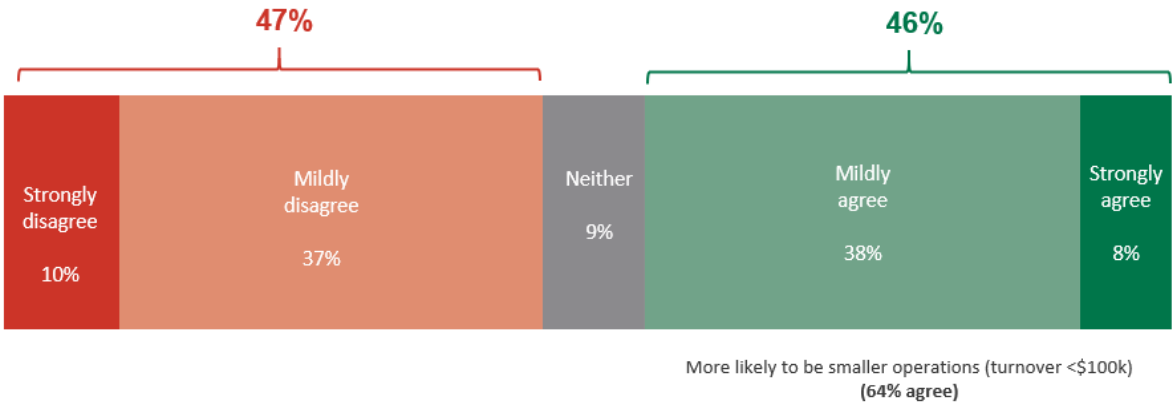
Around half of producers (46%) are only interested in the seasonal climate forecast when it runs contrary to the conditions seen at decision-making times (e.g. pasture is good at first sale window but forecast suggests dry conditions ahead or soil has moisture at sewing time but forecast is for dry season).

Those with the smallest operations (turnover <$100,000) are significantly more likely to agree that climate forecasts are only of interest when they suggest a significant change in local weather (64%, compared with 41% of larger operations). This may be driven by larger operators having greater ability to both monitor and react to the SCF, whereas smaller operators may only have the capacity to identify and respond to significant shifts.

Pushing out an alert at times when there are changes from the expected / norm may be helpful to smaller operators who may be less regularly engaging with SCF, as this is the time when they identify it is of most value to them.

Figure 14. % Agree SCF is only of interest when it suggests a change from the norm

Q.7. To what extent do you agree… "Climate forecasts are only of interest to me when they suggest a significant change in local weather"
(Base: All respondents, n=426)



"I'm not really looking at much longer-term stuff. I hear reports on *Landline* or ABC radio about what they think is coming. If it's interesting [different from normal] I might look it up, but that's about the extent of it."

Dairy producer, South East VIC

Timings

Overall, there is an even spread across the year when producers indicate that the SCF is important. While not statistically significant, winter is directionally less important than other seasons.

Overall, while producers suggest they are not regularly reviewing SCF (44% look at it once a month or less), these results are unable to definitively suggest when the SCF could have less of a focus.

That being said, qualitatively, producers suggest that knowing when a preferred source has been updated (e.g. Cane Growers fortnightly report), can help in minimising time spent looking as information is pushed out on a known timetable. Consistency in timing of important updates can also build in more regular interaction with a forecast.

Table 3. Months when seasonal forecasts are most important

Q.10. Please indicate which months of the year when the following weather forecasts are most important to you for decision-making? (Multiple selection) Shaded columns indicate a figure that is statistically significantly higher than the non-shaded columns.

(Base: All respondents, n=426)

%	Current day's weather	4 – 7 day weather	3-month climate forecast
January	18%	17%	13%
February	15%	15%	15%
March	19%	19%	21%
April	28%	24%	17%
May	22%	22%	13%
June	11%	11%	8%
July	7%	7%	6%
August	8%	7%	8%
September	17%	19%	12%
October	24%	24%	11%
November	28%	24%	12%
December	23%	22%	12%
This type of forecast is useful to me all year round	39%	39%	27%
I don't use this type of forecast for decision-making	4%	5%	29%

4.1.6 Recommendations: Improving utility of Seasonal Climate Forecasts

Summarised and interpreted information

- SCF information that is summarised and interpreted by a trustworthy source is of the most benefit to producers.

Industry specific information

- Sources that concentrate on nominated sectors and can outline what a forecast means to specific producers are highly valued and add a layer of credibility and trust.
- Localised interpretation by experts within a region (i.e. not necessarily sector specific) is also of value.
- Work with intermediaries such as: The Break; The CottonInfo Moisture Manager; Jon Welsh monthly report; Cane Growers fortnightly report from Roger Stone; SunRice (customer); sources used by agronomists who are a trusted advisor. *(This is not an exhaustive list, simply the examples given by qualitative participants.)*

Be clear about limitations

- Being clear about the limitations of the information, outlining how it has been arrived at and degree of forecast confidence helps give a source credibility. Producers, across all aspects of their business, tend to be matter-of-fact and value this same 'matter-of-factness' in information provided to them. They place more assurance in a forecast which expresses confidence in terms of a percentage likelihood.

A focus on rainfall and difference from 'the norm'

- Rainfall is by far the most valued longer-term information across all sectors, in particular whether it will be a drier or wetter year ahead, and if conditions will be sustained.

Highlighting consistency between sources

- Highlighting consistency between multiple models will fulfil a user need and mirror current behaviours.
- Seasonal forecasts that take into consideration multiple forecasting models and can provide a range of possibilities for the longer-term outlook are of interest to producers. Producer perception that any one model is highly likely to be inaccurate at such a long range, increases interest in comparing the predictions and looking for consistencies.

Graphical representation

- Maps provide a quick and efficient way to review information on seasonal trends.

Push notifications at times of key shifts

- To minimise producer effort needed to seek out the most relevant information, notifying producers (in particular smaller producers) in shifts from the norm would be useful.

4.2 Producers and short-term forecasting

4.2.1 Relationship

Checking the weather is built into the pattern of a producer's day. It dictates the schedule of the week, day and even hour as given the nature of farming, weather impacts almost every task. Short-term forecasts are seen as a tool of the job. That the weather is checked every day is a given across all regions and sectors. Prevailing conditions dictate the daily plan, as well as acting as a trigger for the bigger decisions, such as applying chemicals or planting.

> "I like looking at the BOM rain radar in real-time. I plan when I can do my maintenance and when to stay indoors."
>
> ***Livestock producer, NSW***

Table 4 Frequency of using different types of weather forecast

Q.9. How often do you look at the following types of weather forecast? Shaded columns indicate a figure that is statistically significantly higher than the non-shaded columns. (Base: All respondents, n=426)

Column %	Current day's weather forecast	4 – 7 day weather forecast
Multiple times a day	26%	15%
Once a day	45%	42%
Once every 2-3 days	18%	20%
Once or twice a week	9%	18%
A few times per month	1%	1%
Once a month	0%	2%
A few times per year	0%	0%
Once a year	0%	0%
Less often than once a year	0%	0%
Never	2%	2%

Rainfall is still 'king' in short-term forecasts, as it is in SCF, but temperatures and wind also become important for activities such as spraying, livestock movement and irrigating.

> "Wind becomes really important. You don't want to be spraying out the neighbours."
>
> ***Grain producer, North West VIC***

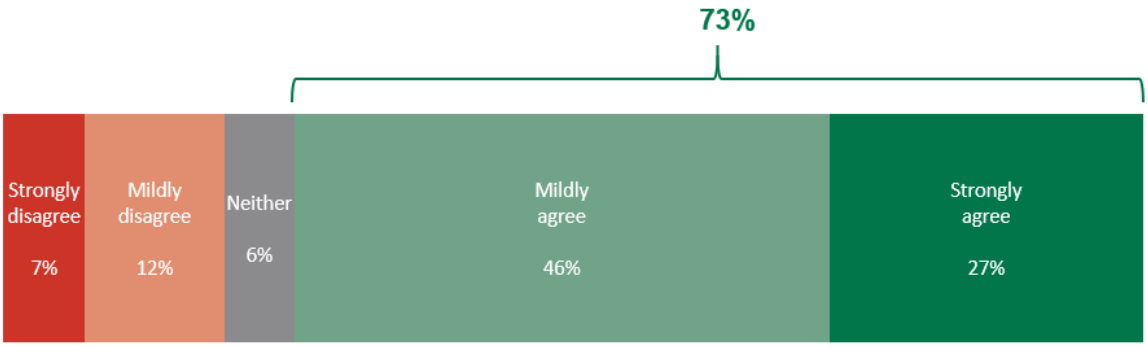
4.2.2 Reliance and reliability

The majority (73%) of producers agree that short-term forecasts have improved over the last twenty years.

Figure 15. % Agree short term weather forecast has improved in the last twenty years

Q.5. To what extent do you agree…"Weather forecasts have improved a lot over the last 20 years"

(Base: All respondents, n=426)

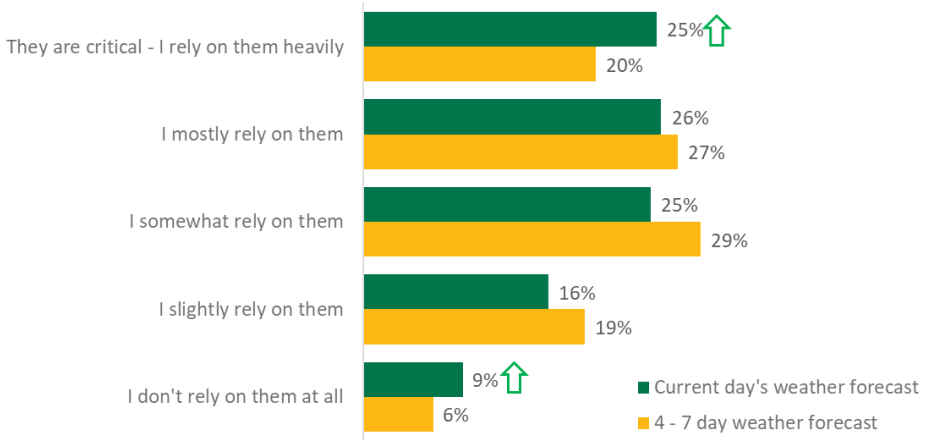


And in contrast to SCF, the short-term forecasts are seen as more reliable and are more relied upon. They play a key role in decision-making across sectors.

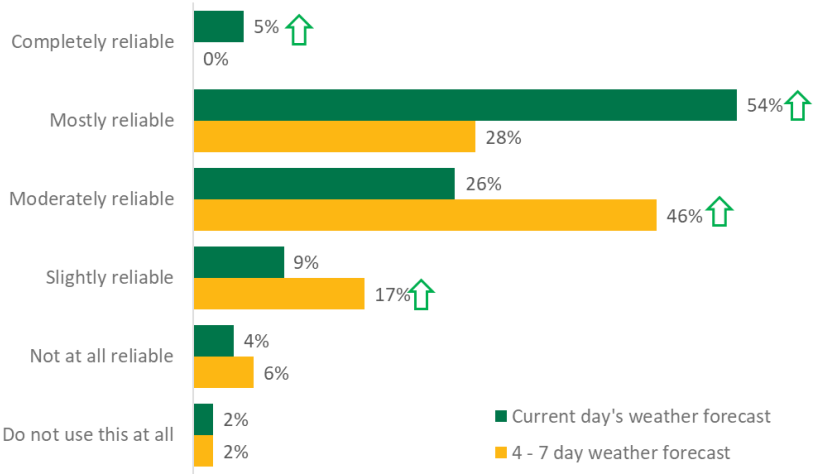
Figure 16. Use of short-term forecasts v perceptions of reliability

Q.11. In general, how useful do you feel the forecasts you look at are to you? (Current day, 4-7 days)

(Base: All respondents, n=426)



Q.12. And overall, how reliable do you feel the following types of weather forecasts are? (Current day, 4-7 days) (Base: Respondents who have ever used each of the forecast types)



Not surprisingly, the more immediate the forecast, the greater reliability it is perceived to have. However, that the 4-7 day and moreover the current day forecasts are seen by some as only 'moderately reliable' indicates there is room for improvement.

There is still a degree of cynicism around the short-term forecast. Producers employ a similar pattern of behaviours with the short-term forecasts as seen with the SCF, in that they are looking at multiple sources for alignment. Cynicism is driven by multiple forces, including changeability of forecasts from day to day, historic observations about how actual weather on farm compared to forecast, and the wide variability across a small region.

> "We like to joke that there must be a day shift and night shift at the BOM, and they don't talk to each other. That's why it can look so different each time you check."
>
> ***Cotton producer, Southern QLD***

> "I don't really think about making plans to move the herd to a shaded paddock unless I see a pattern of hot days, the forecast for a single day is not reliable enough."
>
> ***Dairy producer, South East VIC***

> "There might be 30mm difference between my farm and the place on the ridge. It just varies so much even with a few kilometres. That can be frustrating. You have to find a way to calculate what the forecast might mean for you – like I always look and think well it will be about 20mm less on my property than what they say."
>
> ***Dairy producer, South East VIC***

4.2.3 Checking and double checking - rainfall

Given the importance of rain, if an event is shown on a producer's go-to forecast, they will confirm information by looking for alignment across multiple sources. They will monitor an event over time, checking back periodically, expecting that the more immediate the forecast, the more likely it is to be reliable. The more astute producers will consciously check sources that draw from various models.

"The rain arrives here very suddenly. We use the BOM to track that weeks out. Once we know it's coming there's a lot to do to get everyone out [before roads are cut off], and get the plant cleaned down and stored safely."

Livestock producer, WA

"MetEye tends to be really conservative. There's no good predicting rain if you're going to be so conservative that you're not giving the confirmation until it's already falling. Elders probably goes the other way and is optimistic. I take a balance of the two."

Mixed (Livestock and Grain) Producer, WA

Like SCF, short-term forecasts are also treated with caution and producers seek trends across sources and days to give them confidence. There is also a pattern of applying a personal lens to forecast information, with producers having worked out their own system of calculating what forecast will mean on their farm.

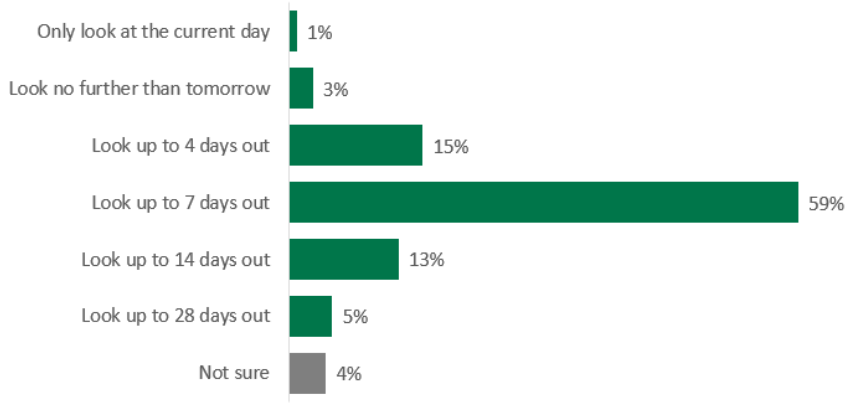
4.2.4 What producers need from a short-term forecast

7-day focus

Producers need to be planning tasks out ahead of time, and largely, they are looking at about seven days, and at times fourteen days out. Victorian producers are significantly less likely to look fourteen days out as standard practice when using a short-term weather forecast. The majority of Victorian producers (88%) only look up to 7 days (compared to 72% of other producers). Qualitatively, Victorian producers suggest less variability in their weather patterns, perhaps explaining the reduced need to look further ahead.

Figure 175. Typical short-term weather forecast usage

Q.6. When you are looking at a short-term weather forecast, how far out do you usually look? (Base: All respondents, n=426)



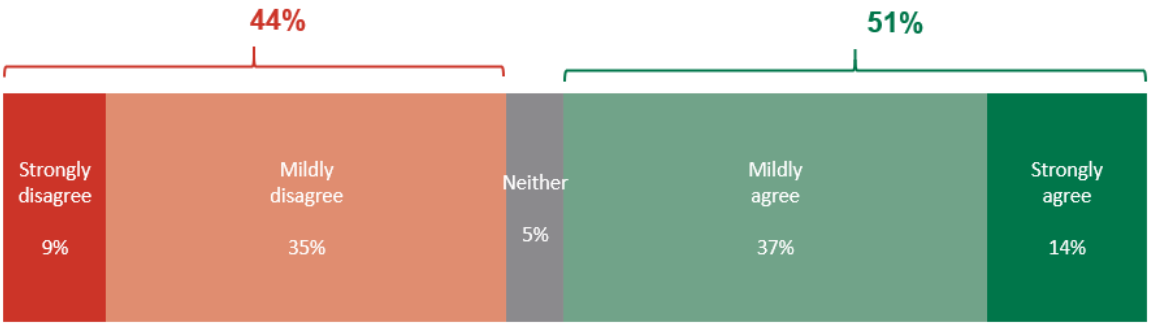
> "I need it to go out to 14 days. Some of our decision we need more than just a week – like 10 days. I'm aware that accuracy falls off but because I need to see a pattern of days. Some of the jobs can take 5 to 7 days."
>
> ***Sugar producer, Coastal QLD***

4.2.5 Localised information

About half (51%) of producers feel that weather forecasts are not localised enough to be useful.

Figure 18. % Agree weather forecasts for my region are not localised enough

Q.5. To what extent do you agree…" "The weather forecasts for my region aren't localised enough to be useful to me"
(Base: All respondents, n=426)

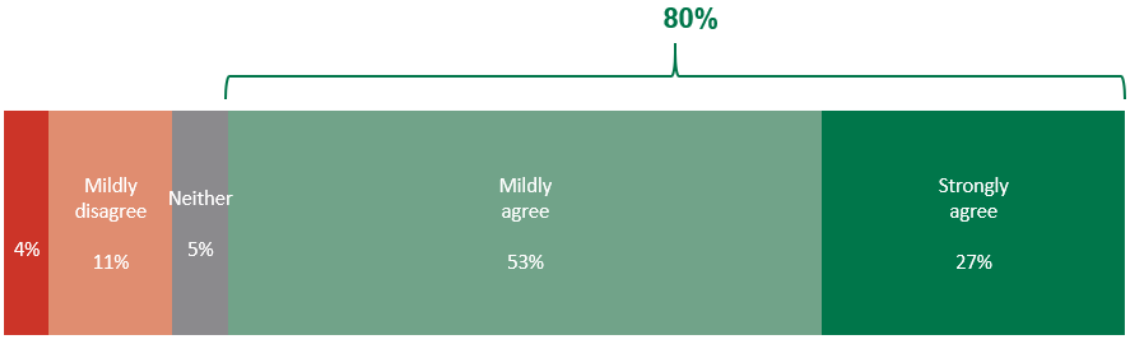


4.2.6 Interpretation

Written and verbal Interpretation adds value to producers, even on the short-term forecasts. Qualitatively, producers are looking to understand what the forecast means for them practically. The forecast information can be technically 'heavy'. Producers value the forecast being made simple to digest, with key information pointed out with clear outlines of what the key information means 'on-the-ground'.

Figure 19. % Agree forecast interpretation is helpful

Q.5. To what extent do you agree… "A written or verbal interpretation of the short-term weather forecast is helpful to me"
(Base: All respondents, n=426)



4.2.7 Timing

Producers indicate some key timing needs, these reflect key activity periods (see appendix for examples of producer annual plans by sector).

Current day's weather forecast: Grain producers more likely than other producers to say April (47%) and May (43%) are important months for the days forecast, while Sugar producers more likely to say in June (56%), July (40%) and August (36%) are important.

4-7 Day weather forecast: Grain producers more likely than other producers to say April (45%) and May (43%) are important, while Sugar producers more likely to say June (40%), July (24%) and August (24%). Livestock producers more likely than other producers to say February is important (21%).

Figure 20. Months when weather forecasts are most important

Q.10. Please indicate which months of the year when the following weather forecasts are most important to you for decision-making? Shaded columns indicate a figure that is significantly higher than the non-shaded columns. (Base: All respondents, n=426)

%	Current day's weather	4 – 7 day weather	3-month climate forecast
January	18%	17%	13%
February	15%	15%	15%
March	19%	19%	21%
April	28%	24%	17%
May	22%	22%	13%
June	11%	11%	8%
July	7%	7%	6%
August	8%	7%	8%
September	17%	19%	12%
October	24%	24%	11%
November	28%	24%	12%
December	23%	22%	12%
This type of forecast is useful to me all year round	39%	39%	27%
I don't use this type of forecast for decision-making	4%	5%	29%

4.2.8 Recommendations: Improving utility of Short-term Forecasts:

The short-term forecast is an essential input to guide producers' workflow. There are a number of ways to optimise the presentation of information to aid producers in better digesting and therefore making good use of this information.

Local information

- Being able to zoom in on specific regions is valued in forecast displays (even if it's a disingenuous minutia, producers at least feel confident they're looking at the best available estimate for their particular footprint).

> "I liked the Elders forecast because it asked for your postcode and then just brought all the local info up."
>
> ***Mixed (Livestock and Grain) Producer, WA***

Specifically call-out variability for a region

- Producers often comment that conditions will vary on their property vs. forecast. Better representation of the degree of variation across regions would help improve producer understanding of the forecast and improve perceived transparency.
- Equipping producers with an understanding of how to interpret a forecast for their specific property given the location and topography would help them better utilise forecast information.

Hyper-local (i.e. on-farm) information

- Producers, particularly in sectors where variability has a more significant impact (e.g. grains), have interest in installing weather stations on their land. They see this as a means to accessing to detailed information regarding current temperature, rainfall, evaporation rates and soil moisture as well as facilitating a way to monitor historical data from which they might infer patterns and projections. This interest was typically framed in relation to the lack of accuracy of local weather stations from which they received their forecasts. Due to the distance between such weather stations, producers were often not confident that the conditions described would transpire on their farm.

Language choice

- Similar to SCF, producers appreciate information that is displayed with transparency.

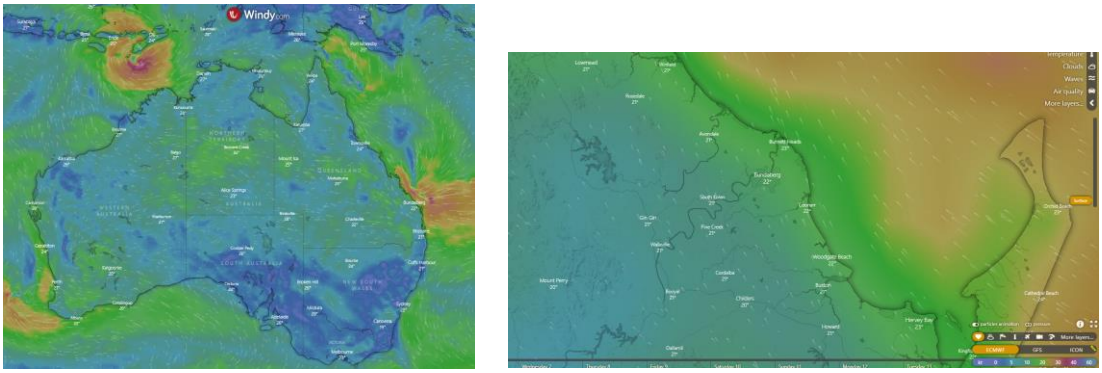
Graphical

- Graphical representations are easy to digest and add value for planning a day. WillyWeather is a good example of graphical presentations of temperature and also wind.

Figure 61. WillyWeather – Graphical Representation from website (WillyWeather 2021)

- **Producers are often looking at map** information and are adept at finding their area (and other areas of interest). Windy is a good example of navigating by map. This app/ site allows producers to zoom right in on a location, which is a useful function leveraging visual navigation.

Figure 22. Windy (Windy 2021)

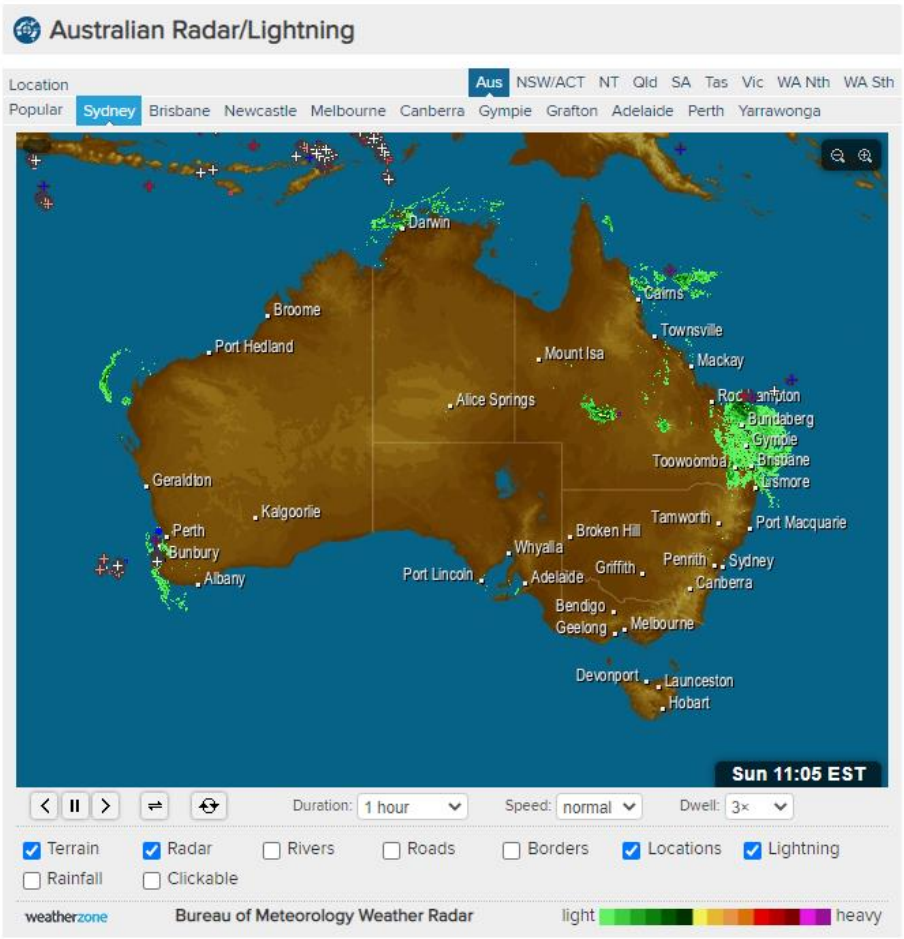


> "I am very visual so I like the Windy app. It also lets me zoom right into our property. I find that, particularly for spray conditions, it's an easier to read representation of what's happening in terms of windspeed and temperature."
>
> ***Grain producer, WA***

> "I prefer to look at a map. I just look at what is happening over my area for rainfall of temperature or whatever."
>
> ***Sugar Producer, Coastal QLD***

- **Colour choice for quick interpretation is key**. Producers feel some are better than others, with Weatherzone an example of good representation.

Figure 7. Weatherzone website map (Weatherzone 2021)



> I mainly look at Weatherzone and WillyWeather. The radar layout on the BOM isn't as good, the colours aren't as clear colours don't work well. WillyWeather is clearest for wind."
>
> ***Grain Producer, North West VIC***

- Displaying direction that weather (rain, storm, wind) is coming from is helpful. Producers can adjust their tasks to suit prevailing conditions. Also, over years of experience they can be aware of differences of impact that storms coming in from different directions will have on their property.

> "On days when there's rain forecast I might keep checking where it is and try to get some jobs done in the dry before it hits. I look at the 512Km one on the BoM app because I know the rain will come in from NW / W so I want to be able to see the coast."
>
> ***Grain producer, WA***

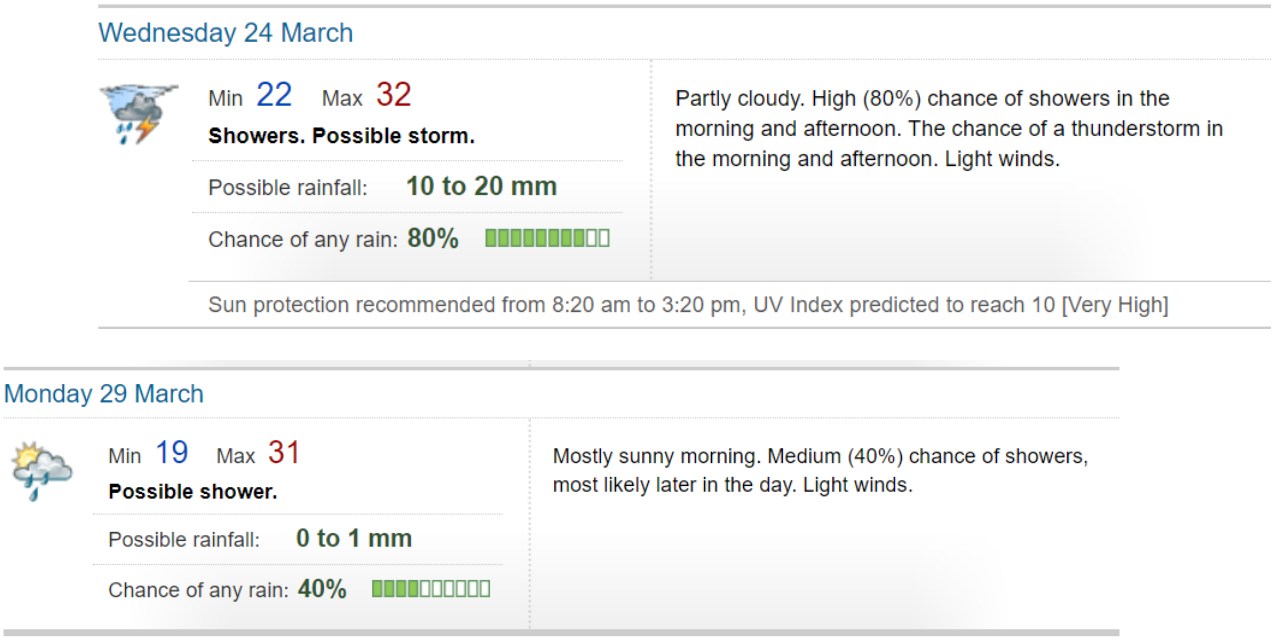
4.2.9 Concise

- Producers are particularly "time poor" and appreciate tools and information sources that make decisions regarding the weather, easier and quicker to make. For this reason, concise information about the current weather conditions, displayed in an engaging graphical way is sought by most producers. An example of this 'done well' is the Willy Weather hourly wind graphic, which producers describe as an exemplary means to represent detailed information in a clear and accessible format. Elders information is felt to be clear, but it's noted that the inclusion of more and more superfluous information and advertising is eroding this clarity with time.

4.2.10 Explain rainfall forecast in plain language

- Interpretation of rain forecasts vary, and producers have come up with their own ways of using the forecast.
- Improving the communication of the rainfall forecast with plain language would help producers to better utilise the information.

Figure 84 – Bureau of Meteorology website extract (BOM 2021)



> "When I see a forecast like Wednesday (above) and it says 80% chance, I think OK we will get some rain. And though it says 10-20mm we won't get that. From my experience, it could be more, or it could be less.
>
> When I see a forecast like Monday, that means I don't even worry about it because it's only 40% and 0 to 1 mm. If it said 40% chance of 40mm? I also wouldn't worry about that. I take note if it's high mm and if the chance is high."
>
> ***Sugar producer, Coastal QLD***

4.2.11 Additional information

- Some producers express interest in weather information regarding frost and evaporation rates, both of which they feel are not adequately accounted for in existing weather apps and forecasts.

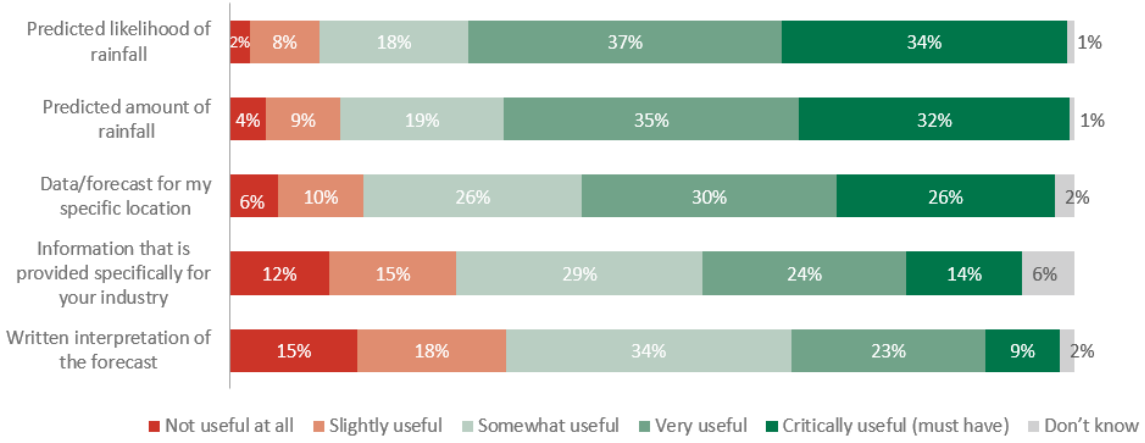
4.2.12 Overall forecast inclusion priorities:

Across all sectors, for both SCF and short-term forecasts it is rain that tops the list for producers in terms of what makes the biggest impact to their bottom line. The importance of rain impacts how producers view the rainfall forecasts. Rain forecasts are under greater scrutiny.

The amount of rainfall is important, but also timing. Traditional windows for planting and harvesting feel to producers to be shifting and they can feel pushed against 'last chance' windows more often.

Figure 9. Perceived usefulness of different elements of a weather forecast

Q.13. How useful are the following aspects of weather and climate forecasts to you?
(Base: All respondents, n=426)

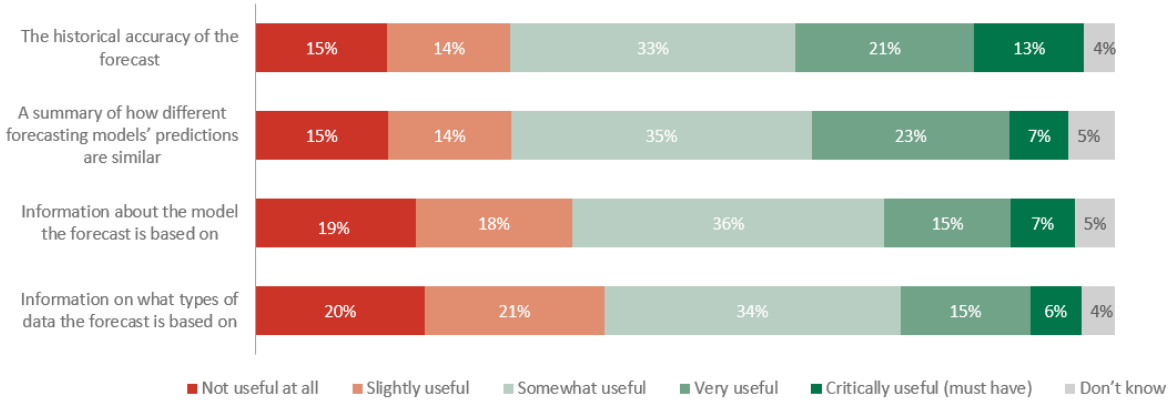


Producers in low rainfall areas (self-identified), are more likely than average to consider predicted likelihood of rainfall as critical/very useful (92%), and more likely than average to consider predicted amount of rainfall as critical/very useful (88%). Across sectors, it is livestock producers who are less likely than average to rate predicted likelihood of rainfall as critical/very useful (64%).

Information that provides background on the model, measures and historical accuracy are important to some, with historical accuracy being the most valued 'other' measure.

Figure 26. Perceived usefulness of different elements of a weather forecast

Q.13. How useful are the following aspects of weather and climate forecasts to you?
(Base: All respondents, n=426)



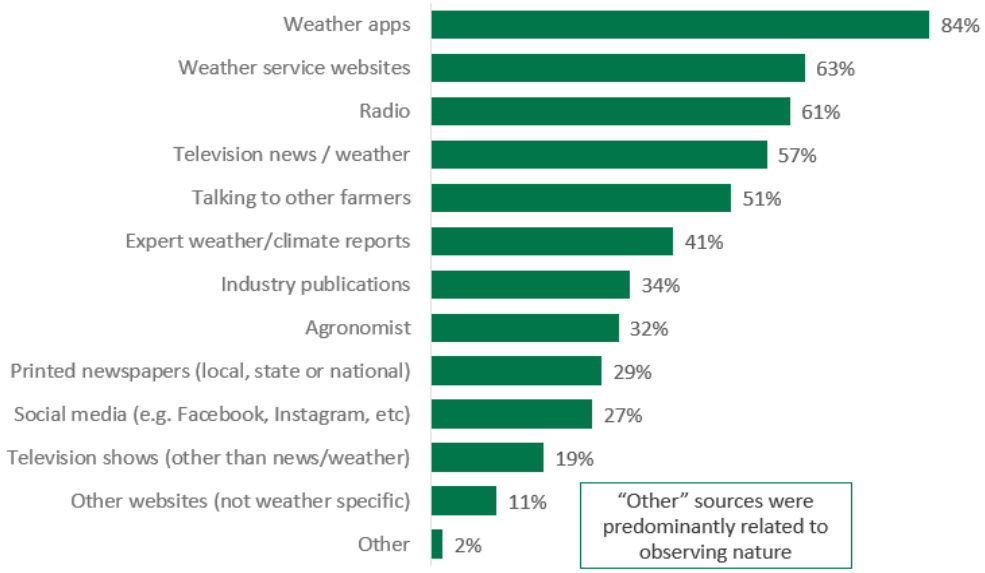
4.3 Forecast sources and Bureau of Meteorology

4.3.1 Sources

Aside from Landline and industry related magazines and people, producers are using a variety of digital sources to review forecasts. Most commonly, producers are reading longer term projections on their daily weather apps (i.e. BOM, Elders, YR, Weatherzone – links to the websites are in the reference section); from which they can get a "general sense" of how the immediate weather relates to longer term forecasts. Some astute producers are also looking at websites such as meteologix.com which displays the various global climate models.

Figure 2710. Types of weather information sources

Q.8. What sources do you use to get weather information (either short term weather or seasonal climate information)?
(Base: All respondents, n=426)



42% of producers are currently using an offline source, compared to 95% currently using an online source. The most common offline sources being traditional TV news and radio.

The most common online sources were BOM, Elders, Weatherzone and YR. Producers often have multiple iPhone and iPad weather apps which they switch between on a daily basis. Indeed, many producers describe particular preferences for which apps and websites they use for various elements of the short-term forecast. Producers tend to get accustomed to certain sources and how to read them. Familiarity can determine the go to source.

Figure 28. Sources of weather forecasting information - offline

Q.8.a And which weather forecasting services brands have you actually used (e.g. the site or app name)? Q.8.b And which of those weather forecasting services do you currently use? (Base: All respondents, n=426)

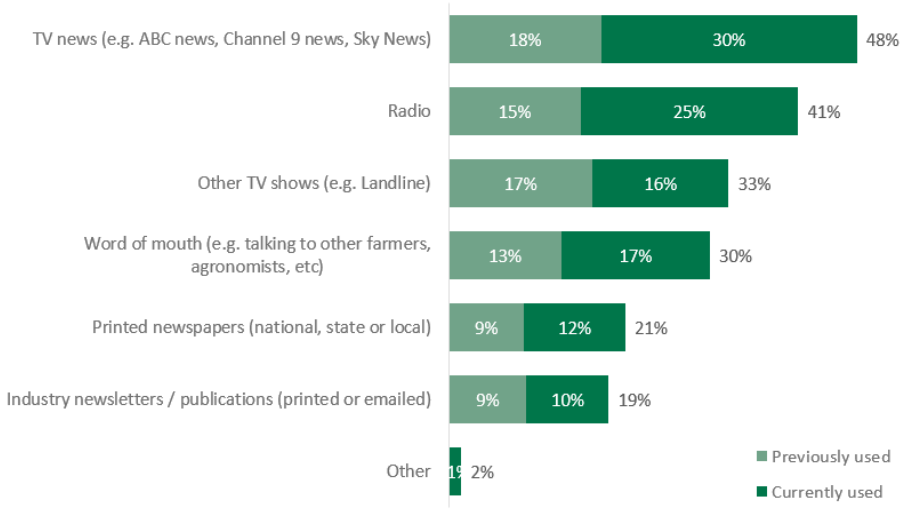
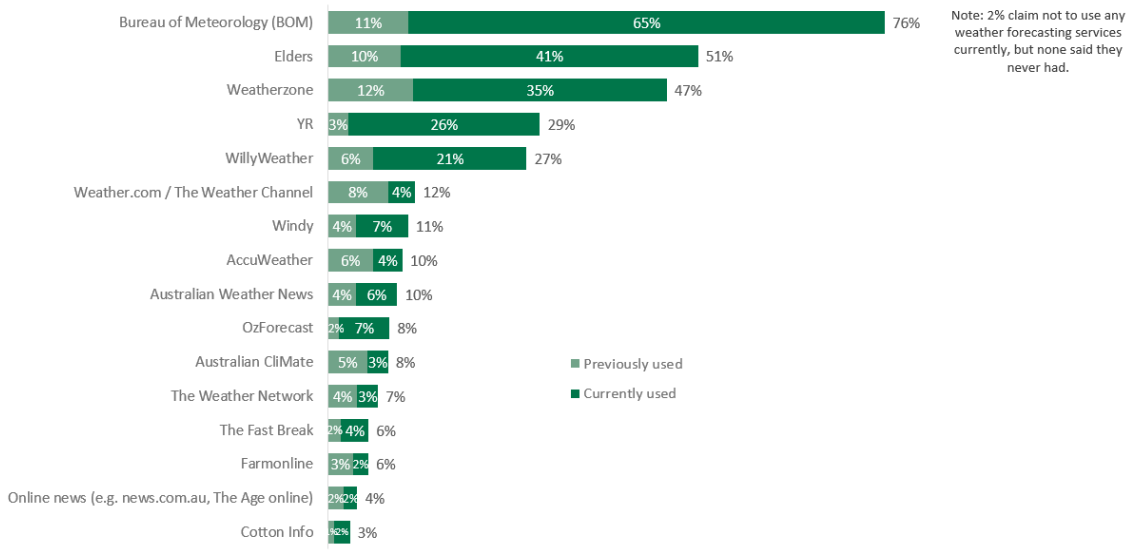


Figure 29. Sources of weather forecasting information - online

Q.8.a And which weather forecasting services brands have you actually used (e.g. the site or app name)? Q.8.b And which of those weather forecasting services do you currently use? (Base: All respondents, n=426)



Producers are using 3.6 number of sources on average. **Grain producers are using the highest number of sources, mentioning use of an average of 4.5 sources.**

Online, producers are using an average of 2.4 sources. The number of online sources used by grain producers is significantly higher than other sectors, with an average of 3.2 sources. Grain producers are more likely to use Australian CliMate (21%), Australian Weather News (24%), OzForecast (20%),

YR (51%) and The Fast Break (14%) (Links to these websites are in the reference section). The higher than average use by grain is indicative of their relationship with forecasting, the high risk nature of their sector and the lengths they go to for reassurance in decision-making.

Where only one source is used, it is most typically BOM (7%), the next most common single source is Elders (3%). Where two sources are used, it is BOM and Elders that is the most typical combination (4%), followed by BOM and Weatherzone (2%) and Weatherzone and YR (2%).

BOM is a go-to source, with 65% of producers using (higher total than any other source). And as above, the proliferation of sources is leading some producers to feel overwhelmed. There is an opportunity to improve confidence in BOM to counter some of the behaviours producers feel they must take to give themselves confidence in forecasts (e.g. checking multiple sources).

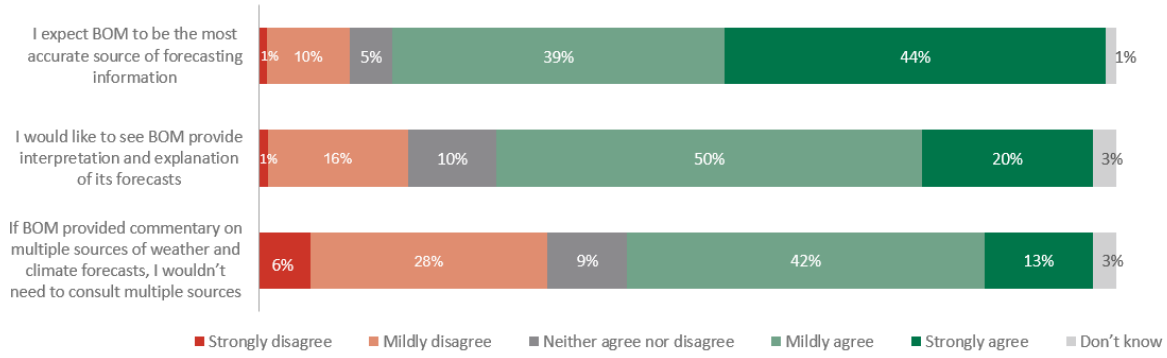
4.3.2 Bureau of Meteorology (BOM)

Producers have high expectations of BOM, with the majority (83%) expecting that it is the most accurate source, and half (**55%) suggesting that if BOM made improvements, such as providing commentary, they would not need to consult another source.**

Figure 30. Expectations of and preferences for BOM forecasts

Q.14. To what degree to you agree or disagree with the following statements about BOM?

(Base: All respondents, n=426)

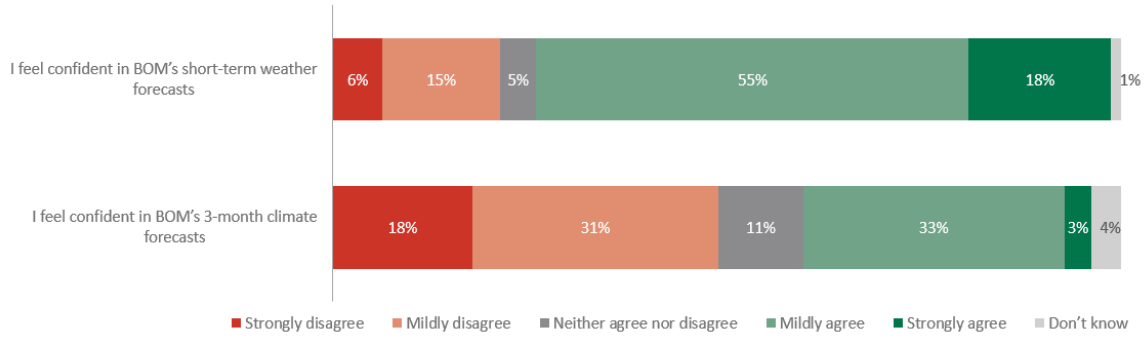


Overall, producers feel confident in BOM's short-term weather forecasts (73% agree). However, there is a job to be done to address the comparative low confidence in the 3-month climate forecast, as fewer than half (47%) agree they feel confident in the BOM SCF.

Figure 31. Confidence in BOM forecasts

Q.14. To what degree to you agree or disagree with the following statements about BOM?

(Base: All respondents, n=426)



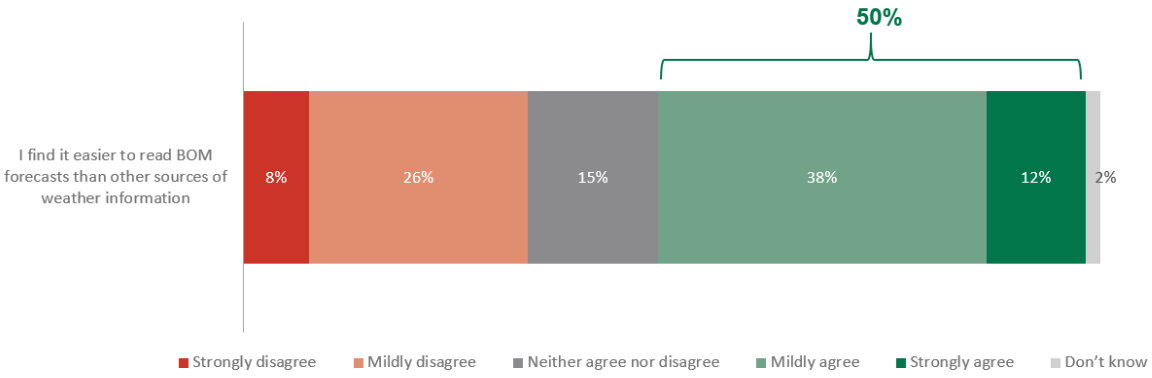
From a utility point of view, half of producers (50%) agree that BOM forecasts are easier to read than other sources.

Producers using OZ Forecast and producers using YR are more likely to disagree that BOM is easier to read than others sources (58% and 48% disagree respectively). As outlined above, there are learnings to be taken from other providers on ways to present information.

Figure 32. BOM usability

Q.14. To what degree to you agree or disagree with the following statements about BOM?

(Base: All respondents, n=426))



While there is division over whether BOM is the definitive source (see Fig. 33), across SCF and short-term forecasts, producers have similar levels of agreement that **BOM is the most accurate Australian source** (57% and 40% respectively).

Figure 33. BOM, the definitive source?

Q.14. To what degree to you agree or disagree with the following statements about BOM?

(Base: All respondents, n=426l)

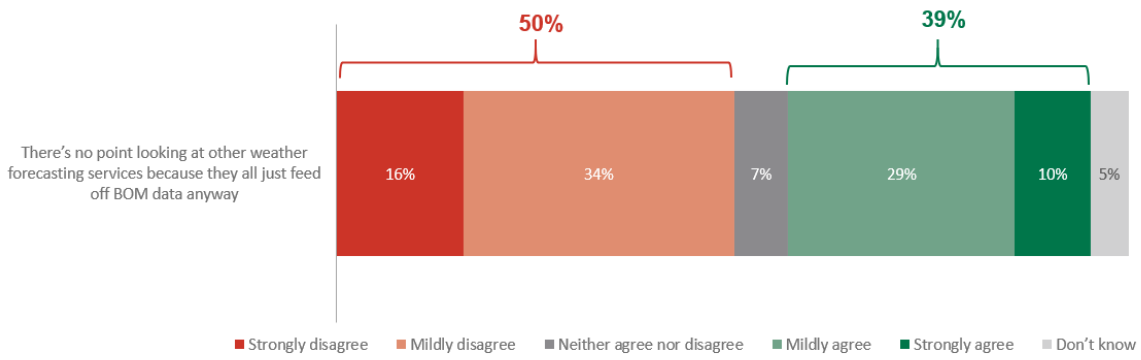
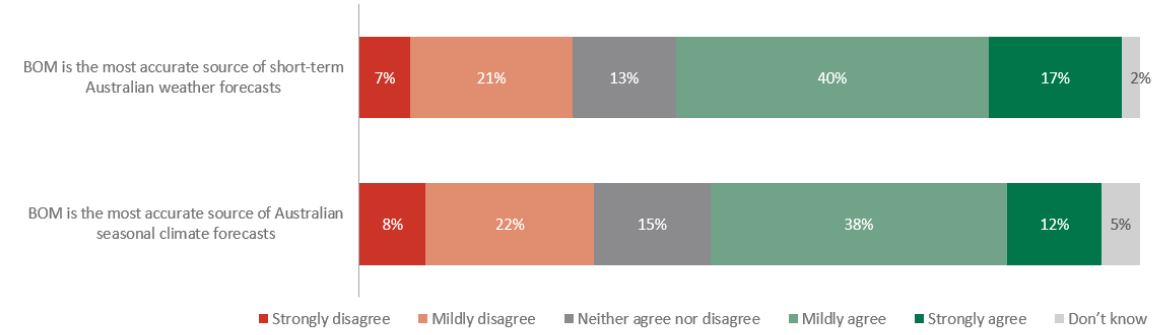


Figure 34. BOM accuracy

Q.14. To what degree to you agree or disagree with the following statements about BOM?

(Base: All respondents, n=426)



Whilst attitudes toward BOM are consistent between industry sector, there are meaningful differences observed among those producers whose operation has a turnover of >$1million per year. These producers are significantly less likely to agree that BOM is the most accurate source of short-term Australian forecasts (48%, vs. 61% of all other producers), or of SCFs (37%, vs. 56% of all other producers). Further to this, they are significantly less likely to agree that BOM's forecasts are always one of the sources they consult (65%, vs. 81% of all other producers). They are less likely to agree that there's no point looking at other weather forecasting services because they all just feed off BOM data anyway (24%, vs. 45% of all other producers).

While currently producers are divided on whether they see BOM playing the role, an opportunity does exist for a forecast to cut through and ease the load on producers. Producers are currently finding work-arounds to boost the utility of forecasts and their confidence information (e.g. comparing across sources, applying independently derived calculations to measures shown). BOM is well placed to take on that role as producers see BOM as a leader and usage of BOM is higher than other sources across sectors.

5. Conclusion

5.1 Key findings

High level attitudes toward seasonal climate forecasts (SCFs) are largely consistent between sectors and regions. Addressing commonplace limitations is an opportunity to realise benefits across industry:

- While the majority (82%) of producers are accessing a SCF, only half (59%) are using this information to make a decision on-farm.
- Rather than taking direct decisions as a result of the SCF, producers use the SCF as a confidence booster for decisions taken based primarily on other information (such as on-farm soil moisture measurements). The majority (83%) of producers agree that current conditions have a greater impact on their decision making than do SCFs.
- Overall, two thirds (61%) of producers feel SCFs are too unreliable to pay attention to.
- To counter concerns of reliability, producers are doing significant 'leg work' to build their confidence in the SCF forecasts. Most commonly this includes checking multiple forecasts. The majority (87%) agree they don't put faith in any one forecast alone. This adds to the burden of producers who are already time-poor and needing to act as an expert across many other fields.
- That being said, three in five (59%) agree that SCFs have improved in the last twenty years. There is clear correlation between recognising this improvement and active use of SCFs (of those who say they rely on SCFs, the majority (82%) acknowledge the improvement). Having negative past experiences with SCFs (e.g. when forecasted conditions do not eventuate) 'burns' producers and inhibits them from placing confidence in SCFs; this mindset can persist for many years.

Differences between key audiences may affect prioritisation, and how delivery of SCFs are optimised to meet varying needs:

- It is commonplace (40%) for producers to feel overwhelmed by the proliferation of different sources of SCFs. This is most prevalent in situations where climate variability has a greater effect on a producer's rate of return, including by sector and rainfall reliability. For example, almost half (44%) of grains producers say they feel overwhelmed by there being so many different SCFs, compared to only a third (36%) of livestock producers.
    - → Where the effect of climate variability is more pronounced, such as in the grains industry and / or in areas of low rainfall, producers are more engaged and improvements made to reduce the burden of interpreting SCFs will be felt more immediately and stand to make a greater positive contribution.

- This report clearly details how SCFs influence different decision-making by sector (Section 12). However, overall there is an even spread across the year when producers indicate that the SCF is important. In addition, the type of information producers say they want from SCFs as a priority is consistent across sectors.

The Bureau of Meteorology (BOM) is the single largest stakeholder with the influence to positively affect how short-term and SCFs are used. A number of opportunities are highlighted to realise this potential:

- Two thirds (65%) of producers access forecasting information directly from BOM – the largest audience of any individual source. Furthermore, the majority (83%) agree that BOM is the most accurate Australian source of forecasting.
- Producers offer a number of consistencies when asked what would improve the utility of short-term and SCFs from their perspective.

5.2 Benefits to industry

Proper interpretation of forecasting information can significantly affect the profitability and risk management of a farming operation. As such, there is substantial industry benefit to be gained from ensuring that the forecasts are expressed in a way which equips farmers with the optimal insight to inform their decision making at critical junctures. This research takes a 'needs first' approach to understanding farmers' existing use of services and where there are knowledge or information gaps.

By providing a comprehensive understanding of primary producers' needs from weather and seasonal climate forecasting services, and how those services might be developed and expressed to best serve industry end-users, this research will enable investment into appropriate refinement of resources.

6. Future research and recommendations

6.1 Recommendations

High-level attitudes toward seasonal climate forecasts (SCFs) are largely consistent between sectors and regions. Addressing commonplace limitations is an opportunity to realise benefits across industry:

- The job to be done is not building awareness of or access to the forecasts, but building *pro-active usage.*
- Given that producers use the SCF as a confidence booster for decisions taken based primarily on other information, there is an opportunity to build on how producers use SCFs in combination with on-the-ground observations. It may be a better reflection of actual usage, and therefore build trust with producers, *to promote SCFs as a compliment*, rather than as a stand-alone decision making tool.
- While they are clearly in the habit of interacting with the forecasts, a primary opportunity is to *address their gap in confidence* (61% feel they are too unreliable to pay attention to) and thus increase the use of SCFs.
- There is clear correlation between recognising this improvement and active use of SCFs (of those who say they rely on SCFs, the majority (82%) acknowledge the improvement). *Communicating the improvements made, and encouraging reluctant producers to take a fresh perspective on SCFs, is required* to break their inertia and increase use.

Differences between key audiences may affect prioritisation, and how delivery of SCFs are optimised to meet varying needs:

- It is commonplace (40%) for producers to feel overwhelmed by the proliferation of different sources of SCFs, and this is particularly true for grain. Focussing on industry-specific decision making is a communications opportunity to increase the resonance of a SCF (e.g. when hosted in an industry-specific publication, brought to life by commentary and interpretation).
- Deviation from the norm is always the priority information. Pushing out an alert at times when there are changes from the expected / norm may be helpful to smaller operators who may be less regularly engaging with SCF, as this is the time when they identify it is of most value to them.

The Bureau of Meteorology (BOM) is the single largest stakeholder with the influence to positively affect how short-term and SCFs are used. A number of opportunities are highlighted to realise this potential:

- The BOM clearly stands out as a category leader, and has the largest share of voice to positively influence how producers use short-term and SCFs. There is an opportunity to improve confidence in BOM to counter some of the burdens producers feel they must absorb to seek more confidence in forecasts (e.g. checking multiple sources).
- Refinements which reduce the burden on producers to review and interpret forecasts (and the inherent confusion incurred by consulting multiple sources) will be of significant potential value. Producers suggest refinements could include:
    - → Primary focus on rainfall presentation, including assurance that it is correctly interpreted. Rainfall likelihood and amount is overwhelmingly the most important aspect of any forecast, and its perceived reliability the biggest single factor in determining producers' propensity to utilise forecasts overall.
    - → Inclusion of straight-forward and accessible interpretation of forecast information, read in plain language. As one producer points out: "As a farmer I don't need to be a climate scientist, but I need a scientist to tell me what to expect and what it means for me."
    - → The BOM may not have the resources, or even be best placed, to offer industry-specific refinement to forecasts. Instead, it may support industry-specific stakeholders to interpret and communicate forecasts via their channels.
    - → Easy and digestible graphical representations, including map-based navigation to localised information, are consistently to part of forecasts, which producers navigate to first. Tending to access forecasts quickly and often, producers may only lift what information is presented to them in this way. Other services (such as Windy) may not be as widely known, and are not as widely trusted as accurate, but often draw producers' attention because of their visualisations.
    - → Some producers express interest in weather information regarding frost and evaporation rates, both of which they feel are not adequately accounted for in existing weather apps and forecasts.

6.2 Future research

This report captures a broadly comprehensive portrait of how the livestock, grain, dairy, cotton, sugar and rice industries use weather monitoring and SCFs, and their needs from those resources. There is an opportunity to extend understanding to include other Australian agriculture sectors, in particular the horticulture and viticulture industries.

Producers offer a number of consistencies when asked what would improve the utility of short-term and SCFs from their perspective. A limitation of this report is that it is based only on those resources which are currently available. From this report, stakeholders may develop innovations in how weather and SCFs are expressed to different audiences.

To build on this research it would be useful to review specific product prototypes with producers, that bring to life the key areas of improvement identified within this report. User co-creation and testing would help to deliver the recommendations as outlined in this report.

At this time, there would be an opportunity to 'concept test' specific innovations with those audiences, capturing their feedback at a mid-point in the development phase and using it as a steer to optimise the final design.

As part of any concept testing work, it would be useful to explore the role of industry tailoring, and how this could be best delivered by sector. While this report shows that at a high level, barriers to use and needs from a forecast are consistent across sector, there are some indications (as provided in the appendices) that some tailoring by sector would of use. As part of any prototype co-creation and testing, it is recommended that a by-sector approach is taken. This report includes indicative findings that suggest there are some differences.

7. References

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8. Appendices

8.1. Key decisions and perceived value of forecast by sector

8.1.1 Grain

Current research suggests that investment in improving forecast skill will likely deliver incremental rather than step-change. (Darbyshire 2020) As such it is required to understand the most important aspects of forecasting on decision-making and profitability so that efforts can be focused on the areas that will deliver the most impact.

Perceived value of forecast, both seasonal climate forecasts and short-term forecasts differs by sector.

What, when (and if) to plant, when to sell, and what, when (and if) to spray. Grain producers must decide the types and amount of crop they plant as well as the chemicals they use to manage weeds, pests and promote soil nutrients. Temperature, rainfall, wind, as well as evaporation rates, frost and humidity impact producers' ability to grow crops, and on a national, and even international scale, affect the prices at which crops can be sold. Additionally, chemical choice, amount and usage is employed in close consideration of the actual and projected weather. Detailed information regarding daily as well as seasonal weather forecasts is hence sought by grain producers.

Grain farming is impacted by nearly all aspects of the weather. Based on producers' knowledge about their local soil and climate, decisions will be made regarding what crops to plant, when to plant them and whether to prepare the soil with any chemical or fertiliser. A projected season of high rainfall, for example, will prompt at least two considerations, namely: what crop will work well with this weather given the farm's soil type and, secondly, what crop will be most profitable relative to cost of growth (a calculation with includes the input of chemicals as well as the national and international markets). Having decided the types of crops to sow, producers must manage the growth of the crop and prepare for harvest season. In particular, producers will use weather forecasts to estimate the size of their yield, which will in turn impact the labour and machinery required for harvest. Given that grain markets are also impacted by the weather, in that a high-yield season due to favourable weather conditions for a particular crop in one state or country may translate to lowered prices nationally or even internationally, grain producers are interested in national as well as international weather trends and events. Depending on their access to grain storage, grain producers may also decide to store rather than sell their harvested crop until weather conditions change and the market price is more favourable.

Throughout the year, grain producers may choose to apply chemicals to improve soil nutrients and moisture and/or protect their crops from various weeds or pests. The choice and application of chemicals is an expensive exercise and is often done in close consultation with an agronomist who will discuss the particular soil conditions of the farm and how they are likely to respond to the forecasted weather. Once the specific chemicals and relative amounts have been chosen and purchased, the producer then needs to decide when to spray and hence distribute the chemicals. This is a decision and practice that is highly dependent on the daily as well as hourly weather forecast, in particular relation to rainfall as well as wind speed and direction.

Seasonal climate forecast needs:

- Local, national and global weather patterns that will impact price of crop and producers' yields.
- Seasonal climate information can impact crop selection, this is most relevant ahead of sowing (Autumn, Spring)
- Information is needed for the coming year (ideally), as crop rotations can be impacted by selections. That being said, grain producers are pragmatic about what the forecast can offer them and are cognisant that there is inherent risk in their choices. Grain producers will take an 'educated gamble', balancing possible conditions with potential yield and market pricing to make a decision on crop.
- Ideally a forecast would offer a long-range view of rainfall and other factors that may impact soil moisture retention.

Example weekly forecasting needs:

- Local rainfall, detailed wind information (on an hourly basis), information regarding frost and evaporation rates for spraying as well as crop management.

What impact could good forecasting have?

- In the extreme, a particularly dry year may mean that it's best to avoid cropping all together. As one producer described "*So many years it would've been better to not sow anything and for us to just go caravanning around Australia, rather than waste all our money putting chemical and seed in for such low results."*

Darbyshire, R., Crean, J., Cashen, M., Anwar, M.R., Broadfoot, K.M., Simpson, M., Cobon, D.H., Pudmenzky, C., Kouadio, L. and Kodur, S., 2020. Insights into the value of seasonal climate forecasts to agriculture. *Australian Journal of Agricultural and Resource Economics*, *64*(4), pp.1034-1058.

[1] MCV Business Case document 2016-2020

[1] ABARES Insights, Issue 6, 2019, The effects of drought and climate variability on Australian farms

Example: Victorian Grain Producer Annual Cycle

★ Key decision-making time: crop selection - seasonal climate forecast most needed here

★ Operational decisions: input management

★ Watching forecast for contingency planning

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Farm seasons/ cycle	Holiday, summer spraying (if any rain to 'use every drop')	Conserving moisture – post harvest things – meeting with agronomist, finalising crop choice, searching seed and fertiliser, selling crop, and maintenance Feb and March - GDRP updates – info seeking – lots of talks and events	Maintenance, getting ready for cropping . Selling crop, spraying if needing. Sourcing fertiliser and seed	Planting	Planting	From end of May to August - crop spraying and fertiliser		Aug and September most stressful for rain – worst year you can get is looking good till end of July and then its stop raining – you've spent majority of money by then	Waiting for rain! Applying fungicides if need be	Getting ready for harvest, trucks serviced, labour supply, making sure we have enough storage in silos	Harvest	Harvest
Decisions	Rain determines spraying schedules. Wont take holidays if raining a lot	We know how many hectares we will plant based on previous rotations but if really dry and it suggests that it will be a dry winter or year by autumn we may alter the grain we will plant, particularly canola	Same -	Sowing dry – the date we want to finish by 21st of May. Traditionally you'd be waiting to the autumn break - we just sow on time		Controlling weeds or pests – so always judging what yield could be based on seasonal forecast and that determines how much fertiliser is used						
Most helpful information	OCF website - the BOM – longer term or historical stuff – we use CliMATE, and if it's a wet month Weatherzone BOM app.	The Break –summarises all the models. BCG has similar discussion in monthly newsletter. Talk to agronomist. Information from BCG trial review day – Dale Grey will present. His family farm is an hour away so he knows the area he's a great presenter - he's relevant all over the state.		Still checking the weather all the time. Managing need of herbicides etc. Managing the sowing (wet or dry)				Checking for rain on the horizon		Looking at daily forecasts for task management →		

8.1.2 Cotton: When and if to plant cotton is the most impactful decision for a cotton producer, alongside whether to plant a winter crop.

Cotton producers are weighing up the allocation of water resources. The summer cotton crop is a more valuable so will be prioritised over a winter crop. However, there are times when the winter crop is a 'safer bet' than cotton. In extreme years cotton may have to be dropped, and then there is a reliance on winter crop. However, for the most part, cotton producers are making decisions on if to concentrate solely on the summer cotton crop or also plant for winter.

Seasonal climate forecast needs:

- Local rainfall conditions that help determine when and if to plant the seasonal crop.
- Availability of water influences whether and how much cotton is planted.
- Availability and likelihood of more water influences winter crop decision. Producer weighs up using the available soil moisture (instead of risking evaporation), with how much more water must be used to make the winter crop successful.
- Better information on water availability (across source – on and off-farm) would help.

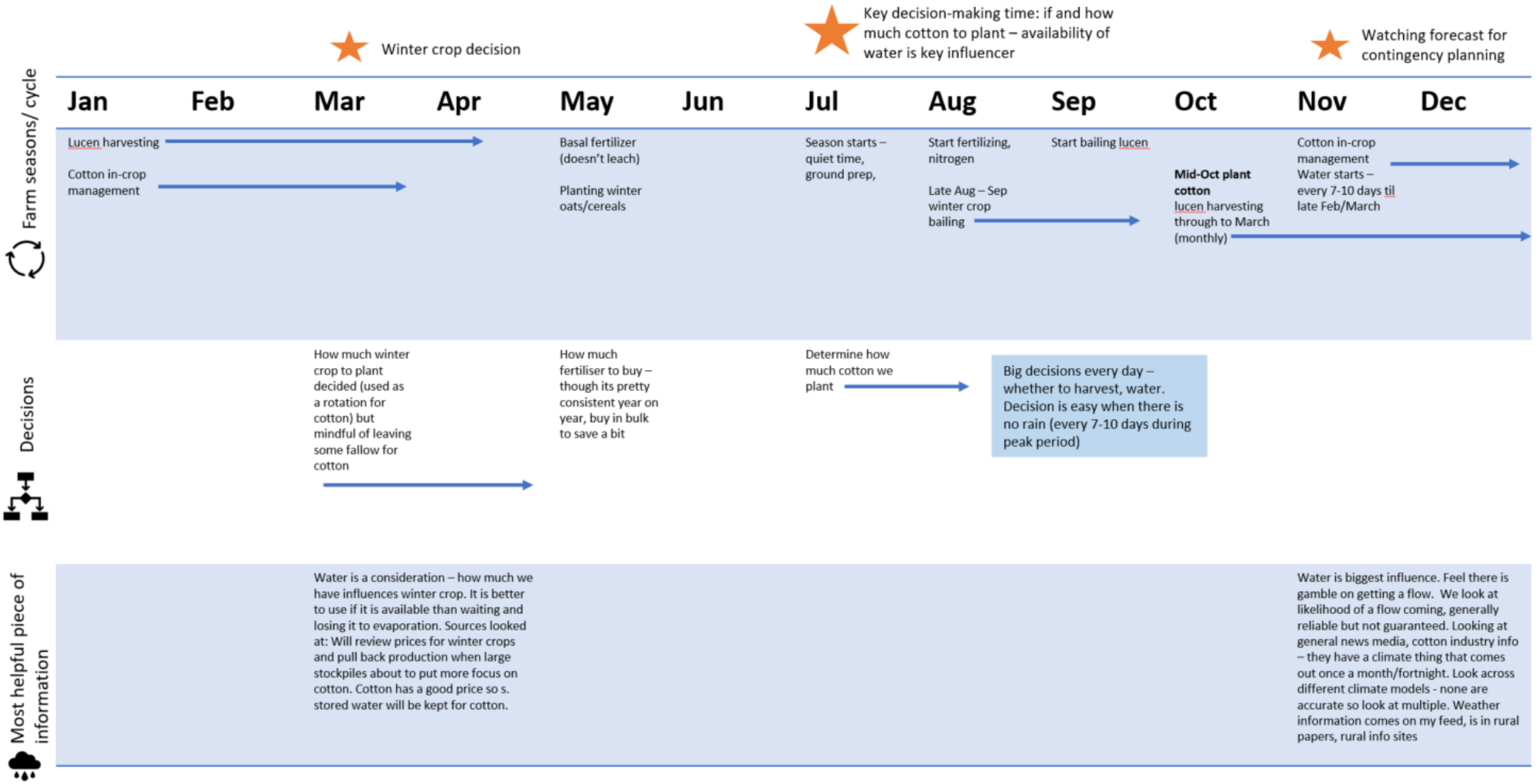
Example weekly forecasting needs:

- Weather conditions such as 'planting rain' that determine timing of planting.
- Weather conditions that allow for crop management, such as wind conditions.

What impact could good forecasting have?

- As above, knowing whether the rainfall can support both crop rotations (summer and winter) would enable cotton producers to better manage ahead. Currently, producers can be missing out on a rotation to minimise exposure and risk.

Example: Southern QLD Cotton Producer Annual Cycle



8.1.3 Rice: How much land to allocate to rice planting is the critical decision for rice producers? Similar to cotton producers, rice is the most profitable and therefore prioritised crop, however, conditions (i.e. water price and availability) must be conducive. In addition, planting temperatures need to occur in set window to give the crop sufficient growing time. Given the small size of the industry rice producers can be working closely with their customers and have a need to lock in contracts at an early stage. This relationship with customer though, also means transparent conversations are being had at a planning stage about climate and rainfall.

Seasonal climate forecast needs:

- Local rainfall conditions that help determine when and if to plant the seasonal crop.
- Water monitoring happens across the year to determine crop, how much rice to prepare for and sow, how to manage the winter crop.
- Many metrics are used to review this, including available stores of water, soil moisture, water markets and trading and also seasonal forecasts.
- Combined water metric information would aid decision-making.

Example weekly forecasting needs:

- Weather and temperature conditions for rice growth.
- Rainfall and temperature for diversified endeavours (livestock, hay).

Example: NSW Rice Producer Annual Cycle

★ Deciding on when to germinate and when to harvest rice

★ Deciding how much water to use for winter crops

★ Deciding how much rice to sow

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Farm seasons/ cycle	Rice crop growing Managing weeds Looking after sheep		Preparing pasture fields for Autumn irrigation	ANZAC day – start rice harvest 2nd week – drain water into next field if any left in rice, irrigate pastureland	Could still be harvesting rice Sow oats in fallow land Mid-May start milling rice →	Fencing, maintenance, renovating rice land	Ticking sheep	Prep for irrigating oats – weather-dependent Maintenance of machines, mills	Get rice paddock ready Cut paddock of hay	Sow rice paddock Mid-Oct – start irrigating rice Sheep graze rice fields on and off – manage weeds	Irrigate rice	Irrigate rice Fill up rice to permanent water Take sheep out of rice paddocks (40Ha rice)
Decisions	Make sure rice has enough water, sheep have shelter - can reach 48 degrees!! Market deadlines		Temperature related decisions. Start germinating seeds before May or else too cold	When to harvest rice - it ripens quickly when hot and it can't be harvested when it's wet	Pre-irrigate fields then wait to dry for weed control Wait for a rain event, then sow oats	Farm maintenance, fencing etc depends on having fine weather			Need window of dry weather to cut and dry hay	150 day growing period for rice. Need a window without rain & ground temp 17 degrees to sow rice so it'll be ready for April/May harvest When to start irrigation		
Most helpful piece of information	Temperature forecast (short-term daily to weekly) Water levels in rice paddocks		Temperature forecast (short-term daily to weekly) Long-range forecast to identify upcoming low pressure system	Temperature forecast (short-term daily to weekly) Rain forecast (short-term daily to weekly)	Rain forecast (short-term daily to weekly)	Daily rain radar		Daily rain radar Water trading	Rain forecast (short-term daily to weekly) Daily rain radar	Rain forecast (short-term daily to weekly)		

8.1.4 Sugar cane: Managing harvesting schedule is a key task for sugar producers. Maximising the yield of the crop by timing which fields are harvested at what point during the harvest season can make a significant difference to profitability. In addition, when and where to plant new crops (given the approximate five-year life of a plant) is also key. Sugar producers need dry conditions for harvest and sufficient rain during planting and growth seasons. In addition, temperatures need to be right for germination.

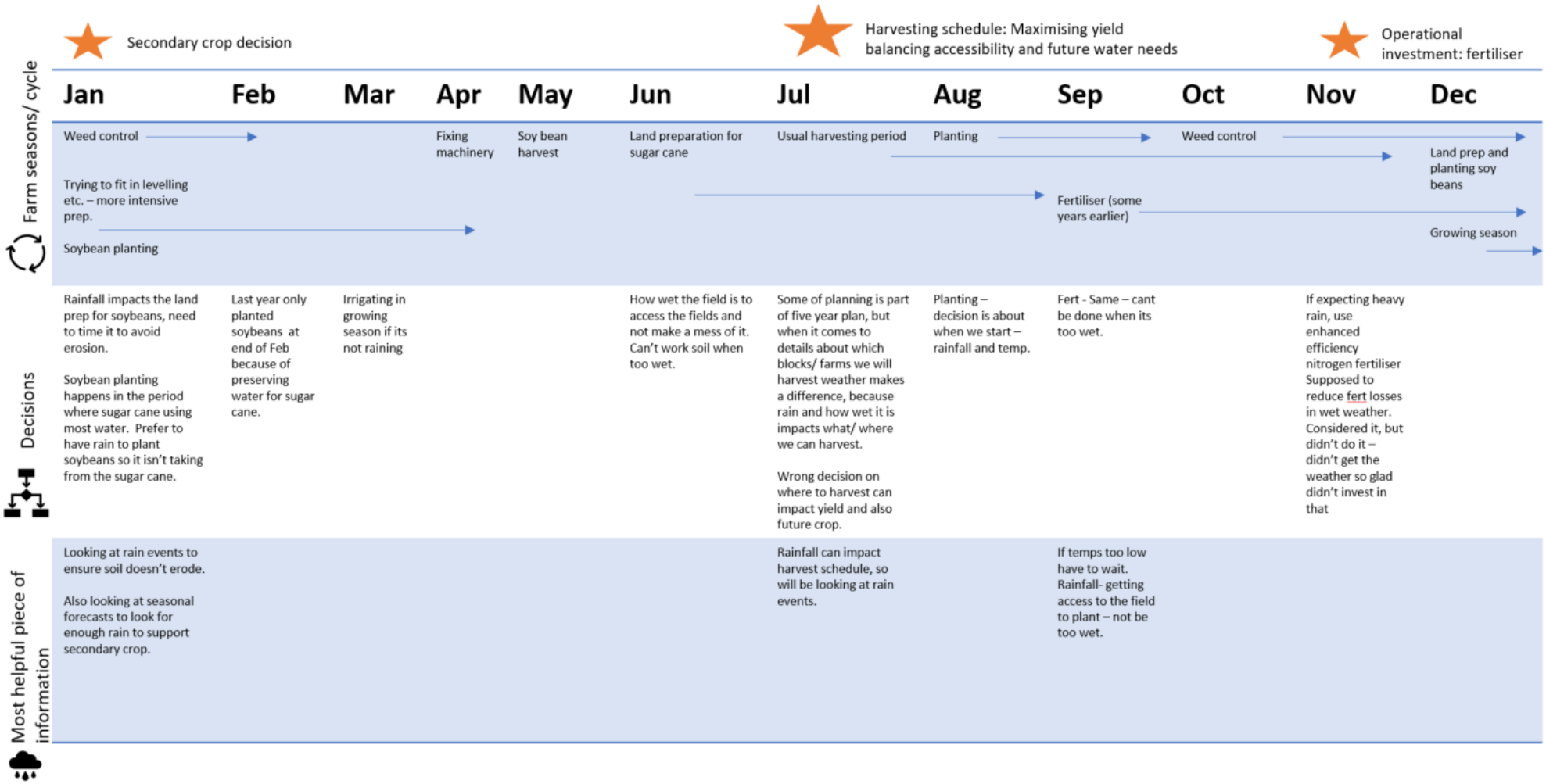
Seasonal climate forecast needs:

- Local rainfall conditions that help determine harvest schedule.
- This schedule can impact yield in the year, and future years (given the lifecycle of a sugar cane crop).
- Sugar producers need to information about the seasonal rains to determine schedule and secondary crop rotation.

Weekly forecasting needs:

- Weather conditions such as 'planting rain' that determine timing of planting.

Example: Coastal QLD Sugar Cane Producer Annual Cycle



8.1.5 Livestock: When to sell stock to maximise return (hold and fatten or sell) is among the biggest decisions livestock producers make each year. Producers weigh up their ability to provide or purchase feed to fatten stock.

Local rainfall and temperature are the most important information and are used by producers to manage feed and pasture for their livestock. As well as impacting specific daily decisions, such as deciding which paddocks livestock should be moved to for various phases of their life (e.g. joining, calving, weaning etc.), local rainfall is also used to estimate the costs of fattening stock in a given year. This estimation will impact the number of livestock bred per year, as well as whether to grow feed or whether to purchase. If rainfall is scarce in a given year, growing as well as buying feed can become an expensive exercise and the producer may need to sell stock rather than feed them to full growth.

Additionally, national rainfall and temperatures are also of interest given their ability to impact livestock prices. Given that livestock is typically sold on a weight basis, producers are required to consider the costs of fattening stock relative to the price at which they can be sold. Therefore, producers will take into consideration the national rainfall, as a plentiful year in a different state, where feed is cheap and hence livestock are sold at full weight, can increase supply and lower the price of livestock nationally.

Seasonal climate forecast needs:

- Local and country wide rainfall and temperatures for feed and herd management as well as livestock prices.
- This will impact decisions about how many and when to sell stock – waiting for optimal pricing or timing, or moving ahead of the market.

Weekly forecasting needs:

- Local rainfall for day-to-day feed and herd management.

What impact could good forecasting have?

- Strong forecasting on conditions can help livestock producers better manage their feed and sale decisions.

Example: WA Cattle Producer Annual Cycle

Key decision-making time: Early/ more stock sell-off

Key decision-making time: Early/ more stock sell-off (feed management)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Farm seasons/ cycle		Busy w/ calving Dry time of year Tough Fickle rains Applying applicants to pasture – e.g. fertiliser Cropping					Easy maintenance Check stock health Feed hay (dry matter bulks feed) Time off farm Wetness limits activity (lie-ins!)		Catching up on odd jobs neglected over winter (rain easing) – marking calves, fencing, etc. Community activities			Weaning / vaccinating calves Pick days (avoid heat)
Decisions		Back to basic stocking rate Fertilising (annual top dressing, does not change meaningfully yr to yr).			If 'year is dry' and the atmosphere is unconfident, may offload early before everyone else does rather than keep fingers crossed for rain.		Can be tough. But always okay if hoping for a 'soft finish' -> More rain, at the wrong time (too much at once) can be bad because causes water logging (drowns grass, cows get issues w/ wet feet, depletes hay which becomes an input cost). Avoiding rain some jobs can't be done in rain.		Crucial for rain "finishes off the season for you, boosts feed reserves, boosts weight of feeding / weaning cattle". Consider off-loading early if looking at poor rain conditions – rather than deplete hay will concentrate on breeding stock.			Selling weaners At market? Live export? Take a price when a good order is offered. Retain some for future breeding stock.
Most helpful piece of information		7-day forecast informs programme for the week: Booking contractors, Avoiding heat - up at dawn or cancel day.			Uses 'gut feeling' based on community spirit. Discussion with neighbours and headlines news		Look at radar on the day to dodge rain, and looking at storm warnings.		Looking for rain to boost feed reserves Looking at feed availability and pricing			Again avoiding heat to avoid stress in weaning process.

8.1.6 Dairy: Feed planning, and in extreme need sale of stock, is the most important decision in dairy farming.

In a typical year, the key decision for the dairy producer is how to minimise the cost of feed as an input. This is about timing of any feed purchase and how to maximise feed grown on-farm, so anticipating the costs of feed and understanding optimal conditions to seed pasture and make hay are key. While selling and expiration of herd is also part of a typical year, selling more head than is desired by the producer can also be a decision in difficult years. The herd is a key asset of the dairy producer and to purchase replacement when sold is difficult and costly, so only when pushed by circumstances such as drought may the producer also need to make decisions on if/when to sell cattle.

Seasonal climate forecast needs:

- Country-wide rainfall conditions that will impact the price of feed.
- Local rainfall conditions that help determine where and when to grow feed for the herd.

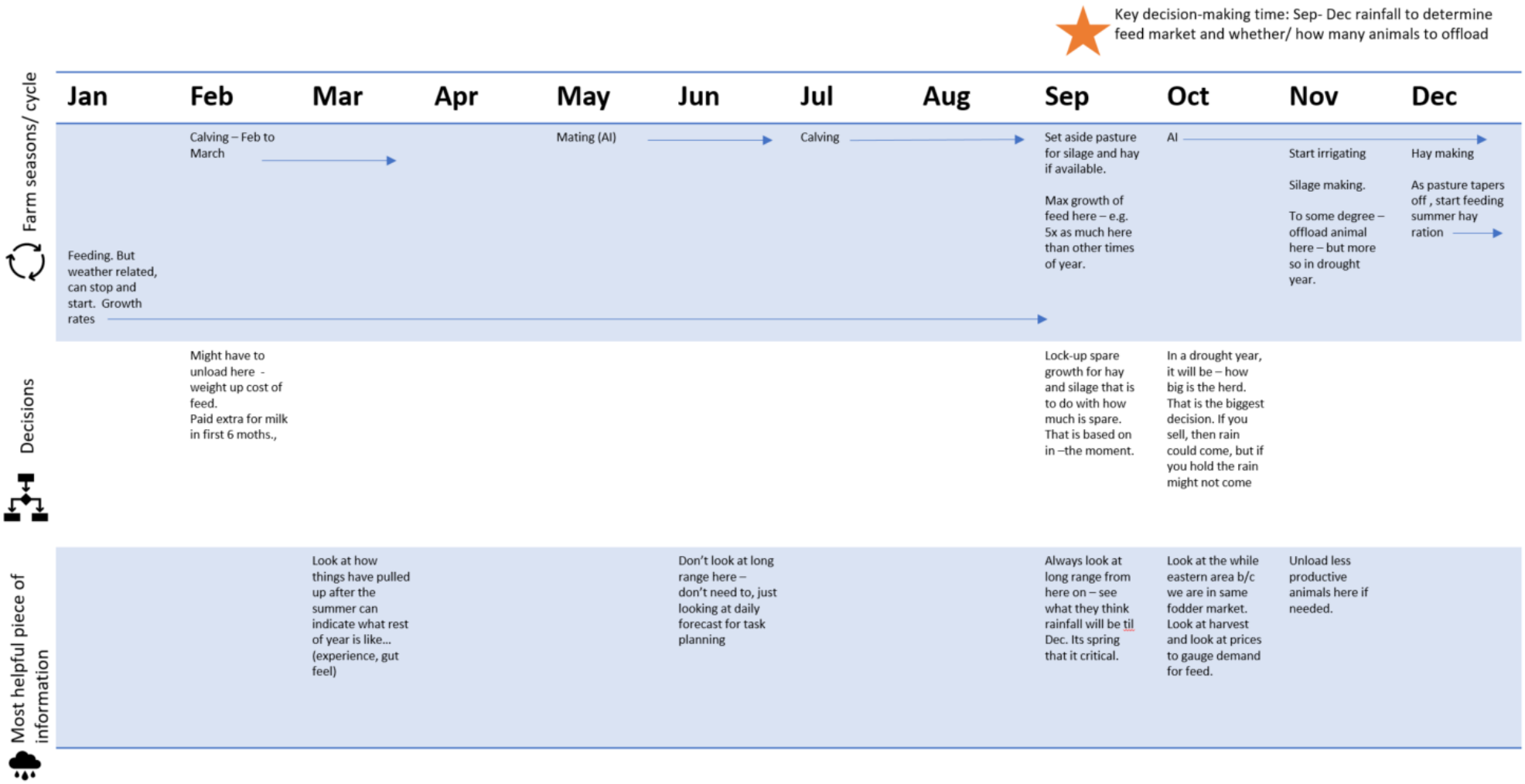
Weekly forecasting needs:

- Weather conditions that dictate herd movement, such as prolonged heat, storms and heavy rainfall.
- Weather conditions that facilitate hay making such as consecutive dry days.

What impact could good forecasting have?

- Rainfall and its impact on the dairy producer's ability to maintain their own feed is important, but also rainfall across other parts of the country is of interest to dairy producers due to its impact on feed prices.

Example: Victorian Dairy Producer Annual Cycle



8.2 Additional analysis

Tables A to E compare forecast types *(for example in which month is the current day forecast statistically more important than the 3-month forecast)*

Table A. Months when weather forecasts are most important - ALL

Q.10. Please indicate which months of the year when the following weather forecasts are most important to you for decision-making? (Multiple selection) Shaded columns indicate a figure that is statistically significantly higher than the non-shaded columns.

(Base: All respondents, n=426)

%	Current day's weather	4 – 7 day weather	3-month climate forecast
January	18%	17%	13%
February	15%	15%	15%
March	19%	19%	21%
April	28%	24%	17%
May	22%	22%	13%
June	11%	11%	8%
July	7%	7%	6%
August	8%	7%	8%
September	17%	19%	12%
October	24%	24%	11%
November	28%	24%	12%
December	23%	22%	12%
This type of forecast is useful to me all year round	39%	39%	27%
I don't use this type of forecast for decision-making	4%	5%	29%

Table B. Months when weather forecasts are most important – LIVESTOCK

Q.10. Please indicate which months of the year when the following weather forecasts are most important to you for decision-making? (Multiple selection) Shaded columns indicate a figure that is statistically significantly higher than the non-shaded columns.

(Base: Livestock producers, n=132)

%	Current day's weather	4 – 7 day weather	3 month climate
January	22%	21%	17%
February	19%	20%	18%
March	20%	23%	23%
April	23%	20%	17%
May	17%	17%	13%
June	6%	6%	7%
July	5%	5%	5%
August	7%	5%	8%
September	15%	18%	14%
October	23%	26%	13%
November	28%	23%	14%
December	26%	22%	14%
This type of forecast is useful to me all year round	38%	39%	27%
I don't use this type of forecast for decision-making	5%	6%	26%

Table C. Months when weather forecasts are most important – MIXED

Q.10. Please indicate which months of the year when the following weather forecasts are most important to you for decision-making? (Multiple selection) Shaded columns indicate a figure that is statistically significantly higher than the non-shaded columns.

(Base: Mixed producers, n=101)

%	Current day's weather	4 – 7 day weather	3 month climate
January	13%	8%	11%
February	11%	7%	13%
March	18%	11%	19%
April	36%	30%	15%
May	31%	32%	11%
June	16%	17%	8%
July	7%	11%	3%
August	5%	7%	6%
September	16%	15%	8%
October	16%	15%	8%
November	21%	23%	9%
December	19%	19%	9%
This type of forecast is useful to me all year round	42%	40%	29%
I don't use this type of forecast for decision-making	3%	5%	32%

Table D. Months when weather forecasts are most important – GRAIN

Q.10. Please indicate which months of the year when the following weather forecasts are most important to you for decision-making? (Multiple selection) Shaded columns indicate a figure that is statistically significantly higher than the non-shaded columns.

(Base: Grain producers, n=79)

%	Current day's weather	4 – 7 day weather	3 month climate
January	10%	8%	4%
February	6%	4%	9%
March	14%	11%	25%
April	48%	44%	30%
May	44%	43%	22%
June	23%	20%	13%
July	16%	13%	11%
August	16%	14%	14%
September	23%	18%	10%
October	30%	22%	9%
November	32%	20%	8%
December	22%	15%	3%
This type of forecast is useful to me all year round	34%	38%	18%
I don't use this type of forecast for decision-making	1%	4%	30%

Table E. Months when weather forecasts are most important – DAIRY

Q.10. Please indicate which months of the year when the following weather forecasts are most important to you for decision-making? (Multiple selection) Shaded columns indicate a figure that is statistically significantly higher than the non-shaded columns.

(Base: Dairy producers, n=48)

%	Current day's weather	4 – 7 day weather	3 month climate
January	13%	19%	6%
February	10%	15%	10%
March	23%	23%	8%
April	21%	17%	4%
May	13%	8%	2%
June	4%	6%	4%
July	2%	6%	8%
August	0%	10%	8%
September	21%	29%	10%
October	31%	38%	8%
November	33%	38%	10%
December	17%	27%	4%
This type of forecast is useful to me all year round	48%	40%	31%
I don't use this type of forecast for decision-making	2%	0%	42%

Tables F to I compare months for each of the forecast types *(for example in which month is the 3-month forecast more important than other months for the 3-month forecast)*

Table F. Months when weather forecasts are most important – ALL SECTORS

Q.10. Please indicate which months of the year when the following weather forecasts are most important to you for decision-making? (Multiple selection) Shaded columns indicate a figure that is statistically significantly higher or lower than the non-shaded rows.

(Base: All producers, n=426)

%	Current day's weather	4 – 7 day weather	3 month climate
January	18%	17%	13%
February	15%	15%	15%
March	19%	19%	21%
April	28%	24%	17%
May	22%	22%	13%
June	11%	11%	8%
July	7%	7%	6%
August	8%	7%	8%
September	17%	19%	12%
October	24%	24%	11%
November	28%	24%	12%
December	23%	22%	12%
This type of forecast is useful to me all year round	39%	39%	27%
I don't use this type of forecast for decision-making	4%	5%	29%

These months are significantly more likely to see usage of this forecast type

These months are significantly less likely to see usage of this forecast type

Table G. Months when weather forecasts are most important – LIVESTOCK

Q.10. Please indicate which months of the year when the following weather forecasts are most important to you for decision-making? (Multiple selection) Shaded columns indicate a figure that is statistically significantly higher or lower than the non-shaded rows.

(Base: Livestock producers, n=132)

%	Current day's weather	4 – 7 day weather	3 month climate
January	22%	21%	17%
February	19%	20%	18%
March	20%	23%	23%
April	23%	20%	17%
May	17%	17%	13%
June	6%	6%	7%
July	5%	5%	5%
August	7%	5%	8%
September	15%	18%	14%
October	23%	26%	13%
November	28%	23%	14%
December	26%	22%	14%
This type of forecast is useful to me all year round	38%	39%	27%
I don't use this type of forecast for decision-making	5%	6%	26%

These months are significantly more likely to see usage of this forecast type

These months are significantly less likely to see usage of this forecast type

Table H. Months when weather forecasts are most important – MIXED

Q.10. Please indicate which months of the year when the following weather forecasts are most important to you for decision-making? (Multiple selection) Shaded columns indicate a figure that is statistically significantly higher or lower than the non-shaded rows.

(Base: Mixed producers, n=101)

%	Current day's weather	4 – 7 day weather	3 month climate
January	13%	8%	11%
February	11%	7%	13%
March	18%	11%	19%
April	36%	30%	15%
May	31%	32%	11%
June	16%	17%	8%
July	7%	11%	3%
August	5%	7%	6%
September	16%	15%	8%
October	16%	15%	8%
November	21%	23%	9%
December	19%	19%	9%
This type of forecast is useful to me all year round	42%	40%	29%
I don't use this type of forecast for decision-making	3%	5%	32%

These months are significantly more likely to see usage of this forecast type

These months are significantly less likely to see usage of this forecast type

Table H. Months when weather forecasts are most important – GRAIN

Q.10. Please indicate which months of the year when the following weather forecasts are most important to you for decision-making? (Multiple selection) Shaded columns indicate a figure that is statistically significantly higher or lower than the non-shaded rows.

(Base: Grain producers, n=79)

%	Current day's weather	4 – 7 day weather	3 month climate
January	10%	8%	4%
February	6%	4%	9%
March	14%	11%	25%
April	48%	44%	30%
May	44%	43%	22%
June	23%	20%	13%
July	16%	13%	11%
August	16%	14%	14%
September	23%	18%	10%
October	30%	22%	9%
November	32%	20%	8%
December	22%	15%	3%
This type of forecast is useful to me all year round	34%	38%	18%
I don't use this type of forecast for decision-making	1%	4%	30%

These months are significantly more likely to see usage of this forecast type

These months are significantly less likely to see usage of this forecast type

Table I. Months when weather forecasts are most important – DAIRY

Q.10. Please indicate which months of the year when the following weather forecasts are most important to you for decision-making? (Multiple selection) Shaded columns indicate a figure that is statistically significantly higher or lower than the non-shaded rows.

(Base: Dairy producers, n=48)

%	Current day's weather	4 – 7 day weather	3 month climate
January	13%	19%	6%
February	10%	15%	10%
March	23%	23%	8%
April	21%	17%	4%
May	13%	8%	2%
June	4%	6%	4%
July	2%	6%	8%
August	0%	10%	8%
September	21%	29%	10%
October	31%	38%	8%
November	33%	38%	10%
December	17%	27%	4%
This type of forecast is useful to me all year round	48%	40%	31%
I don't use this type of forecast for decision-making	2%	0%	42%

These months are significantly more likely to see usage of this forecast type

These months are significantly less likely to see usage of this forecast type

Figure A. Sources of weather forecasting information - online

Q.8.a And which weather forecasting services brands have you actually used (e.g. the site or app name)? Q.8.b And which of those weather forecasting services do you currently use? (Base: All respondents, n=426)

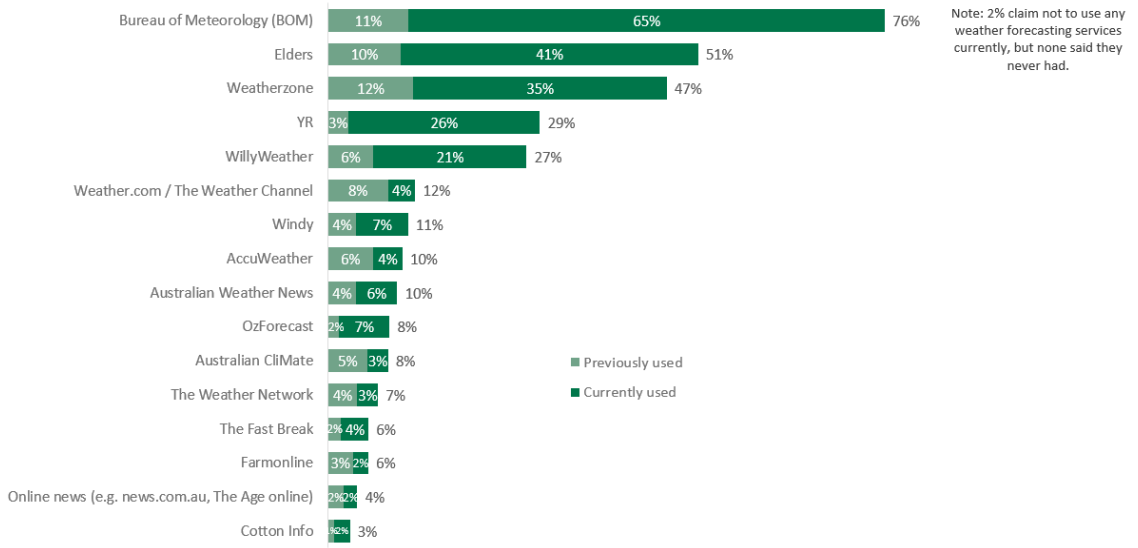


Figure B. Sources of weather forecasting information – online - LIVESTOCK

Q.8.a And which weather forecasting services brands have you actually used (e.g. the site or app name)? Q.8.b And which of those weather forecasting services do you currently use? (Base: Livestock producers, n=130)

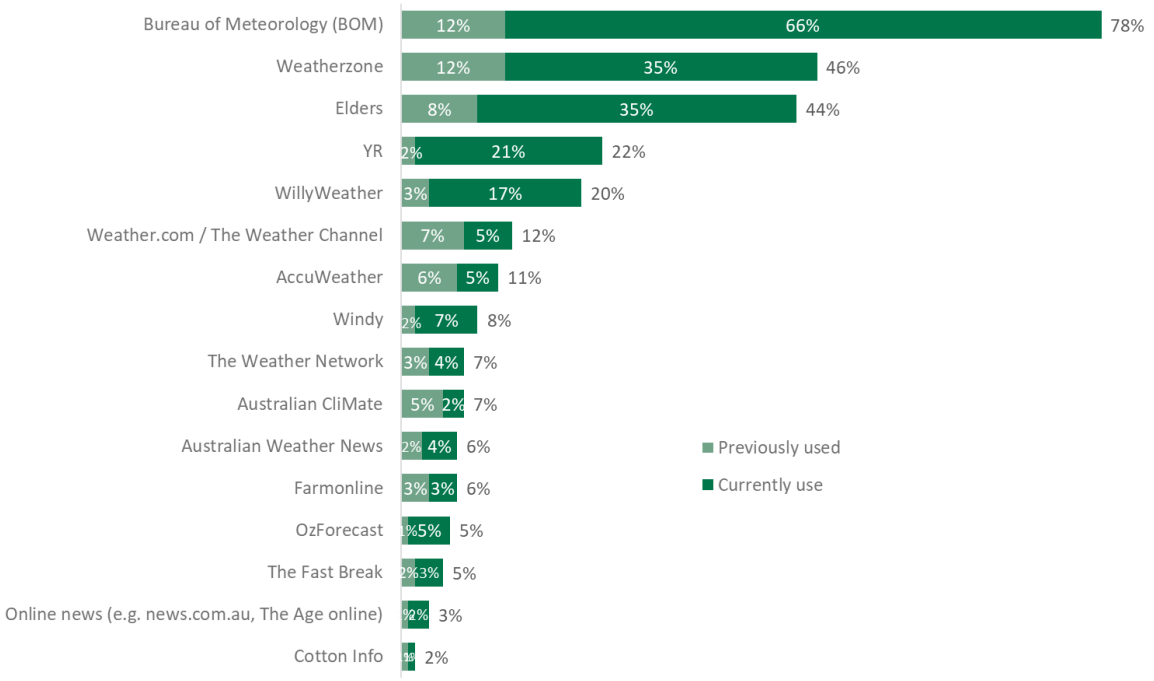


Figure C. Sources of weather forecasting information – online - MIXED

Q.8.a And which weather forecasting services brands have you actually used (e.g. the site or app name)? Q.8.b And which of those weather forecasting services do you currently use? (Base: Mixed producers, n=100)

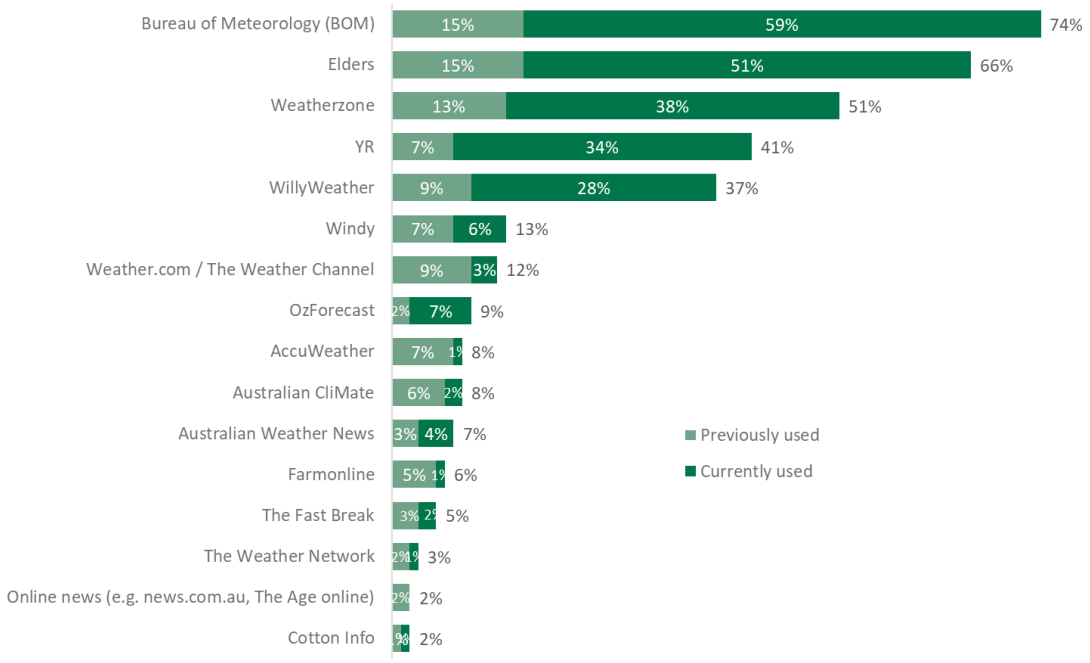


Figure D. Sources of weather forecasting information – online - GRAIN

Q.8.a And which weather forecasting services brands have you actually used (e.g. the site or app name)? Q.8.b And which of those weather forecasting services do you currently use? (Base: Grain producers, n=76)

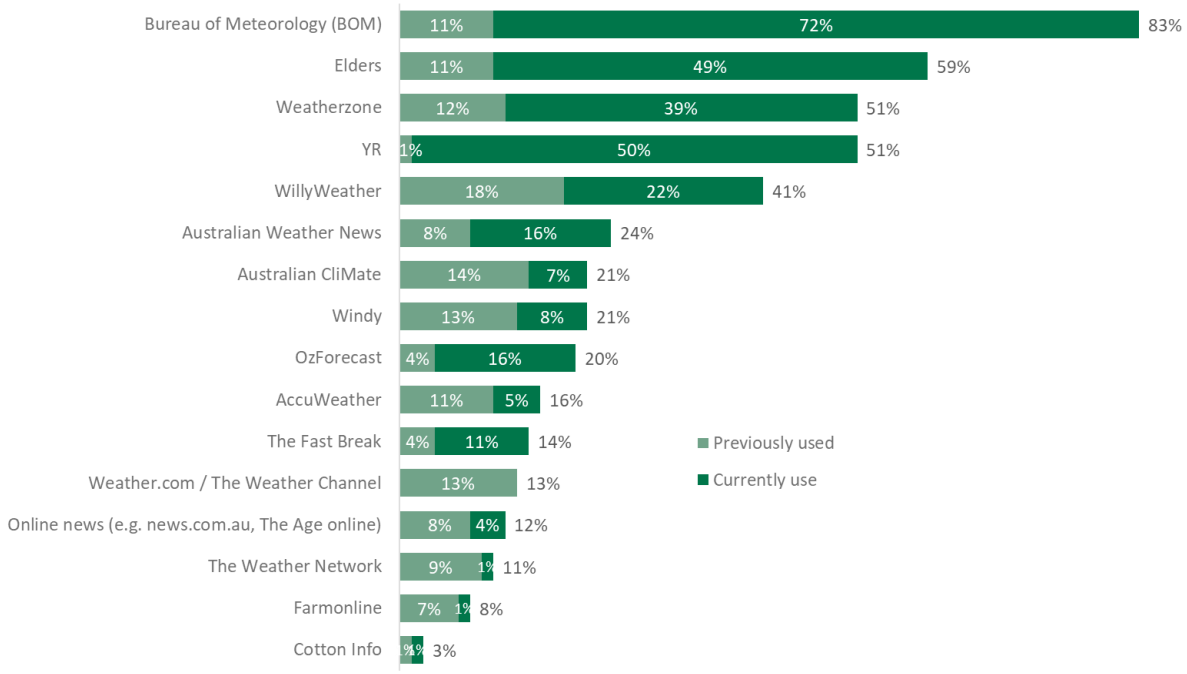


Figure D. Sources of weather forecasting information – online - DAIRY

Q.8.a And which weather forecasting services brands have you actually used (e.g. the site or app name)? Q.8.b And which of those weather forecasting services do you currently use? (Base: Dairy producers, n=48)