Output 3a Identify and provide a map for each industry of the decision-making requirements relevant for sub-seasonal and seasonal climate forecasting information (USQ lead).

KPI 4.4 For all industries, identify and map the decision-making requirements key seasonal information requirements

Background

The 'Improved Use of Seasonal Forecasting to Increase Farmer Profitability' project is focusing on investigating the value of the forecasts (Project 1a), assessing the reliability or skill of the forecasts (Project 1b), improving the use of the forecasts (Project 2) and improving the skill of the forecasts (Project 3). A review literature showing the value of seasonal forecasts has been completed (Parton and Crean 2016) as part of Project 1a.

Use of seasonal forecasts in decision making has been best when the forecasts have been aligned with key decision points. This activity is responsible for understanding the timing and application of key decision points in the agricultural management cycles in order to customise forecasts for use at key decision points.

USQ has worked with the New South Wales Department of Primary Industries (NSW DPI) and Department of Agriculture and Fisheries WA (DAFWA) through the industry engagement and case studies to identify key decision points in all industries, to map using a matrix, the key decisions and identify the important sub-seasonal and seasonal forecasts needed as part of this decision making. USQ has led the northern component (beef, sugar, grains), NSW DPI the southern Australia component (beef, grains, cotton, rice), and DAFWA the western component (grains).

This report presents findings from our industry engagement and case studies in northern, southern and western industries to identify the key decision points in the annual management cycles for beef, grains, sugar, cotton and rice in the different regions, the key decision points and identifies the important sub seasonal and seasonal forecasts likely to have the greatest impact and potential value.

Actions Taken

A summary of the enterprise, key decisions, relevant weather intra-seasonal and seasonal climate systems and their timing needs are in Table 1.

Table 1. A summary of the enterprise, key decisions, relevant weather intra-seasonal and seasonal climate systems and the timing needs for beef, grains, sugar, cotton and rice in northern, southern and western regions in Australia

Enterprise	**Key decisions**	**Relevant weather, intra-seasonal and seasonal climate systems**	**Timing**
Northern grazing	Decisions on stock numbers to be carried for the season are made March-May. If the grazing and herd is being managed well, getting average to 20% below average rainfall for summer is no problem. What people need to know is the chance of getting 50% below, 70% below etc. A forecast for the next 3, 6, 9 months is useful. Rain in the dry season in the Kimberley is useful for grass growth. Weaning in May-June needs to be changed in response to seasonal conditions and good forecasting could play a role in planning. A skilful forecast issued in May-June for the next 9 months would be very useful for deciding on having only 1 Round of mustering, resulting in large savings in labour and mustering costs. Sell in Aug-Sept if outlook is dry and if animals are in suitable condition. Forecast for next 3-6 months is useful. Make plans for further selling if outlook is dry. Round 3 muster in Oct - sell if outlook is dry and animals are in poor condition.	Seasonal forecasts for summer with as much long-lead time as possible (ENSO or otherwise). ACCESS may prove useful for this longer lead time need. Change in forecast terminology may be warranted. Seasonal forecast for winter is still useful. Long-lead seasonal forecasting seems to hold the key to decisions in this far northern zone. Long-lead seasonal forecasts for the summer season very valuable. Forecast of the start of the wet season and end of wet season and use of MJO-based forecasts especially valuable. Long-lead seasonal forecasts for the	March-May July-September

		summer season very valuable.	
Northern grains - pulse/chickpeas	**Crop and variety selection**. High GM $/ha on chickpeas and fababean - does this over-ride normal paddock crop rotation - implications for disease/ascochyta, phytophera, sclertinia, viruses etc. Weed control - persistence of summer weeds into winter due to later start to winter season. Decision to bait mice prior to planting. Nitrogen application rates. Wheat variety selection.	In-fallow and/or summer rainfall - drives soil moisture profile for winter cropping. Also informs decisions such as on row spacing (e.g. chickpeas from 50 to 100cm) and fertiliser application. SOI phase - %chance of xx mm rainfall to ensure early to mid-crop growth and establishment. MJO timing and strength - planting opportunities. ENSO - what is occurring and implications for crop finish - wet/dry and disease and/or insect implications. Frost - likely finish period. Key requirements summary: ENSO outlook updated at least monthly. Rainfall and temperature over the coming seasons - forecast using ENSO/SAM/IOD/STR or through GCMs if high enough skill. Forecasts of frost over the season and date of last frost.	Seasonal forecasts for winter needed earlier than currently available (need winter forecasts in April or early May rather than in mid-May or June).
Northern grains - Central Queensland	Northern workshops - decision to plant dryland summer crop (cotton, sorghum). Irrigated crops - area to plant reflecting availability of water.	In-fallow and/or winter rainfall - drives soil moisture profile for cropping. Producer feedback indicated soil moisture profile at time of sowing as not as	Seasonal forecasts for winter needed earlier than currently available (need winter forecasts in April or early May rather than in mid-May or June)

	Southern workshops - crop and variety selection - (forage or grain), cotton, pulses. Timing of sowing.	important as for winter cropping as there is increased potential for in-crop rainfall during summer. Does help decisions regarding crop selection, opportunity cropping and crop rotations. SOI phase still used and regarded as valuable in decision making- %chance of xx mm rainfall to ensure early to mid-crop growth and establishment. MJO timing and strength - planting opportunities. ENSO - what is occurring and implications for crop finish - wet/dry and disease and/or insect implications. Summary of key seasonal and intra-seasonal forecast needs: Seasonal or longer forecasts of ENSO and/or seasonal rainfall and temperature through GCMs as early as possible (April or mid-May rather than early June). Relevance of MJO at these latitudes needs further work as this aspect appears to influence decisions related to timing of planting and harvesting.	
Northern grains - Darling Downs (summer crops)	Decision to plant dryland summer crop (cotton, sorghum predominately).	In-fallow and/or winter rainfall - drives soil	October-April

	Irrigated crops - area to plant reflecting availability of water. Also issue of whether to persist with managing disease and pest load in chickpea crop. Drier finish and harvest period would help maximise available high returns. Timing of sowing.	moisture profile for cropping. Producer feedback indicated soil moisture profile at time of sowing is not as important as for winter cropping as there is increased potential for in-crop rainfall during summer. Does help decisions regarding crop selection, opportunity cropping and crop rotations. SOI phase - %chance of xx mm rainfall to ensure early to mid-crop growth and establishment. MJO timing and strength - planting opportunities. ENSO - what is occurring and: implications for crop finish - wet/dry and disease and/or insect implications. Summary of requirements: Seasonal summer forecasts of rainfall and temperature plus: Seasonal forecasts of the seasonal risk of hail (high/medium/low). Use of and value of the MJO seems to be important: quantification of the impact and value of the MJO at these latitudes	

		needs to be better quantified.	
Sugar and associated rotation crops	Time of fertilising Conservative forward pricing Starting of sugar crushing Planting in front/back of an MJO event Use of ripeners for longer season length Ratooning – Plough out ratoon Harvesting rotation Planting rotation Nitrogen management – use inhibitors if a wet forecast Weed management – more in a wet year Block rotation and the area of rotation Planting and harvesting timetables. In a dry year leave better yielding blocks until later. Wet year changes decisions Fertiliser application. Decision to use Entec use (20% higher $) (slow release), or use of 'normal' fertiliser Pricing of sugar on the market. Feb 24th locking in of sugar lots on world	Use of MJO highlighted. Use of MJO highlighted. Use of MJO highlighted. Seasonal forecasts, especially of over-wet conditions – Forecasts of La Nina critical, position of the sub-tropical Ridge during winter and spring potentially magnifying impact of La Nina also critical. Seasonal forecasts of extreme low minimum temperatures Seasonal forecasts of wet conditions critical – included number of wet days above critical amounts. Seamless forecasts covering weather, intra-seasonal and seasonal climate critical. Forecasts of critical temperature ranges. Risks of rainfall being in the highest categories (e.g. top 20% of values). More targeted forecasts critical. Seasonal forecasts critical. Seasonal forecasts of local and also	Autumn/winter: March onwards Autumn/winter Summer Winter

	market. Look at what Brazil crop is doing and associated rainfall events Diversification. Rice etc. Irrigation systems	international (eg Brazil) critical. Multi-year forecasts would be highly valuable for more strategic decisions If 'wet' forecast avoid over investment in irrigation, infrastructure (e.g. pumps, piping and other equipment) that won't be used to its potential as it would be in a drier season. Leasing extra water: Buying more water earlier in the season before it becomes expensive if the season ahead is likely to be dry. Irrigation scheduling. If wet crushing expecting then apply less close to harvest. Irrigation management around crop water needs. Irrigation infrastructure investment: new pumps, spears, pipelines. Irrigation scheduling Irrigation allocation Irrigation infrastructure maintenance, upgrading and investment. If season is going to be wet, make sure gear is well maintained and up	May to Nov in the north. Sept/Oct in the south (Bundaberg/Childers).

		to the irrigation demand. Irrigation electricity tariffs. Change to a cheaper tariffs depending on the expected electricity usage. Electricity usage would be higher in a forecast dry season than a forecast wet season. Tariffs could be changed accordingly depending on forecast usage. Irrigation scheduling using MJO –Water early if longer term forecast is 'wet', if dry, water in between passage of MJO. Irrigation – Invest in alternative equipment than irrigation if the season ahead is likely to be dry. Purchasing more water allocation, if dry season is expected.	
Peanuts – southern Queensland	Planting Peanuts: Determining best time to plant peanuts. Early November plant may lead to a wet harvest in March if wet La Nina conditions occur. Early December plant, with harvest in mid-April may be safer in a wet year. □ Planting operations generally throughout the year.	Seasonal risk of rainfall being in the highest 20% of climatological values	Summer and Autumn

Southern beef NSW – Holbrook	How many weaners to sell in March. Also links to key antecedent conditions in regards to cash-flow, weaner price, and available feed at the time.	Rainfall in the forthcoming March to May period. ENSO, SAM, IOD – based systems – However, this could fit well into ACCESS –S outputs, especially given the otherwise poorer predictability capability during this time of the year	March in any given year
Southern beef - NSW – Holbrook	How many weaners to sell in January (beef industry)? (Hence how many weaners to keep over winter to sell as steers/ heifers). Important antecedent conditions include current cash-flow, weaner prices and available feed	Rainfall in the forthcoming January to March period. Requirements fit the current ENSO forecasting systems well. Links to ACCESS valuable.	January in any given year.
Southern lamb NSW – Holbrook	How many lambs to sell (lambing industry)? Antecedent conditions include available pasture supply and both stock and grain prices.	Rainfall in the forthcoming November to February period. ENSO and other well tested systems fit easily into this decision. ACCESS-S should also pick this up.	November in any given year.
Southern dryland cotton industry Bungunya region – southern Queensland border region.	What area of cotton to plant (dryland cotton industry). What row spacing to apply in dryland cotton planting (e.g. single skip rows; double skip rows, etc.)?	Rainfall in the forthcoming November to February period. ENSO and other well tested systems fit easily into this decision. ACCESS-S should also pick this up.	November in any given year.
Southern winter cropping Birchip – mid Victoria region	What area of canola to sow? Important antecedent conditions include Soil moisture levels and whether sowing rains have already occurred.	In-crop growing rainfall April to October. ENSO and SAM/IOD based systems plus sub-tropical ridge forecast based systems would apply. ACCESS-S may well be able to synthesise these systems into useful output.	April in any given year

		April forecast requirement would normally be regarded as within the autumn predictability gap period but ACCESS may be able to overcome this issue.	
Southern winter cropping Birchip region	How much in-crop nitrogen to spread? Important antecedent conditions include cash-flow, soil nitrogen levels and soil moisture levels. Similar decisions are common throughout the entire eastern Australian cropping system.	July to October rainfall. All known seasonal climate forecast systems (e.g. ENSO/SAM/IOD /sub-tropical ridge influences) should be able to assist this decision. ACCESS-S may be able to combine and facilitate this need.	July in any given year.
Western winter cropping: Burracoppin, South west Western Australia	Important forward selling issues: "What percentage of my wheat crop will I forward sell"? Antecedent conditions include (global) wheat prices and soil moisture conditions	In-crop growing rainfall April to October. Suggest this would be a major challenge. ENSO and SAM/IOD based systems plus sub-tropical ridge forecast based systems may apply. ACCESS-S may well be able to synthesise these systems into useful output. April forecast requirement would normally be regarded as within the autumn predictability gap period but ACCESS may be able to overcome this issue.	April in any given year.
Western winter cropping: Burracoppin, South west Western Australia	What percentage of my crop will I forward sell (2)? Important antecedent conditions include wheat	August to October rainfall forecast needed. Suggest common use of ENSO-based indicators	August in any given year.

	prices and soil moisture conditions.	plus sub-tropical ridge information may be valuable. ACCESS-S may hold the solution for this difficult to forecast region.	
Rice industry - Deniliquin, southern NSW	When to drain a paddy in the rice industry. "When will I drain my paddy"? Important antecedent conditions including the need to target soil moisture at harvest and assess grain moisture levels	Interesting need for a short term, three week forecast of evaporation levels. ACCESS (and similar?) multi-week weather forecast systems may apply here.	Late March in any given year.

Outcomes and Next Steps

USQ were responsible for the northern region input (see Attachment A) to Table 1 and acknowledge the input from NSWDPI and DAFWA for the southern and western components respectively (see Attachment B). We recommend that the timing of key decisions information in these attachments could be very useful beyond this project if it was repackaged, graphic designed and presented in factsheets or brochures and published (on the web) for use by other agricultural industry stakeholders.

USQ have been collaborating with Birchip Cropping Group (BCG) and have provided a report on the skill and timeliness of climate forecasts in industry clusters over time (KPI 3.2, Output 4d). Further results regarding the skill and timeliness of climate forecasts will be reported on by USQ in conjunction with NSW DPI in the following outputs, both **due 15/12/2017**:

- Output 3(c): Conduct consultation and feedback workshops with each industry's stakeholders and experts to test and validate draft frameworks developed under Output 3(b) and review the relative skill of all major climate forecast information sources.
- Output 3(d): Report on the results of the skills review of forecast information sources under Output 3(c) against the seasonal climate information needs of each industry. Provide details of each industry's information requirements.

The information contained in this report will be an important reference for the outputs described above.

References:

Parton KA and Crean S (2016). Review of the Literature on Valuing Seasonal Climate Forecasts in Australian Agriculture. NSW DPI.

Attachment A

Climate interactions with annual management cycles, starting conditions and timing of key decisions for the beef, sugar and grain industries in northern Australia (prepared by USQ).

Decision making.xlsx

Attachment B

Climate interactions with annual management cycles, starting conditions and timing of key decisions for the beef, rice, cotton, sheep and grain industries in southern Australia (prepared by NSWDPI) and grains in western Australia (prepared by DAFWA and NSWDPI).

Beef_production_summary_v2.xlsx

cotton_production_summary.xlsx

Grains_production_summary_Sth.xlsx

Grains_production_summary_WA.xlsx

Rice_production_summary.xlsx

Sheep_production_summary.xlsx