Water Risk in Australia Survey Results

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Summary

This research aimed to understand the materiality of water risk to Australian Farms. The survey asked farmers a series of questions about how they manage water risk, where they source their water and how they use technology. The majority of respondents (47%) owned or managed farms within the Murray Darling Catchment, the remaining farms were spread across other catchments in NSW, Victoria, QLD, Tasmania and WA. A total of 72% of respondents used irrigation and the remainder indicated that irrigation was not applicable to their situation.

The mean turnover of the primary farm was $1.48 million and mean operational expenses was $841,000. The mean water expenditure across all farms was $25/hectare or a mean of $34,000 per farm.

The thirstiest crops were sugarcane, cotton, rice and tobacco, requiring.

The mean number of years a farm experienced water stress was 3.04 years. The Murray-Darling Basin had the highest mean years of water stress reported at 4.5 years.

The primary source of water for most farms is on-farm water storage with the next highest source being owned water rights. Surprisingly, very few farms participate in the short term water markets, although farms actively monitor the water price, farmers prefer to exhaust all other water resources before water is purchased on the open markets. Only 22% of farms have purchased water from the short term water markets and only 8.6% have sold water through a temporary trade. When farms do need to purchase water from the markets 80% of farms only purchase between 0-10% of total water requirements. This shows water markets offer an important resource to farms to get gain access to water when they need it.

Traditional methods such as rain gauges and soil moisture monitoring were preferred over new smart technologies. The main barriers to the adoption of new technologies was their upfront cost, and not being considered cost-effective.

Over 70% of respondents said they self-fund the management of water risk management. Finally participants were polarised over the effects of climate change exacerbating water risks with 37.5 considering climate change extremely important or very important and 32.5% considering climate change not important or slightly important.

Introduction

This slide deck provides the results of a survey assessing the materiality of water risk to Australian farms. The research project was conducted by ISF in partnership with the National Australia Bank (NAB). A total 845 farms initiated the survey with 377 farms answering the final question. On average the survey took 28 minutes to complete. Individuals did not receive financial incentives to participate but $10 AUD for every completed survey was donated to a drought relief fund operated by the Australian Country Woman's Association. All participants who completed the survey also went into a draw to win of five $200 shopping vouchers.

The research project aimed to collect information to improve NABs internal processes around the assessment of water risk. The online survey targeted growers and graziers across all states and territories except the Northern Territory.

The survey consisted of 47 questions across five major categories including:

1. Demographic and farm details
2. Water availability
3. Water risk and decision making
4. Water markets and information
5. Finance for water risk mitigation

The complete survey can be found in Appendix A.

Responses

The survey was developed between July to October 2018. The survey was launched on the 1st November 2018 and was available online until the 8th April 2019. Recruitment for the survey was undertaken by an independent organisation where contact details were purchased from a proprietary database. The survey was available for responses over a period where many farms across Australia were experiencing a severe drought (Victoria, New South Wales and much of Queensland) or flooding (north Queensland). XX farms were contacted to participate and from these, 849 participants initiated the survey, 799 agreed to the terms and conditions for participating and 377 completed the survey to the end answering the final question. In total the survey covered responses for 1,378 farms where more than 50% of respondents own more than one farm.

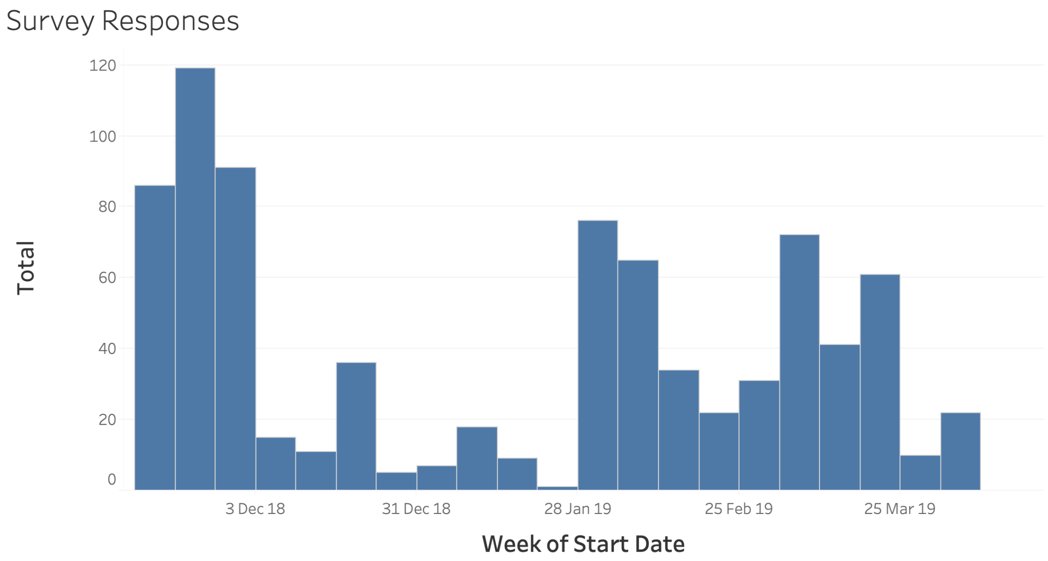

Figure 1: Timeline of survey responses

Farm locations

The highest number of farms participating in the survey came from the Murray-Darling Basin (MDB) equating to 47% of total responses. The second highest was for the category ‘other’ which implies that many farms did not recognise the water catchment area they were in. Upon reviewing the postcodes for these farms, the correct catchment was identified and amended.

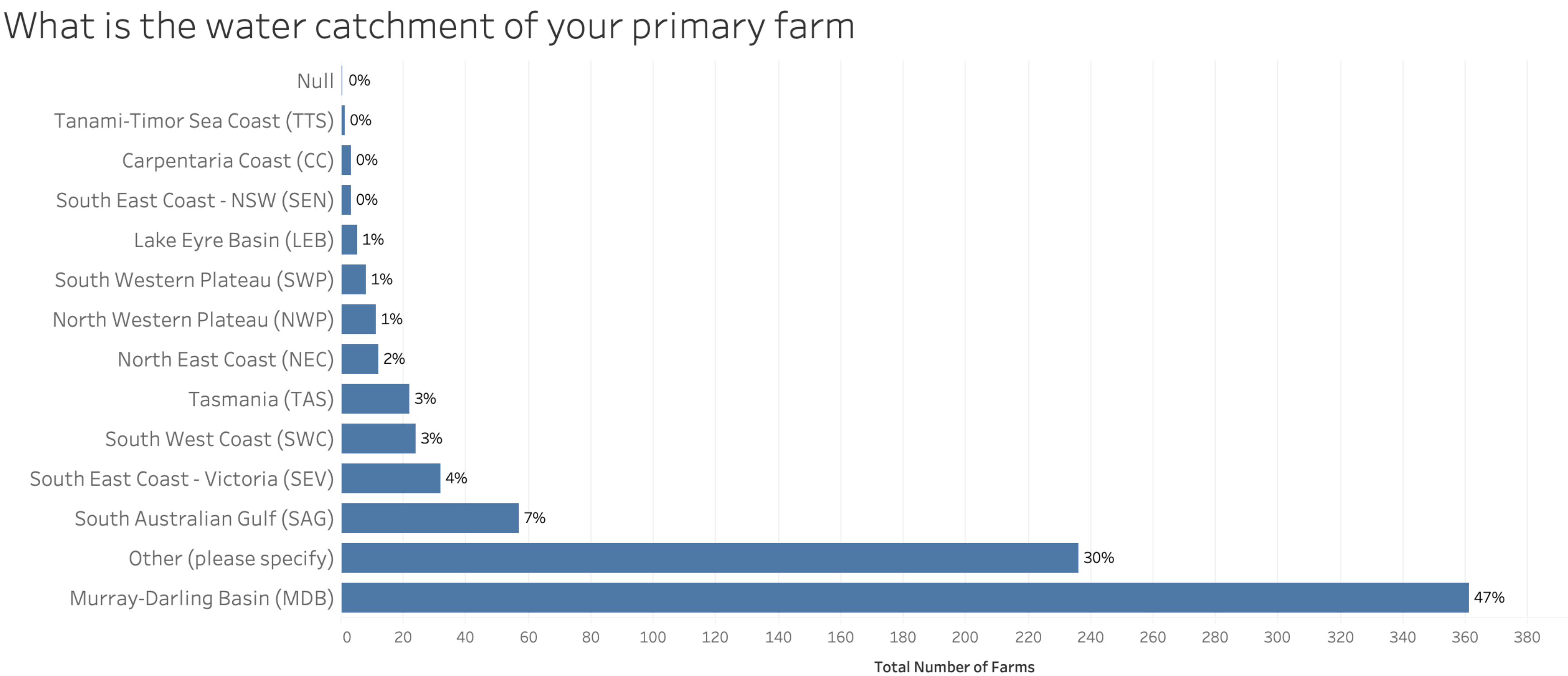

Figure 2: Water catchment of primary farm

Farm locations across Australia

This map shows the location of farms across Australia participating in the survey. The size of the bubble represents absolute water expenditure which ranges from 0 to $500,000 per annum.

In this map blue bubbles represent farms that have irrigation systems available, while orange bubbles represent those farms without irrigation systems. Interestingly non-irrigators also purchase water on the open markets. This map also highlights the areas that have farms with significant water expenditure represented by the size of the bubble.

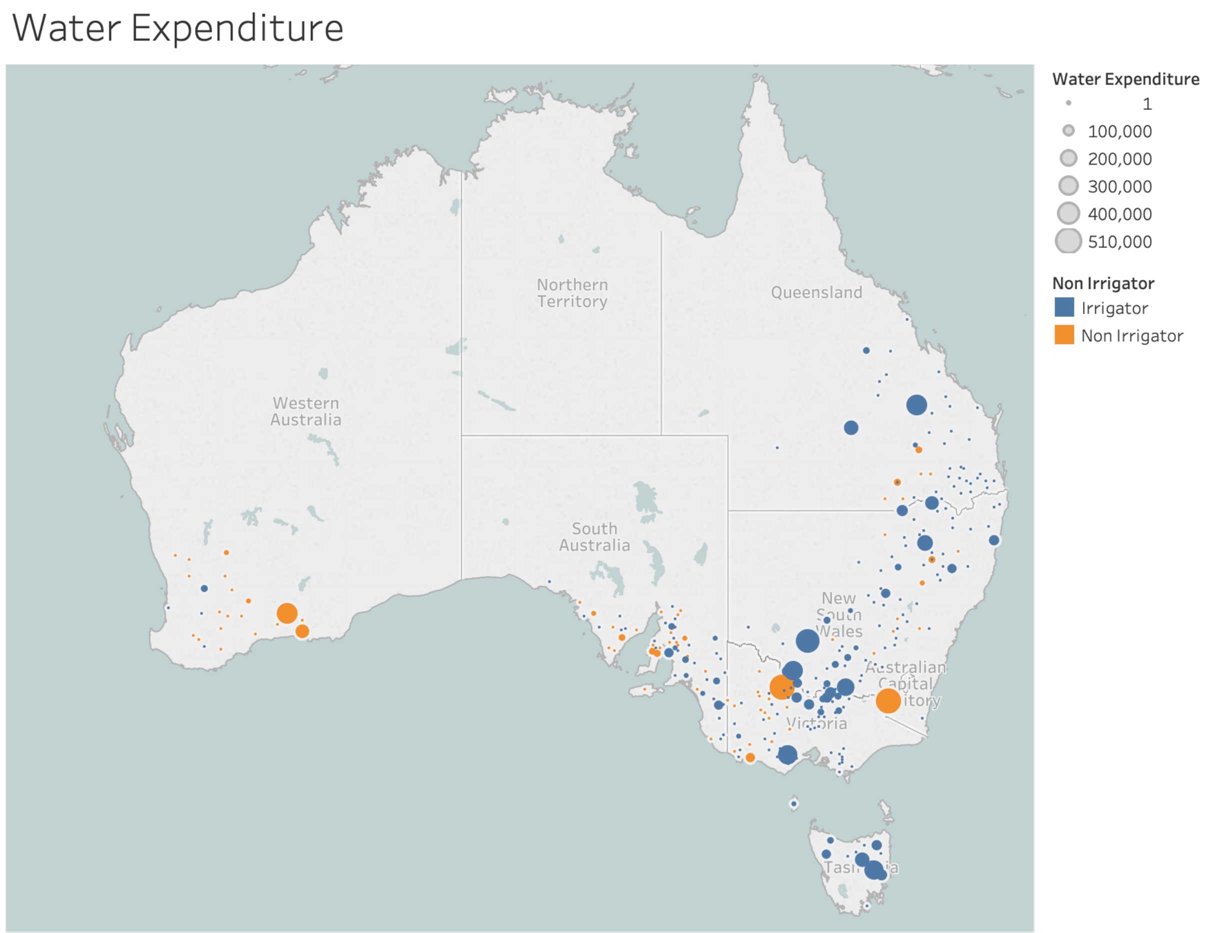

Figure 3: Location of farms and water expenditure of irrigators and non-irrigators

Staff employed

Across the board farms prefer to employ casual staff than part time or full time staff. This makes sense given the seasonal nature of agriculture. On average each farm that responded to the survey will employee 1.1 part time staff, 1.8 full time staff and 3.6 casual staff over a year. As shown by the boxplot, there are several farms that employ multiple staff across the year. Although not shown in the box plot below, the maximum number of casual staff employed was 400, full-time staff was 280 while the maximum number of part time staff was 176. These are clearly farms that have large agricultural operations.

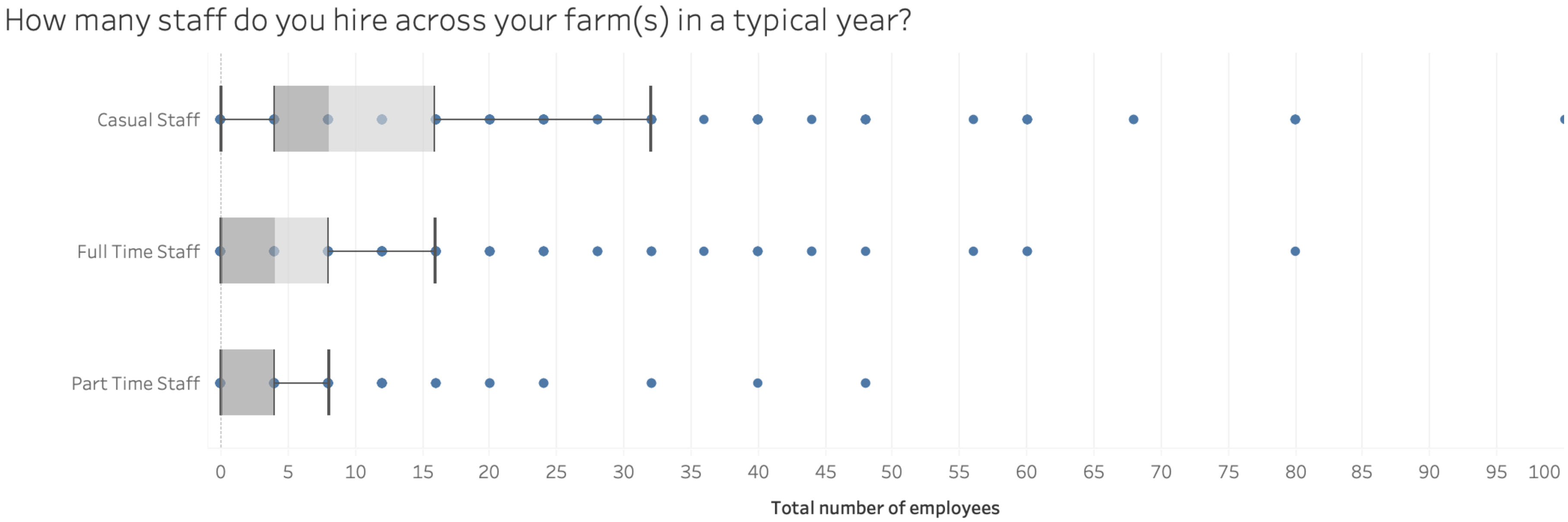

Figure 4: Boxplot showing distribution of number of staff employed by employment type

Additional farm(s)

In total, the survey covers data for 1,378 farms across Australia. Over 50% of respondents own multiple farms with 23% of respondents owning a second farm, 14% owning a third farm, 6.5% own a fourth farm, 3.4% own a fifth farm and 2.9% own a sixth farm.

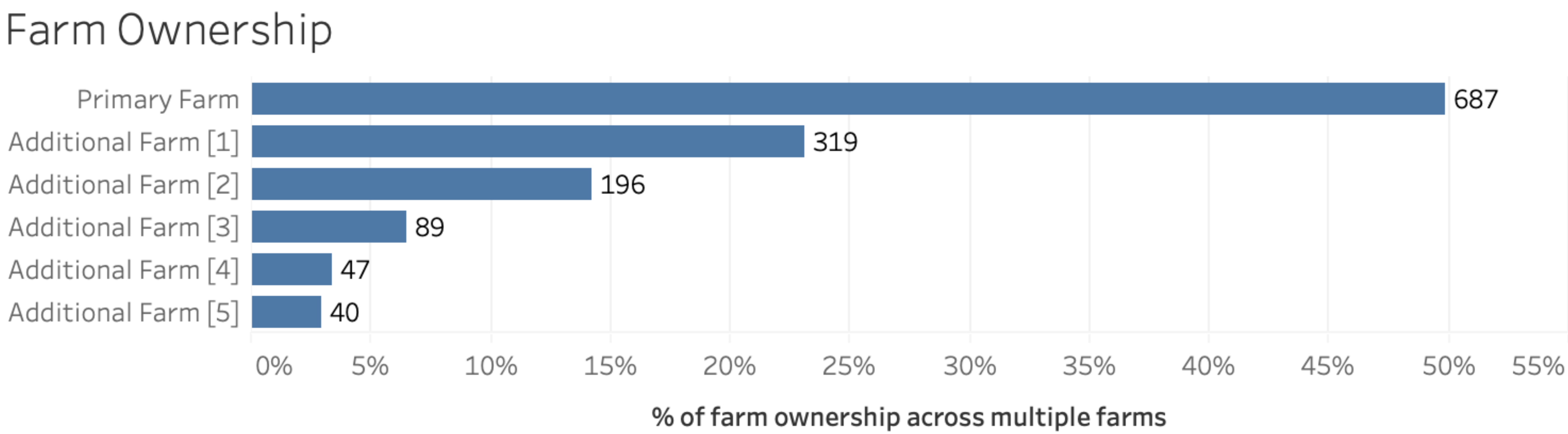

Figure 5: Number of additional farms owned

Length of farm ownership

The figure below shows a histogram (number of farms) by the number of years the farm has been owned. For the primary farm the most frequent period of ownership (e.g. the mode) is a farm that has been owned for between 20-40 years. For the first additional farm the mode is 10-20 years, while the 3rd, 4th, 5th and 6th farms are fairly evenly distributed with most additional farms only being owned for a short period.

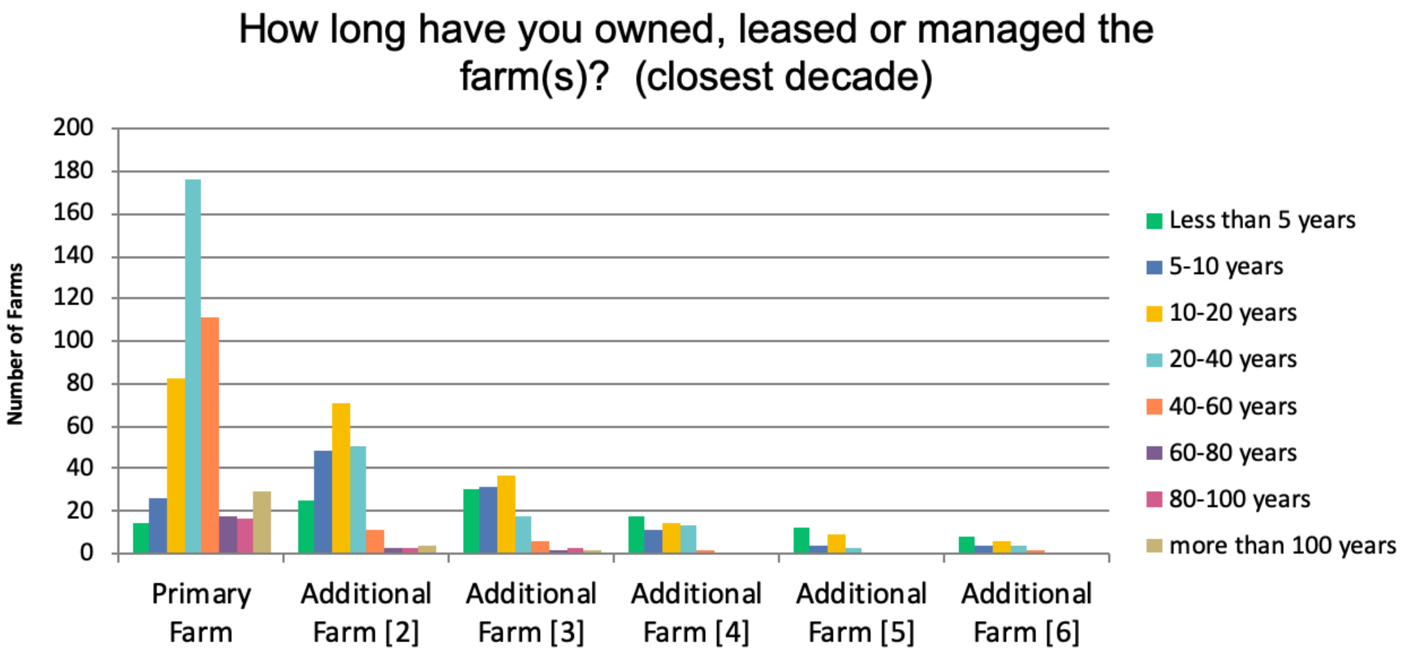

Figure 6: Number of years owned for each additional farm.

Farm ownership

In the chart below it is clear that the majority of farms are owned rather than leased or managed. Interestingly, the number of leased second and third farms exceeds the number of primary farms that are leased.

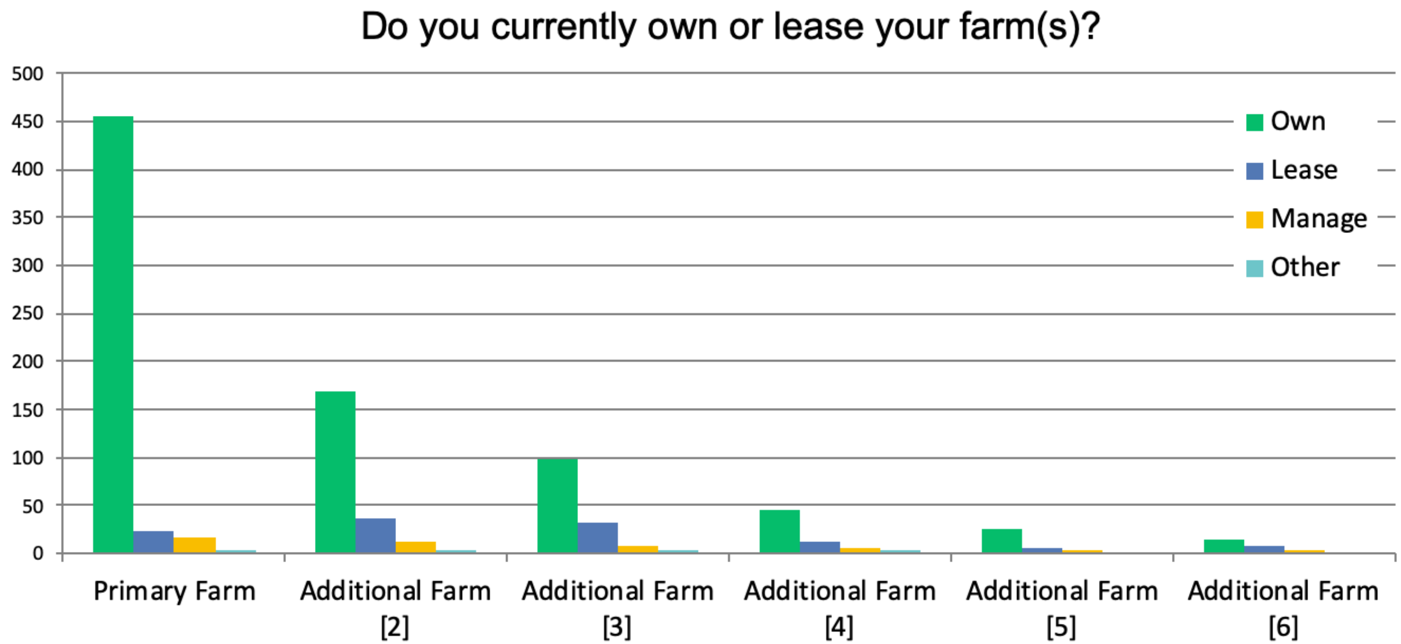

Figure 7: Number farms owned, leased and managed.

Farm Land Area

The boxplot for land area shows the distribution of farm land area across the farms that were surveyed. The mean number area of land per farm is 6,660 Hectares, while the median land area per farm is 1,200 Hectares. The large difference between the mean and median values indicates a heavily skewed distribution with few very large farms and many smaller farms. In fact 75% of all farms surveyed are under 3,000 Hectares.

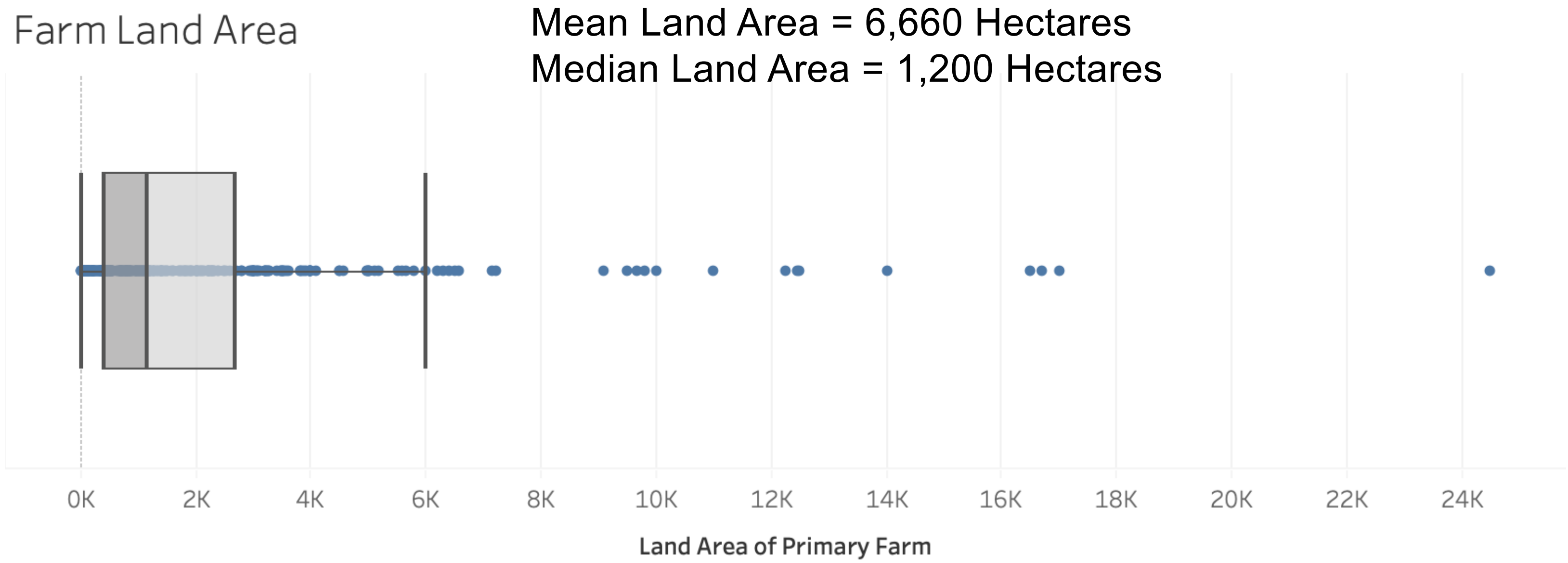

Figure 8: Boxplot showing distribution of primary farm land area

Primary Farm Turnover

Similar to land area, the boxplot below shows the distribution of primary farm turnover. The mean turnover of all primary farms is $1.48 million, while the median primary farm turnover is $400,000. The large difference between the mean and median values indicates a heavily skewed distribution with few farms generating a high annual income. Within the dataset there are seven primary farms generating more than $10 million in turnover, with the farm with the highest turnover generating $150m. We also know that 75% of primary farms have an annual turnover of under $1 million.

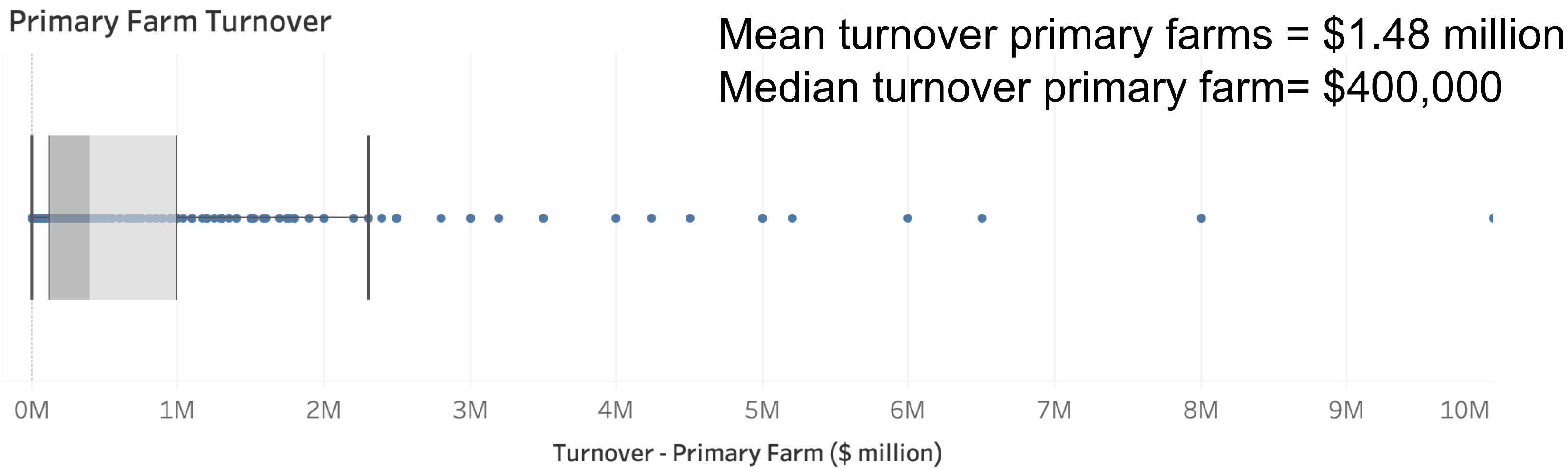

Figure 9: Primary Farm Turnover

Total Farm Turnover

The boxplot below shows the distribution of total farm turnover (turnover summed across all farms owned). The mean turnover of all farms owned is $1.9 million, while the median turnover across all farms $600,000. The large difference between the mean and median values indicates a heavily skewed distribution with few owners generating a high turnover across their farms. Within the dataset there are 10 owners generating more than $10 million in turnover each year, with one of the farms generating $150m in turnover. We also know that 75% of farm owners have an annual turnover across all farms of under $1.4 million.

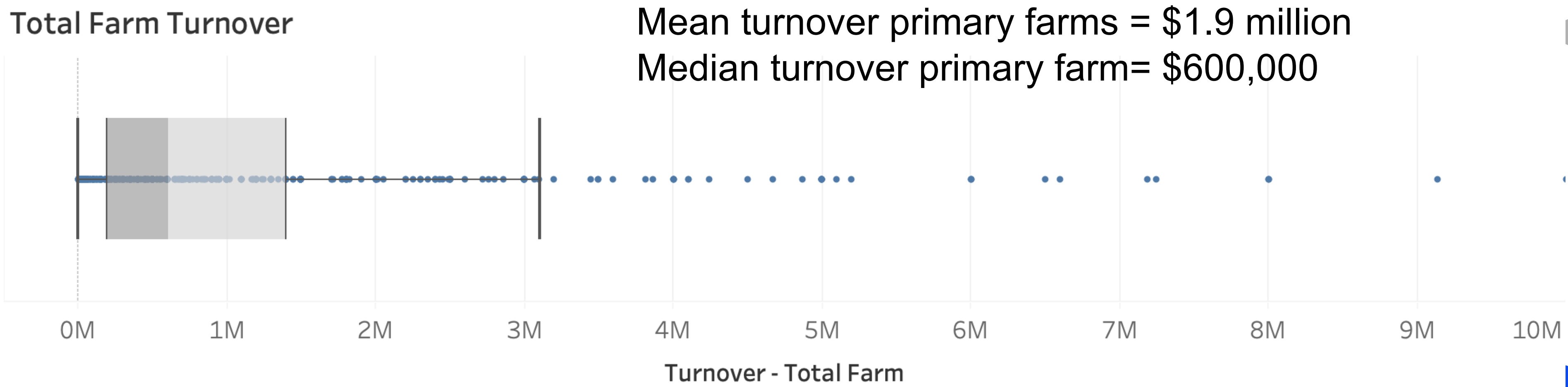

Figure 10: Total Farm Turnover

Operational Costs

The box plots below show the distribution of operational costs by water basin. The boxplots below indicate that the SWP, SWC, SAG and MDB have some of the operational costs.

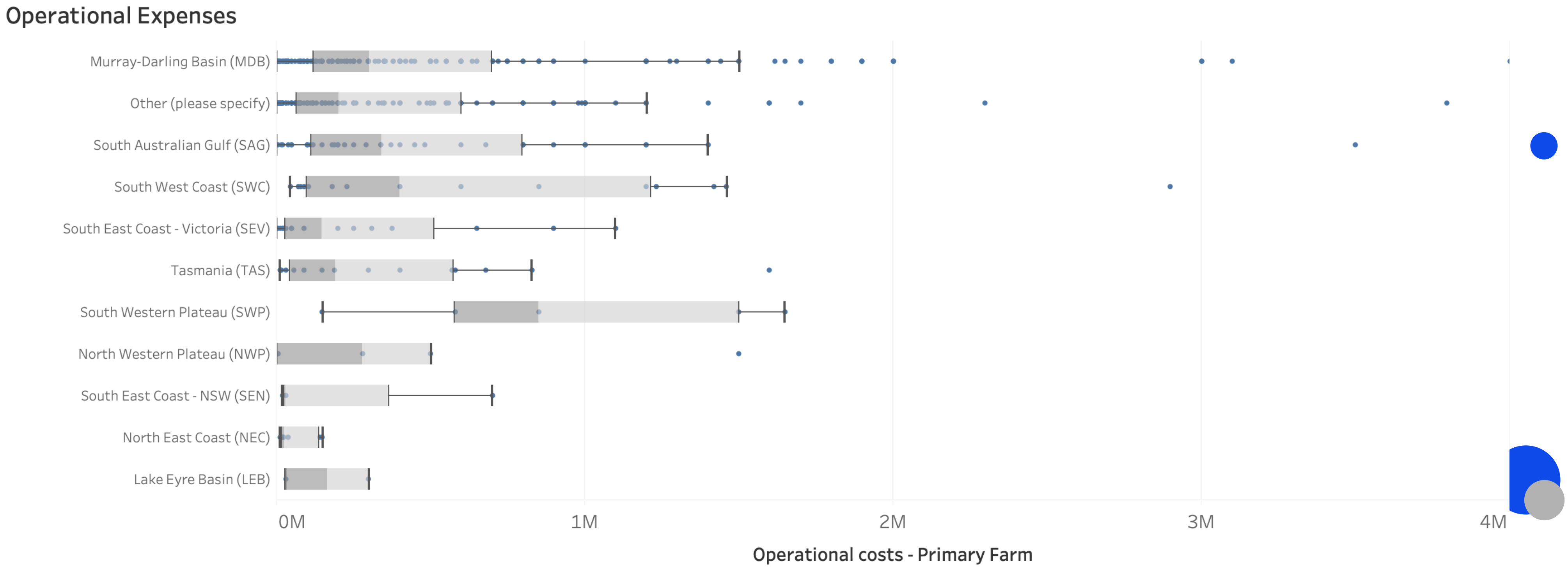

Figure 11: Operational costs by basin

Turnover vs Operational Costs

The scatterplot to the right shows the relationship between self-reported farm turnover and operational costs over a typical year.

The chart shows a simple linear relationship between turnover and expenses. The relationship has an R^2value of 0.52 and is statically significant. The relationship is described using the following equation.

Turnover = $560,000 + 1.8 x Operational Costs
$R^2 = 0.52$
P-value < 0.0001

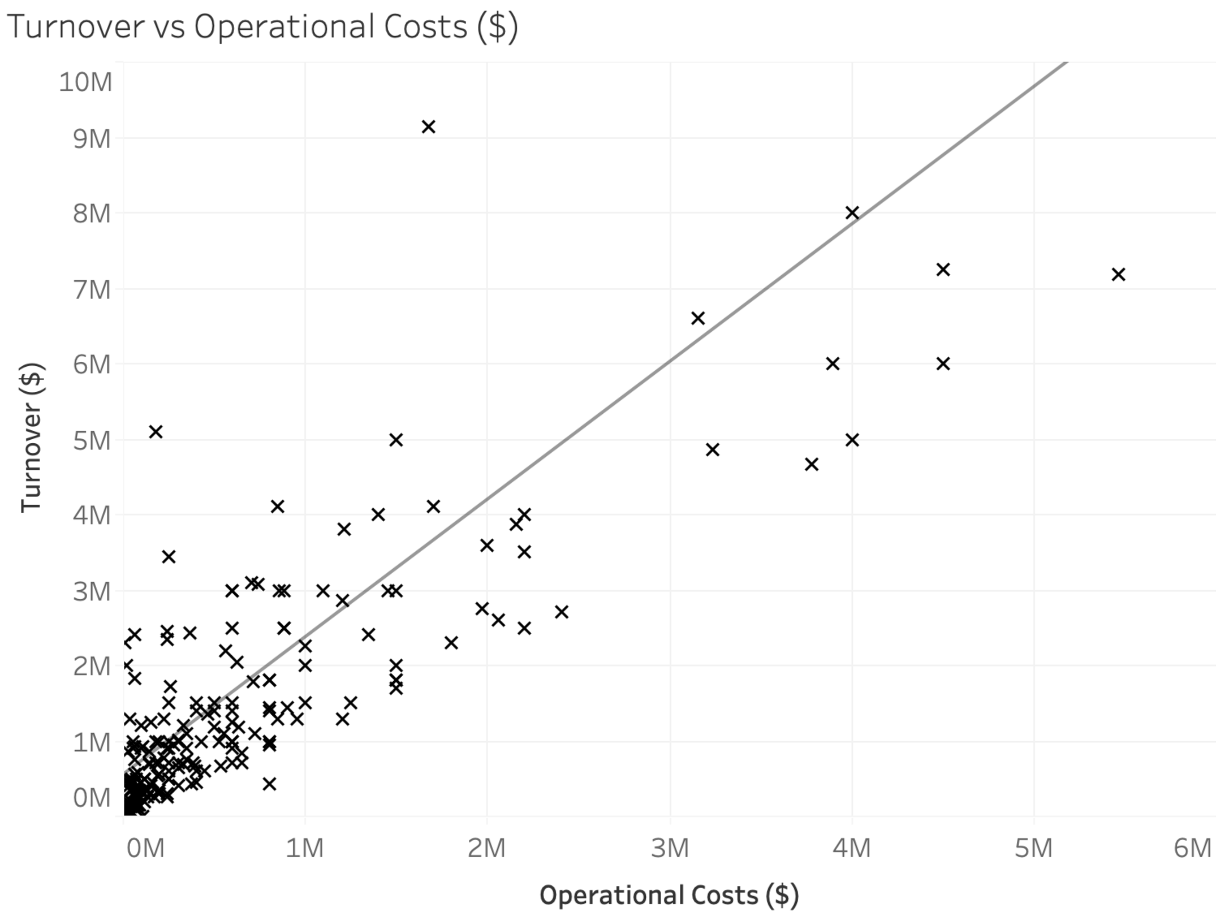

Figure 12: Turnover vs Operational Costs

Profit

The histogram on the right shows the average profit of per hectare. Profit is defined as the total turnover minus operational expenses. The mean profit for all farms is $1.02 million, the median profit for all farms is $464 thousand. The mean profit per hectare is $117,000 while the median profit per hectare is $66,292. While four farms in the sample had a negative profit most farms were profitable, even in the middle of the drought.

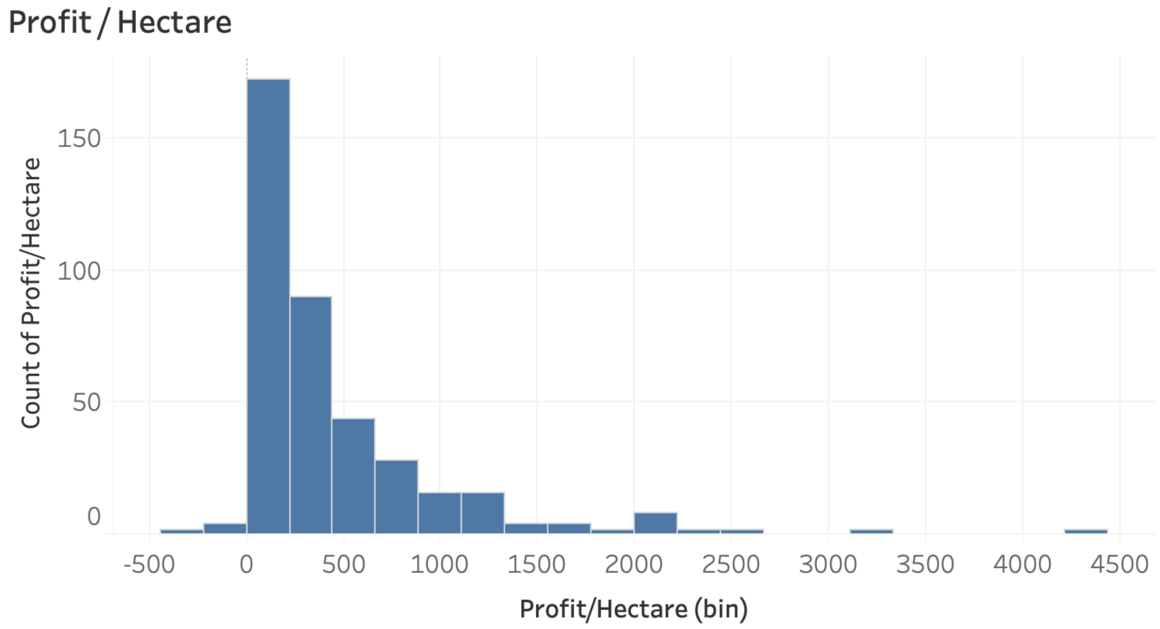

Figure 13: Histogram of profits/hectare

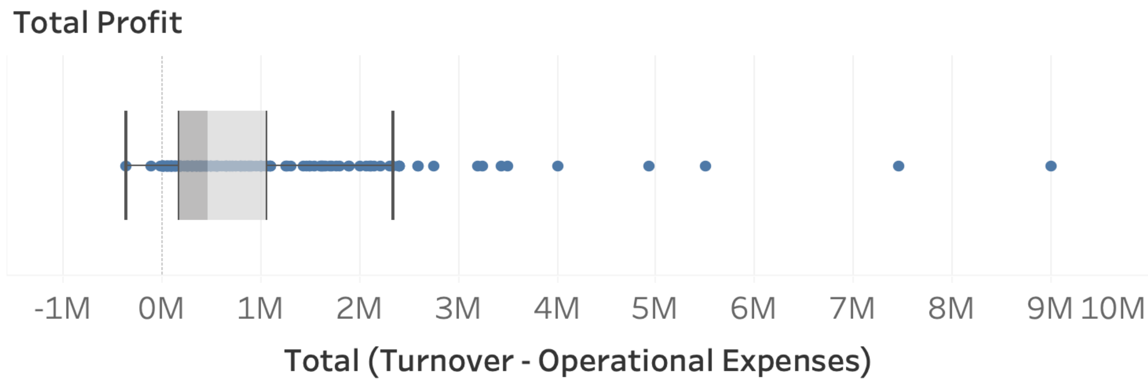

Figure 13: Boxplot of Total Farm Profits

Water expenditure by catchment

The chart to the right shows the proportion of water expenditure as percentage of turnover and profit by catchment. The North East Coast has the largest share, but the NEC only accounts for 2% of farms. The second highest region spending the most on water is the Murray Darling Basin which spends 6% of turnover on water.

The mean water expenditure across all farms was $94,426 and the median water expenditure was $10,000.

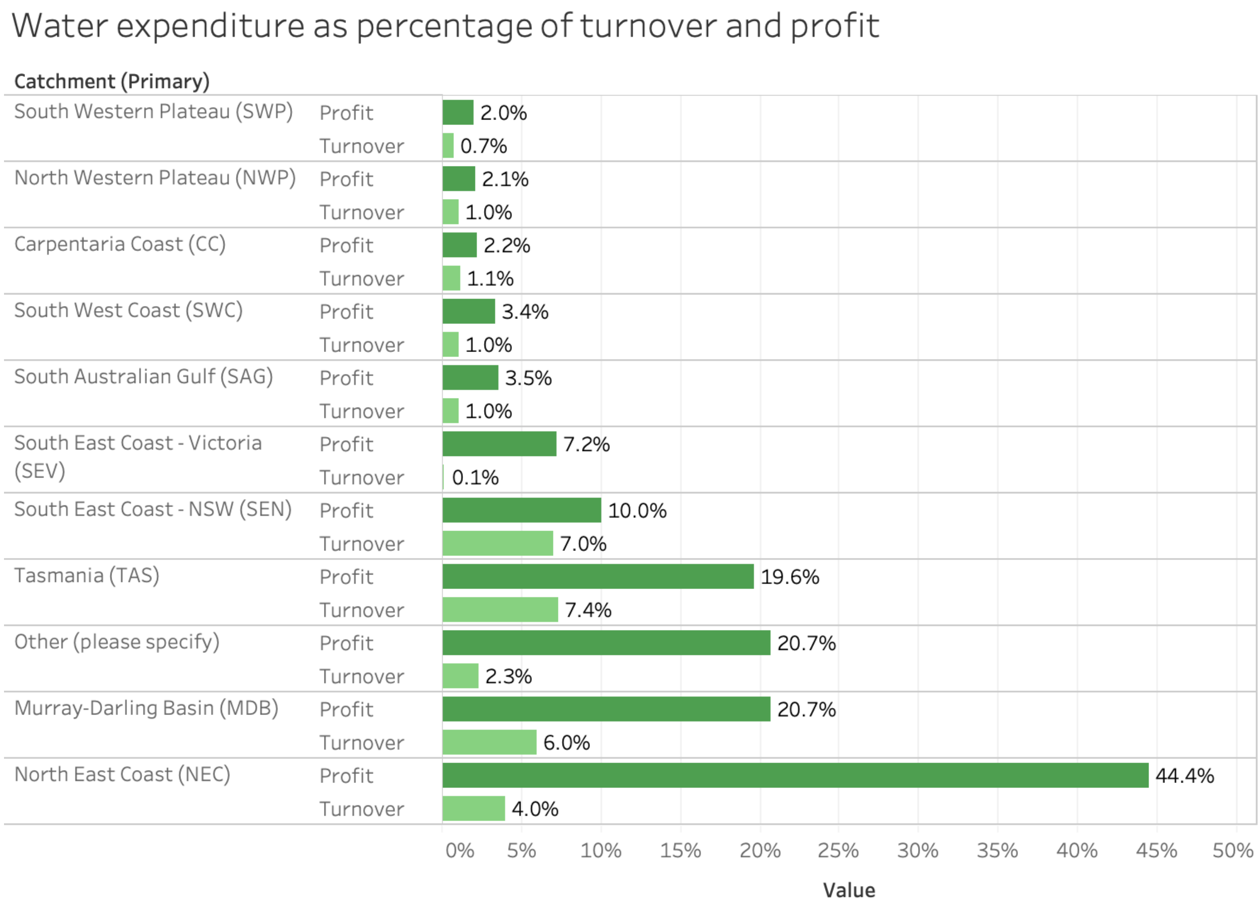

Figure 14: Water expenditure as proportion of turnover and profit by catchment

Water expenditure by catchment

The chart to the right shows water expenditure per hectare for each of the dominant water catchments. As shown, Tasmanian farms pay the highest for water on a per/hectare basis with one farm paying over $350 per hectare. This is followed closely by the Murray Darling Basin with some farms paying a few dollars per hectare to one farm paying $282/hectare.

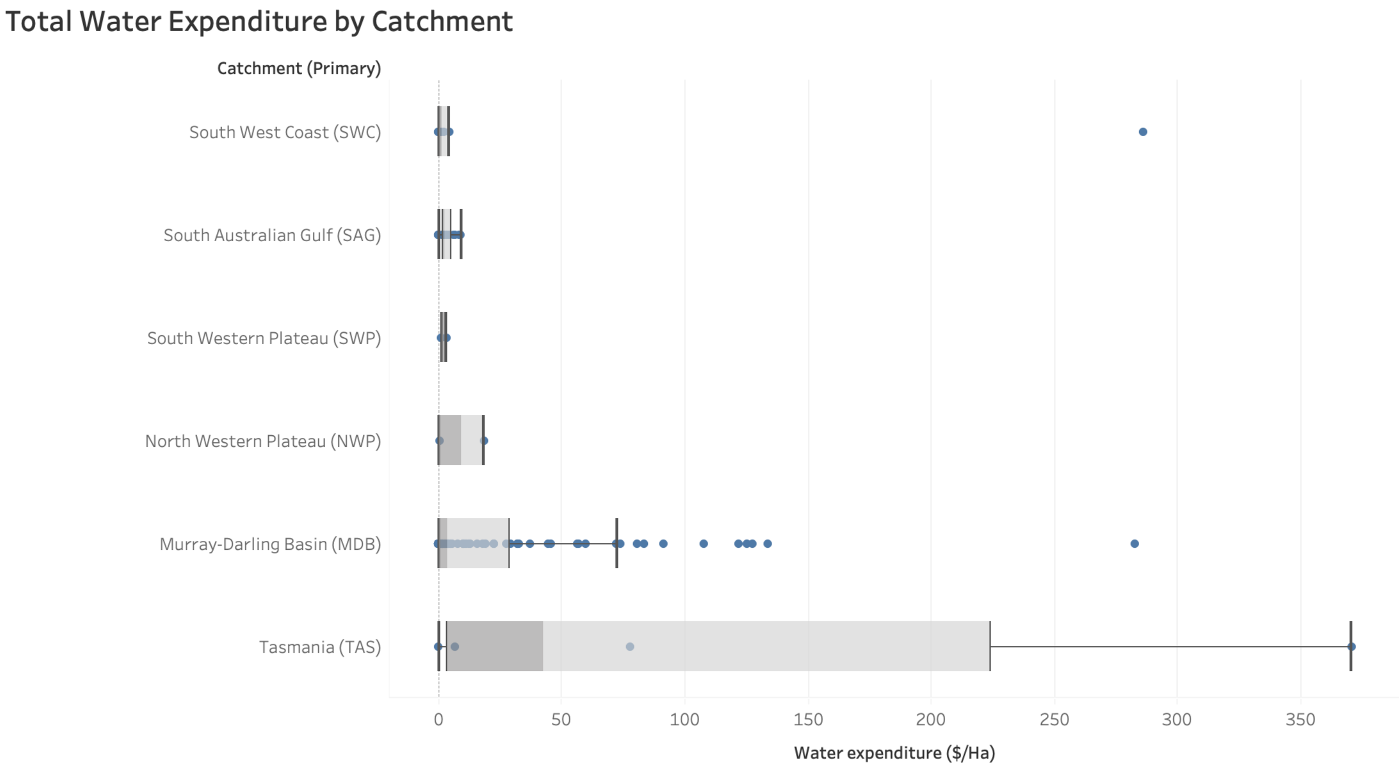

Figure 15: Water expenditure by catchment

Water expenditure by years of water stress

The scatter plot to the right shows the years of self-reported water stress on the x-axis and amount of profit/hectare on the y-axis. The colour of the dots show the percentage of water expenditure as a faction of total turnover. The more red the dot, the higher the proportion of turnover spent on water. Not surprisingly farms that have experienced more years of water stress spend a larger percentage of income on water and have declining profitability.

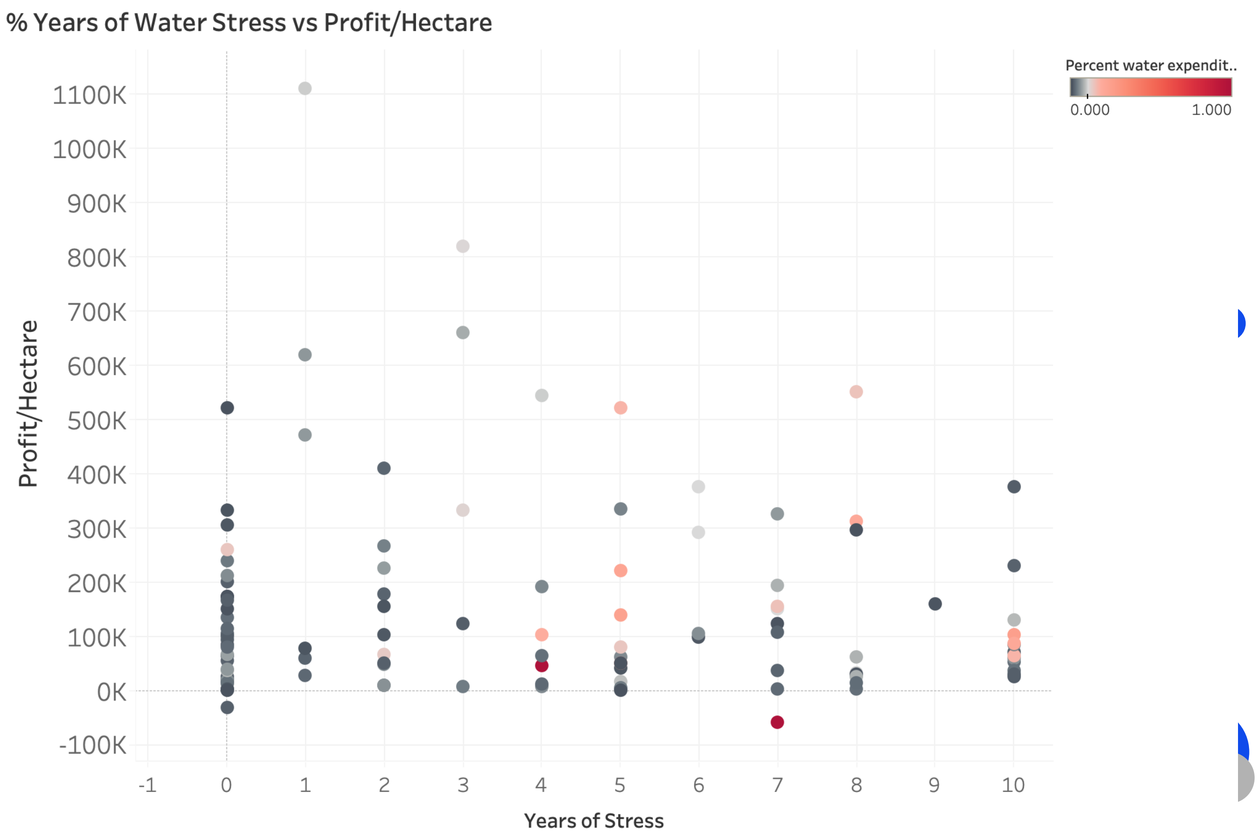

Figure 16: Years of water stress versus profit and water expenditure

Types of irrigation

The figure below shows the type of irrigation systems across the farms. Respondents were free to select multiple options. A total of 28% of respondents do not have any irrigation system.

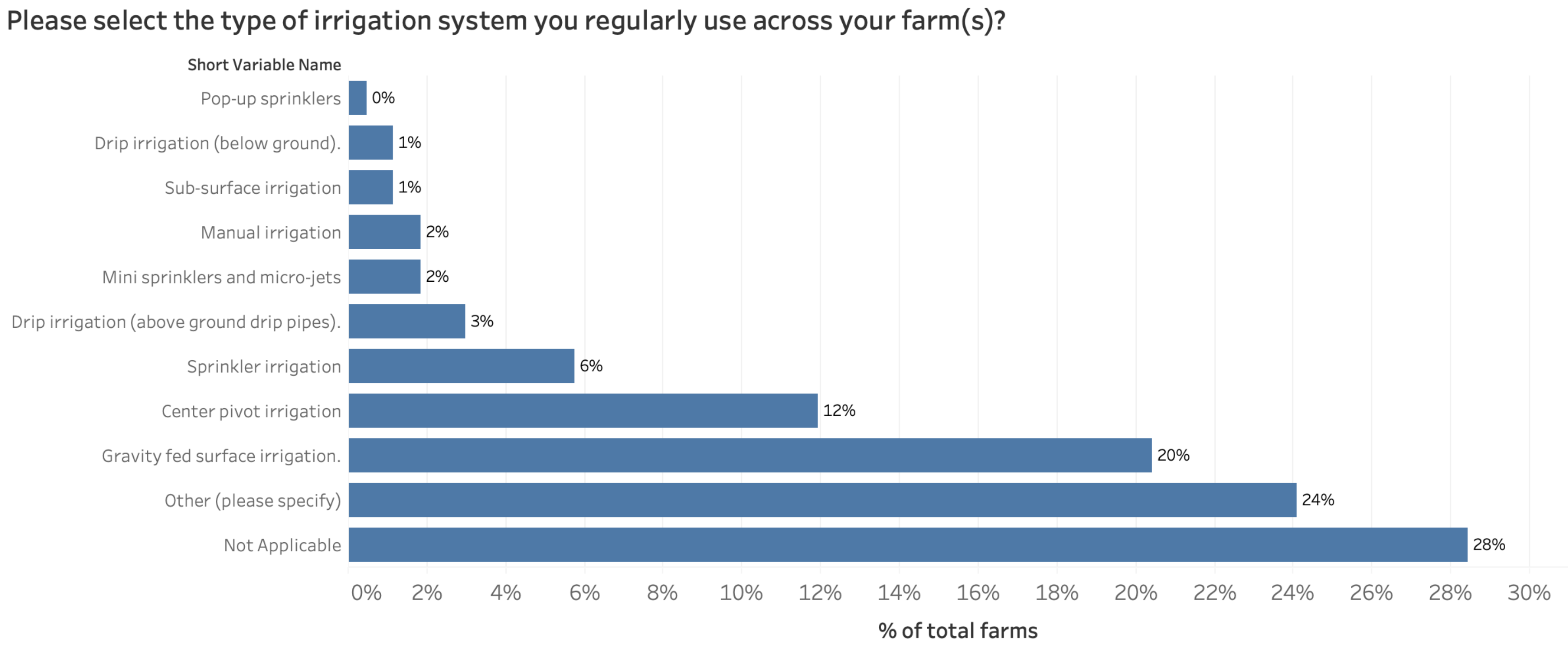

Figure 17: Years of water stress versus profit and water expenditure

Farm produce

The chart below shows the percentage of farms that produce different commodity types. Respondents were able to select multiple responses, this explains why the largest commodity type is represented by grazing livestock because most farms have at least some grazing livestock.

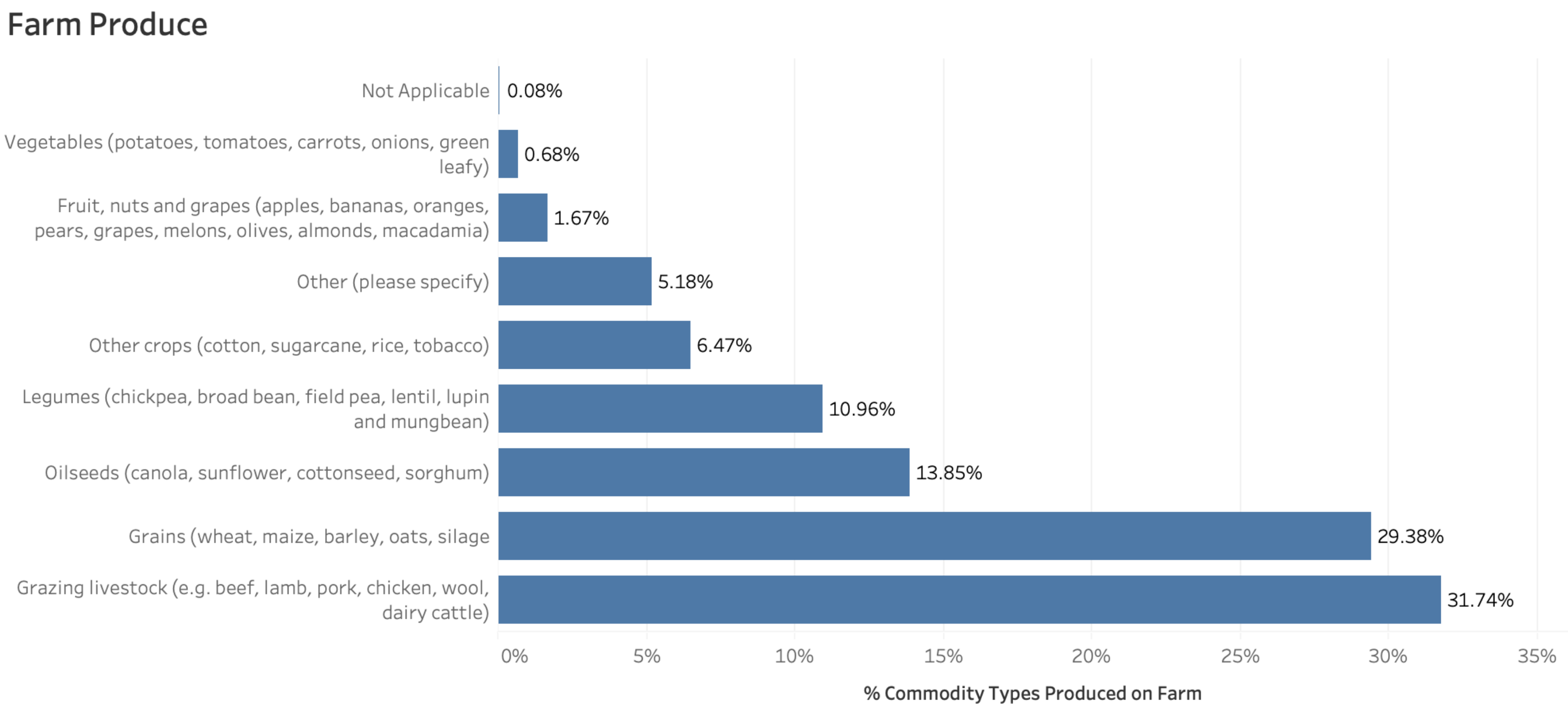

Figure 18: Farm produce as percentage of total responses

Irrigation by commodity type

The boxplot below shows the total water consumption used for various crops. As expected, cotton, sugarcane, rice and tobacco consume the highest quantity of water.

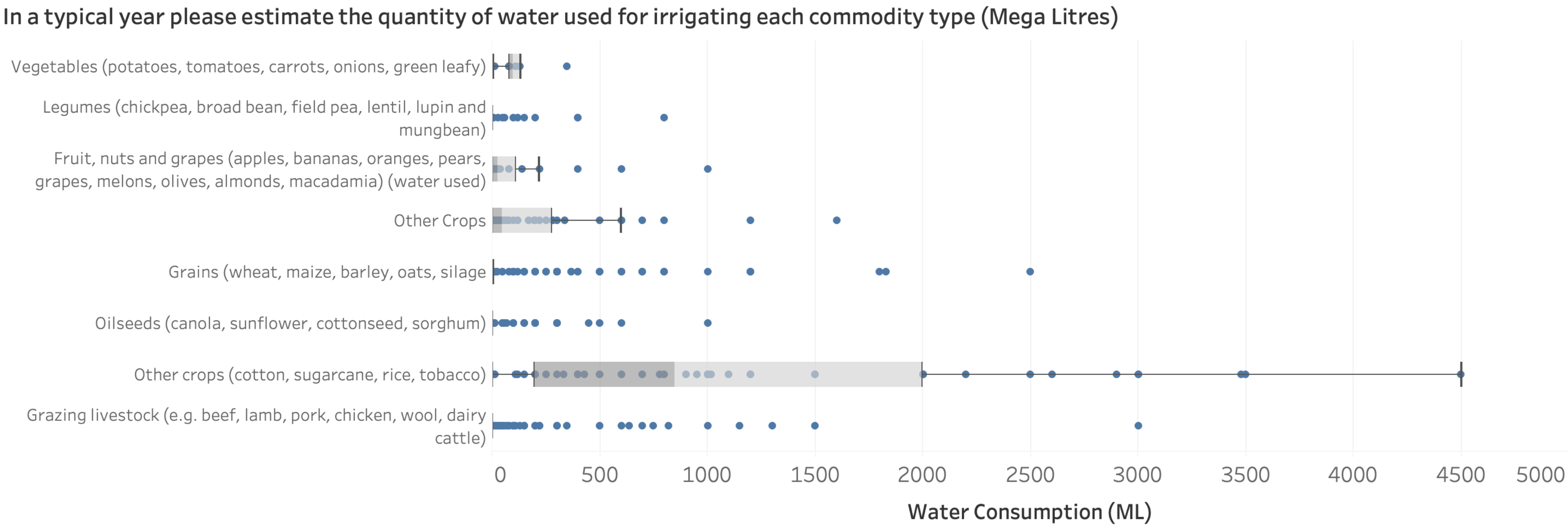

Figure 19: Farm produce as percentage of total responses

Where does water come from?

The boxplot below shows where the proportion of a farms water source across all farms. Each respondent was asked to select multiple options and provide a % so that the sum across all types added to 100%. The figure below shows the box plot of these percentages for all farms. As shown most farms will have some on-farm storage but this ranges from 20% to 100% for the majority of farms. The next largest water resource is owned allocation rights.

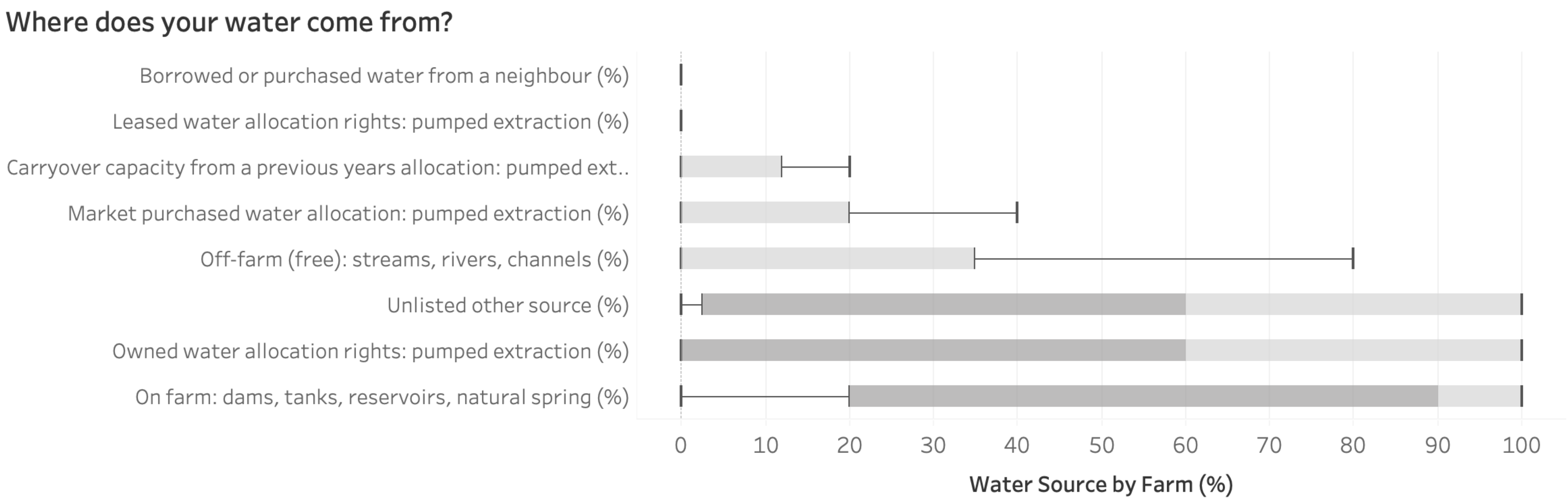

Figure 20: Source of water consumed on farm

Years of water stress experienced •

The boxplot below shows the number of years a farm has experienced water stress. Despite the question explicitly asking for stress in the last 10 years, had entered values larger than 10 years. The mean years of insufficient water across all farms was 3.04 years and the median years of of insufficient water was 2 years.

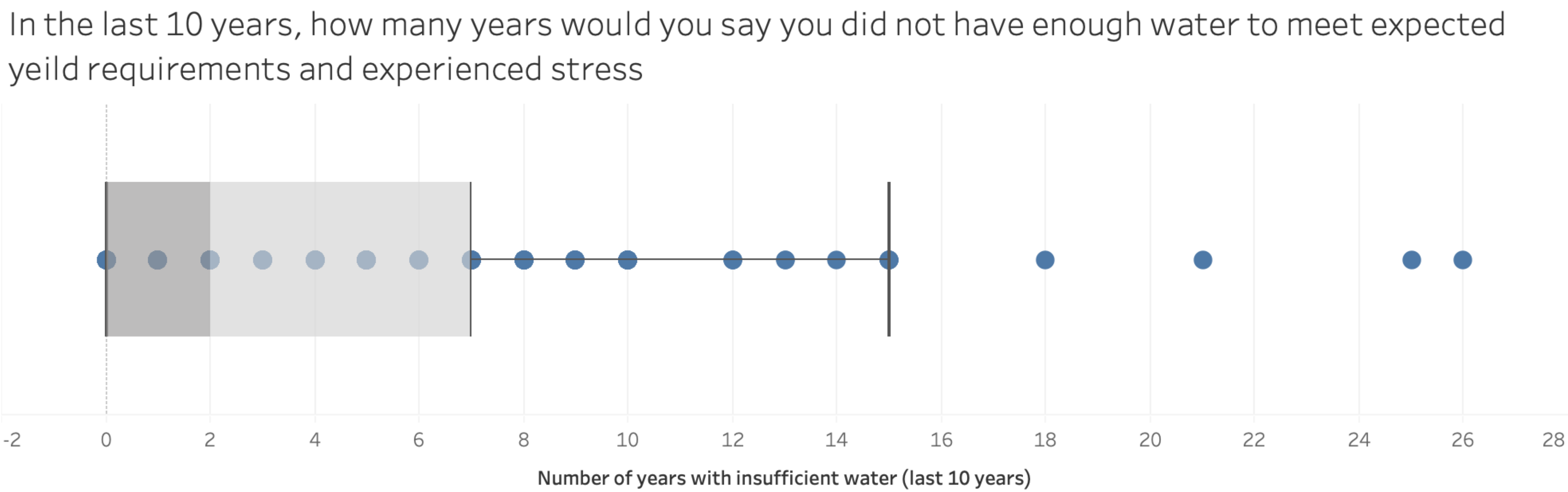

Figure 21: Years of water stress

Years of water stress by region

The char below show the mean years of water stress by different water basins. The Murray-Darling Basin has the largest experiencing 4.1 years of mean years of water stress. The next is North Western Plateau with 3.5 years of mean water stress.

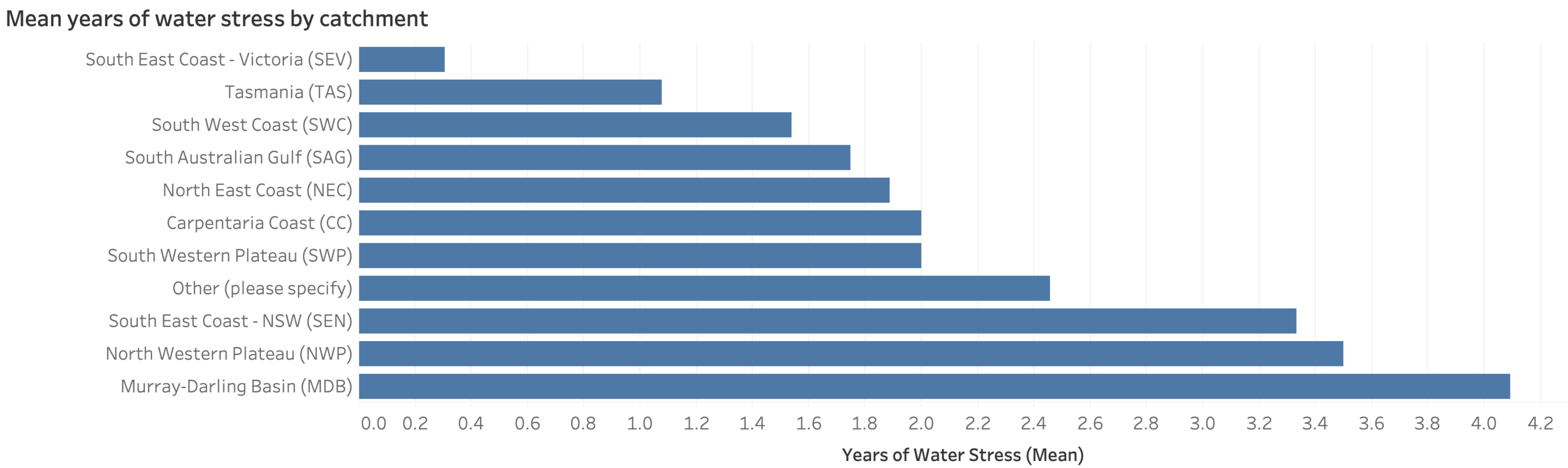

Figure 22: Years of water stress

Participation in government buy back

As shown ion the figure on the left, 87% of respondents have not participated in a government water buy-back or irrigation infrastructure program. In addition only 8.6% of respondents have sold all or part of a water entitlement and only 4.3% have sold a water allocation rights through a temporary lease arrangement.

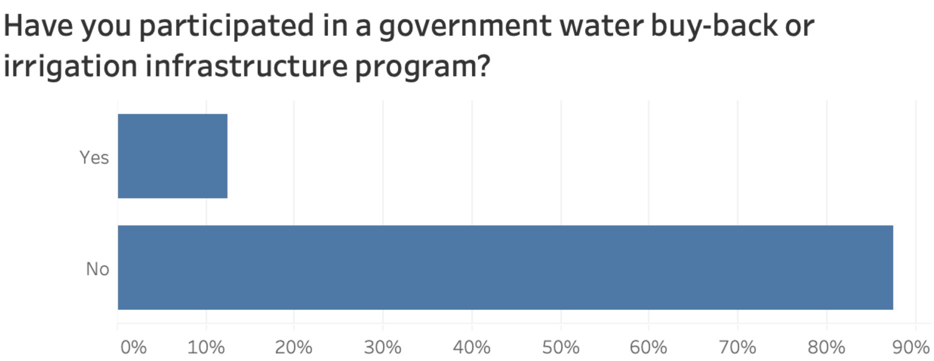

Figure 23: Participation in a government water buy-back or irrigation infrastructure program.

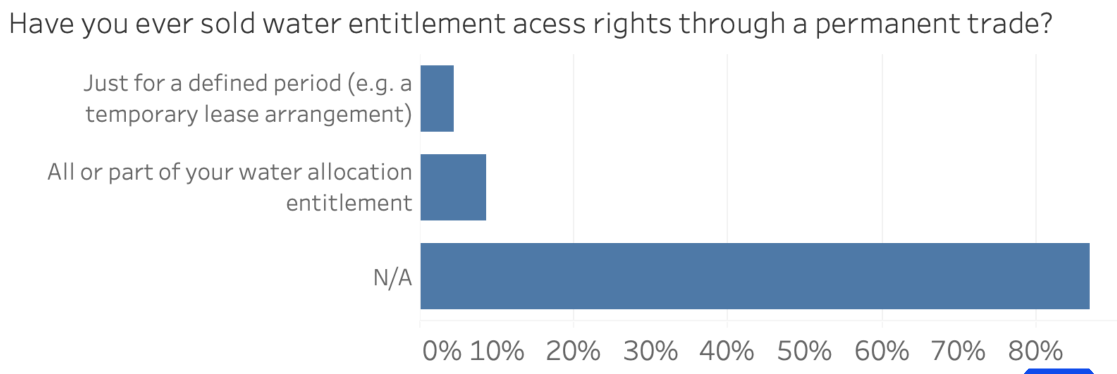

Figure 24: Proportion of respondents selling water entitlement access rights through a permanent trade

Participation in water markets

The chart to the right shows the proportion of respondents who actively participate in water markets. Although many farms rely on their water allocations,78% of farms do not actively purchase additional water from the short term water markets.

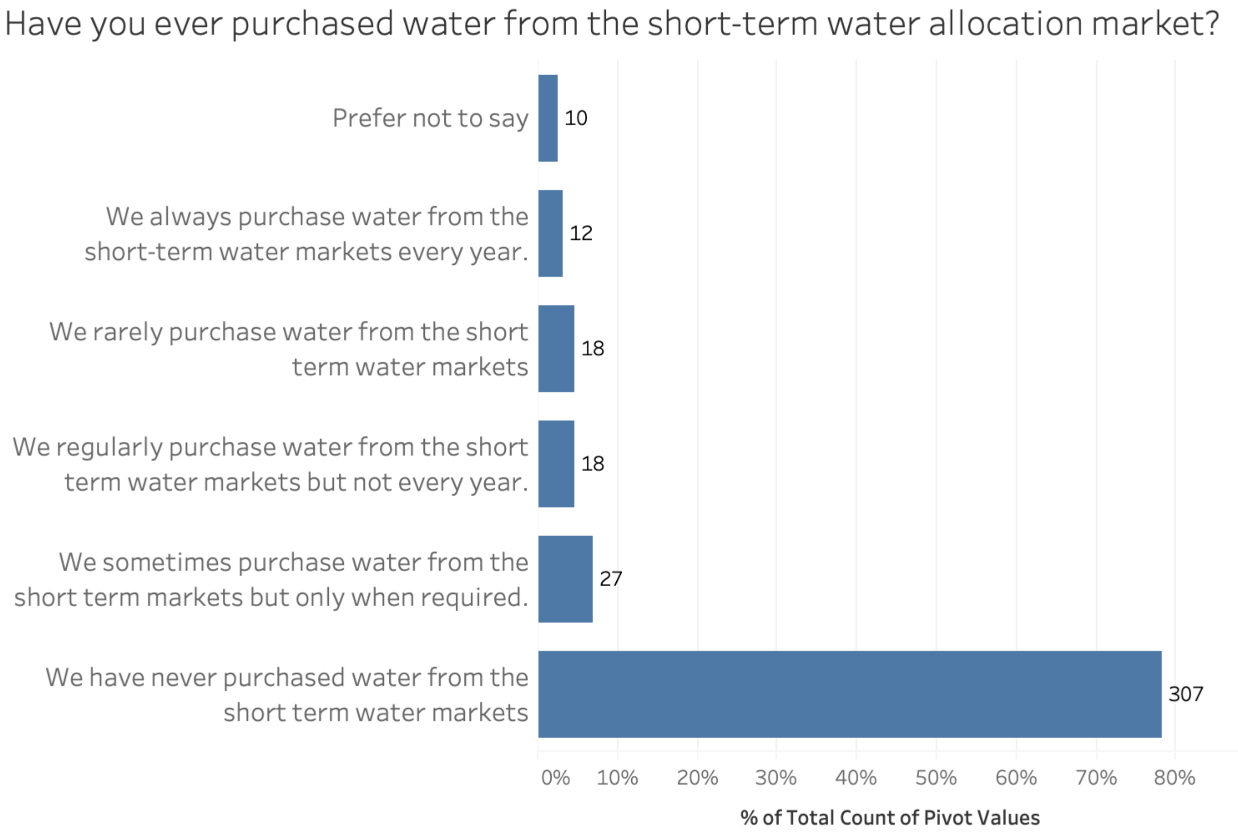

Figure 25: Participation in water markets

Participation in water markets

The chart to the right shows proportion of total water purchased on short term water allocation markets as a % of total water needs met. Surprisingly, over 80% of farms only purchase between 0 and 10% of total water needs from the short term water markets. This means that the short term water markets are used sparingly and only when required to meet minor shortfalls.

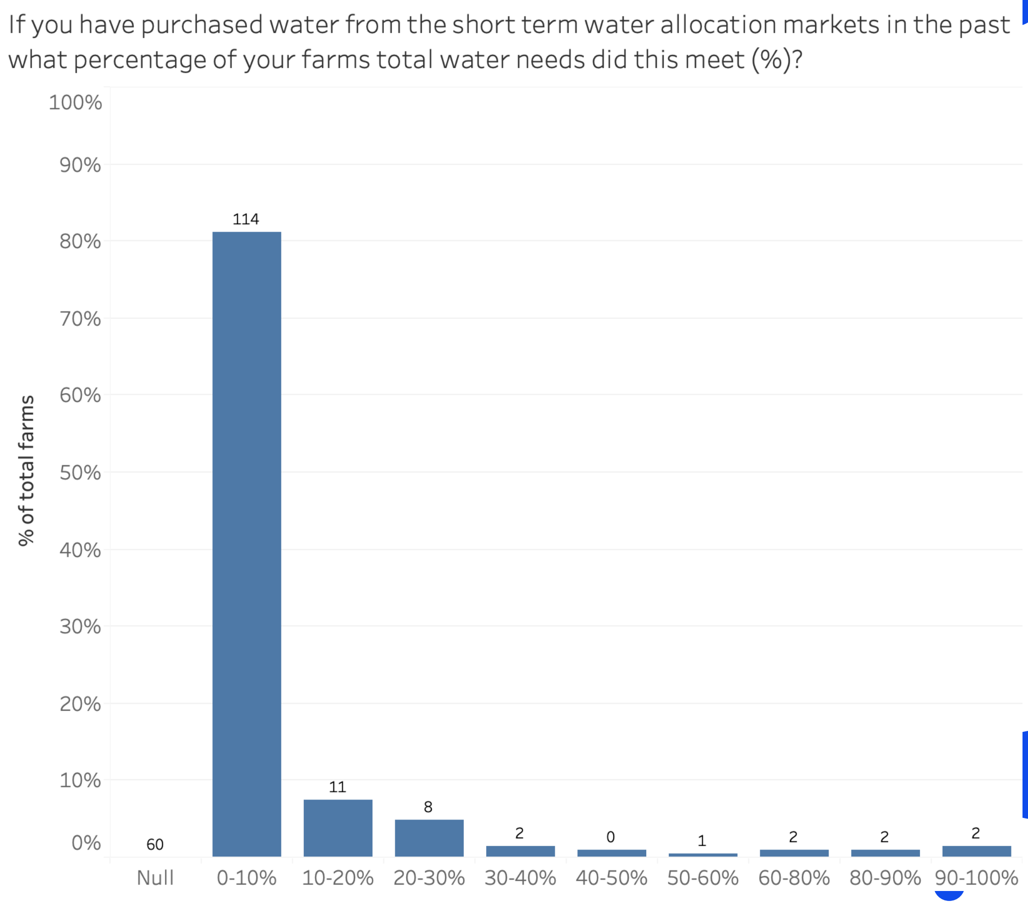

Figure 26: Proportion of short term water purchases

Water purchases

The chart to the right shows proportion of total water purchased on short term water allocation markets as a % of total water needs met. Surprisingly, over 80% of farms only purchase between 0 and 10% of total water needs from the short term water markets, with the remaining 20% of farms purchasing between 10-100% of water needs. This means that the short term water markets are used sparingly and only when required to meet minor shortfalls.

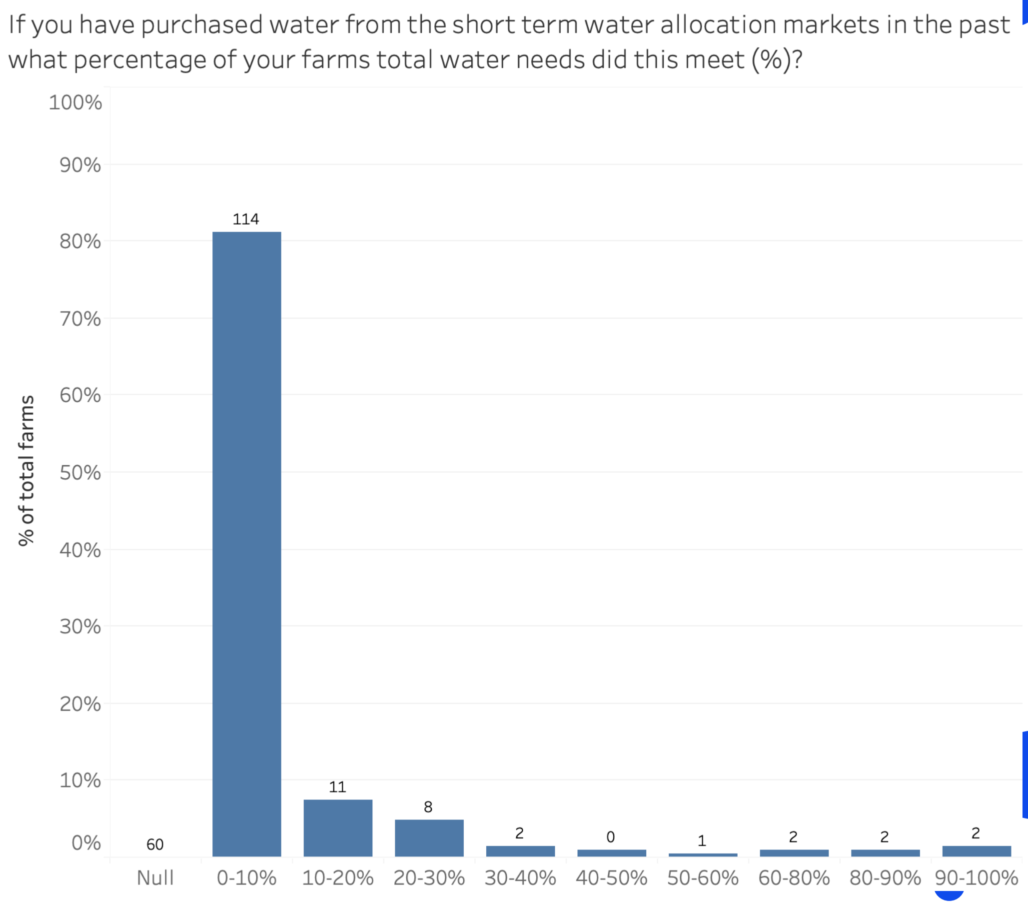

Figure 27: Proportion of short term water purchases

Water purchases in a dry year

Respondents were then asked the same question but were asked to specifically think about a dry year. Surprisingly, the results did not change significantly from water purchases in a typical year. In a dry year 76% of farms meet 0-10% of water needs from short term water allocations, with the remainder (24%) of farms purchasing between 10-100% of their water needs.

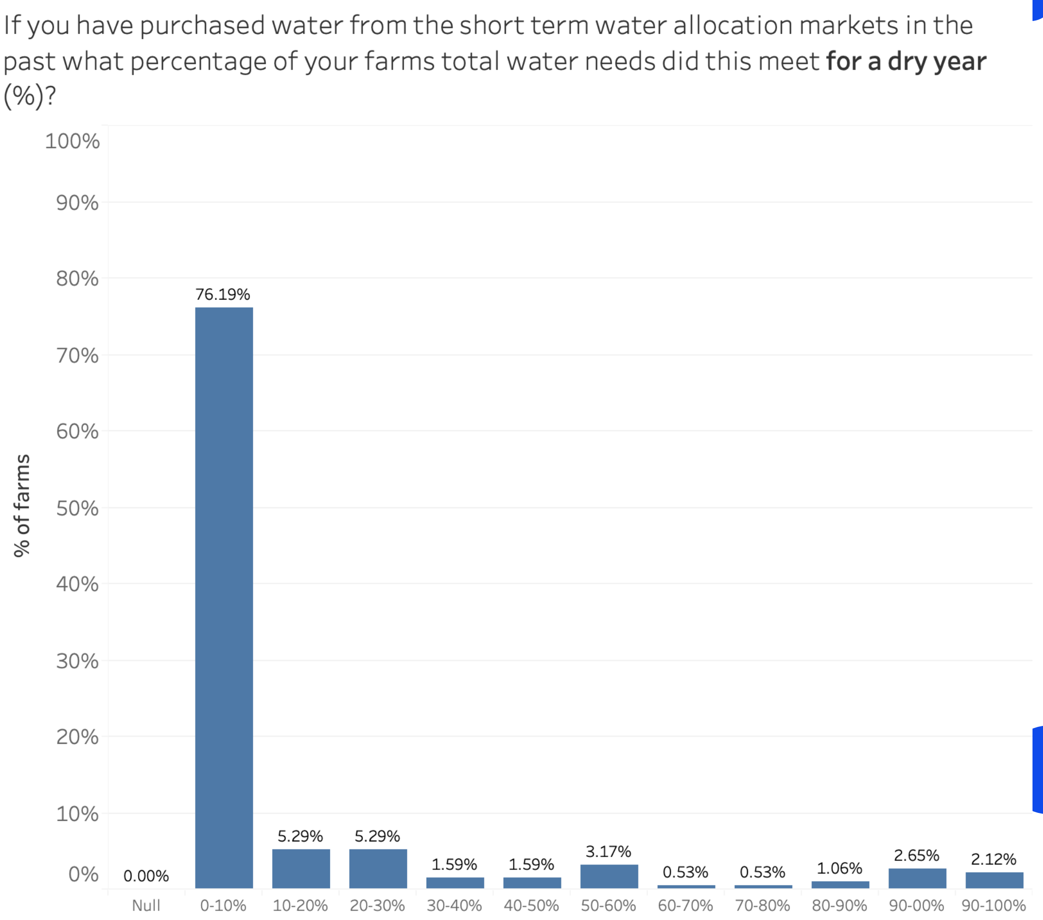

Figure 28: Proportion of short term water purchases in a dry year

Importance of managing water risk

The boxplot below shows the how important water risk is for on farm decision making. The scale of these responses ranged from 0 (none) to 100 (maximum). The mean response was response was 64 and median response was 72. This implies that water risk is an important driver of on-farm decision making.

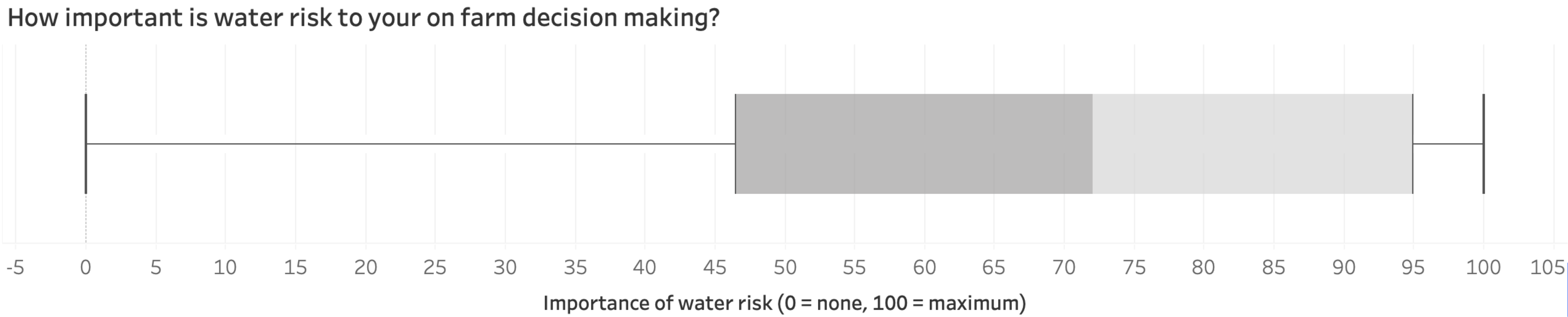

Figure 29: Importance of on farm water risk

On farm water risk flexibility

The boxplot below shows the amount of flexibility a respondent has for managing on farm water risks. The scale of these responses ranged from 0 (none) to 100 (maximum). The mean response was 40 and and the median was 48, implying that most farms have significant room to improve water risk management.

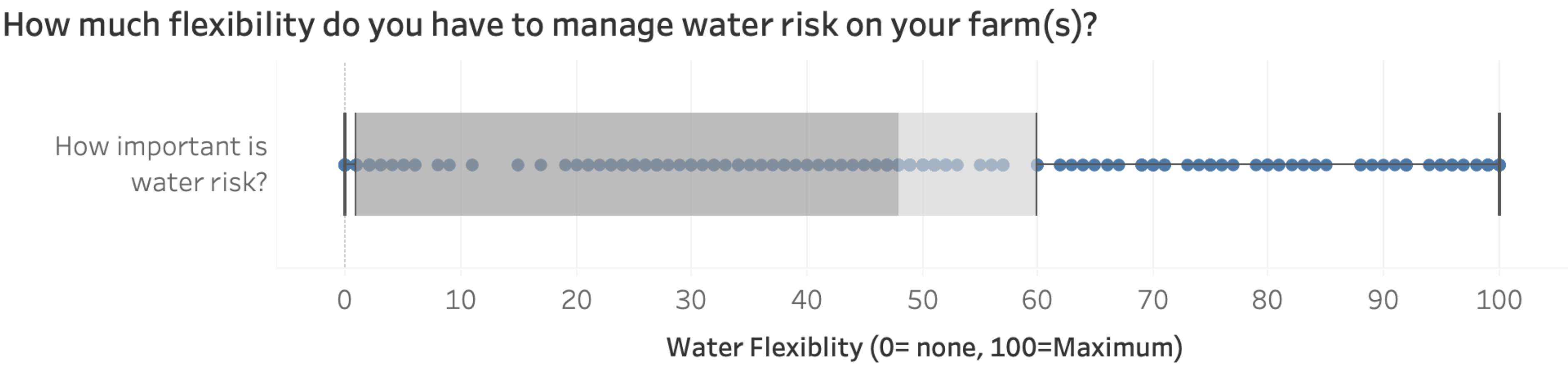

Figure 30: On farm water flexibility for managing water risk

Managing water risk (past)

The chart below shows the different ways that farms have managed water risk over the previous 5 years. The most popular method has been to build new on-farm storage facilities, while the second most popular options is upgrading farm technology and irrigation systems to improve water efficiency. More farms prefer to have a fallow year or change the timing of planting than purchasing short term water allocations.

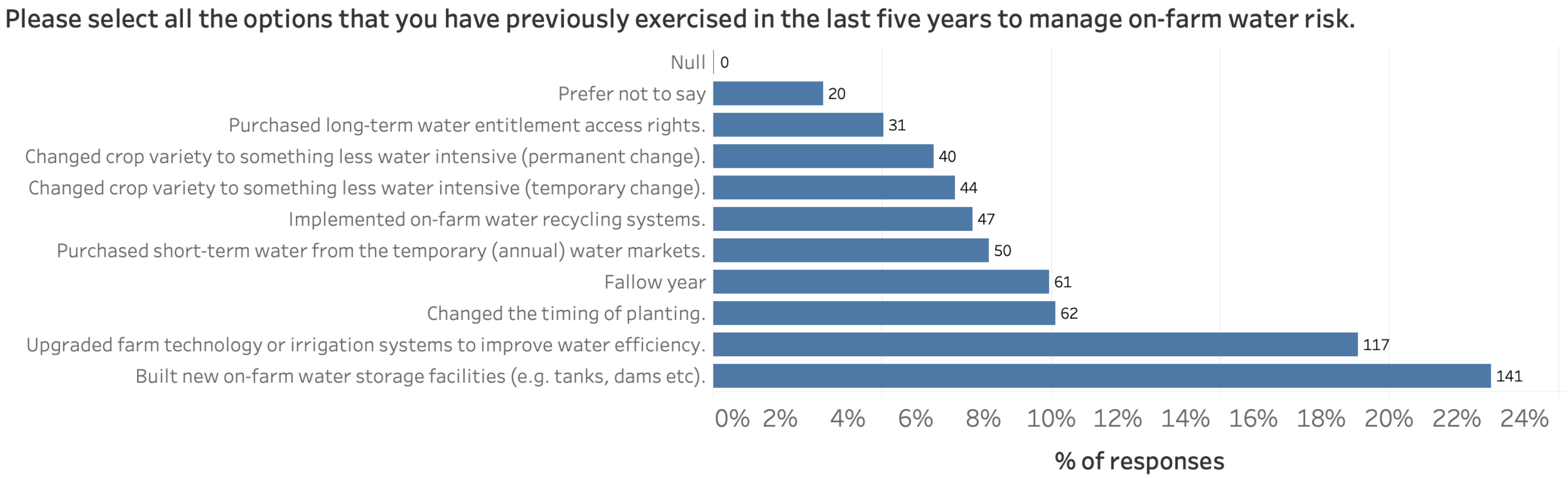

Figure 31: How have farms previously managed water risk?

Managing water risk (future)

The chart below shows the different ways that farms have propose to manage water risk in the future. Developing new on-farm storage and improving water efficiency are still the two top responses, with more farms opting to improve efficiency. Interestingly, farms would explore new farm technology, new machinery, new water sensors and meters and purchase more land than purchase water access entitlements.

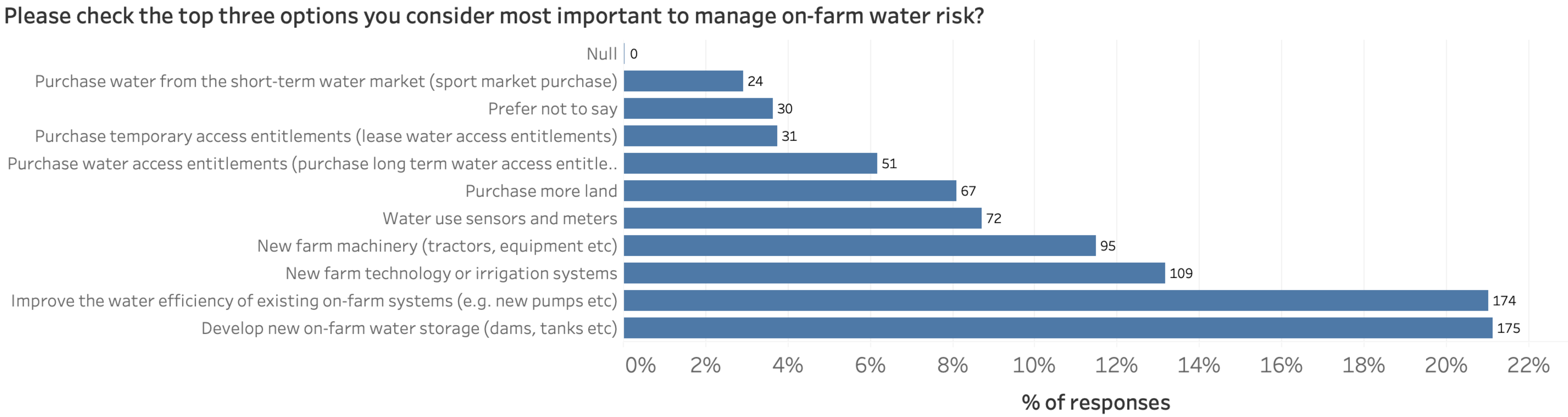

Figure 32: Most important options for managing future water risk

Rank of important water risks

The bubble chart below respondents were asked to rank the most important types of water risks from least important to most important. This has been separated for irrigators and non-irrigators. Most important risks have a value of rank one. The chart below shows the average value across all responses where the least important risks are on the left, and the most important risks are on the right. Droughts are the most important for both irrigators and non-irrigators. High market prices are the least important water risk for both irrigators and non-irrigators.

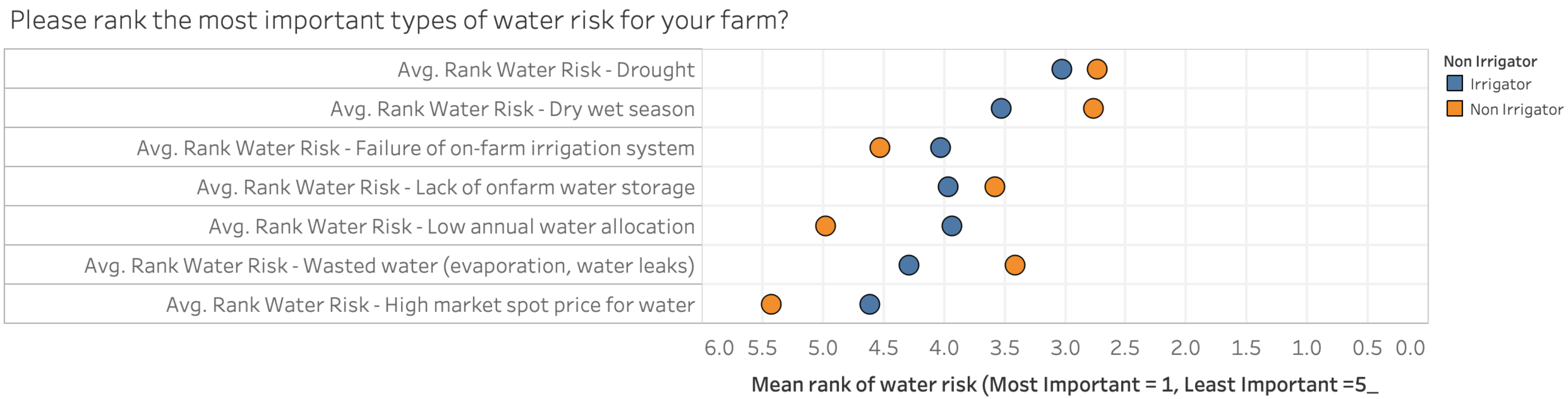

Figure 33: Rank of different water risks for irrigators and non-irrigators.

Do you actively monitor market price?

The figure below shows how often the respondents monitor the market price for water. Even though few farms participate in the markets, over 65% said they **often** actively monitor the price of water. On the other hand 35% of respondents said they sometimes, don't monitor the price of water at all.

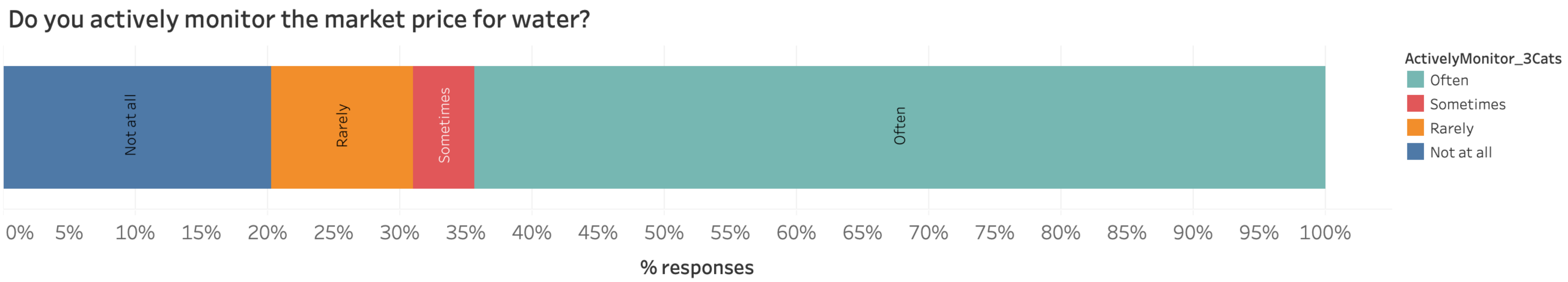

Figure 34: Do you actively monitor market price for water?

Climate change as water risk

When respondents were asked to consider the importance of climate change as a future driver of water risk 37.5% said climate change was very important or extremely important and 32.5% said it was only slightly important or not at all important. This shows a deep split within the farming community where views on the risks of climate change are polarized.

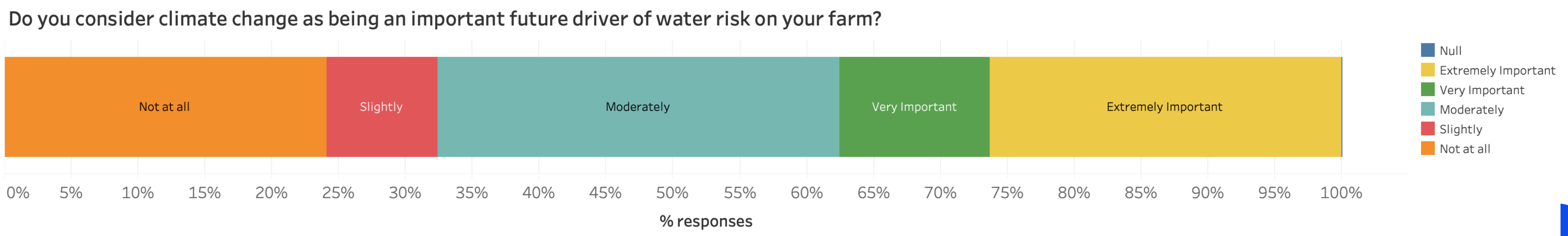

Figure 35: Do you consider climate change as being an important future driver of water risk on your farm?

Information used to manage water risks

The chart below shows the most important information sources used by respondents for managing on-farm water risks. Over 22% of farms said medium weather forecasts were the most important, followed closely by monitoring the availability of water in dams and basins. Again, forecasts on the price of water was the least used information resource.

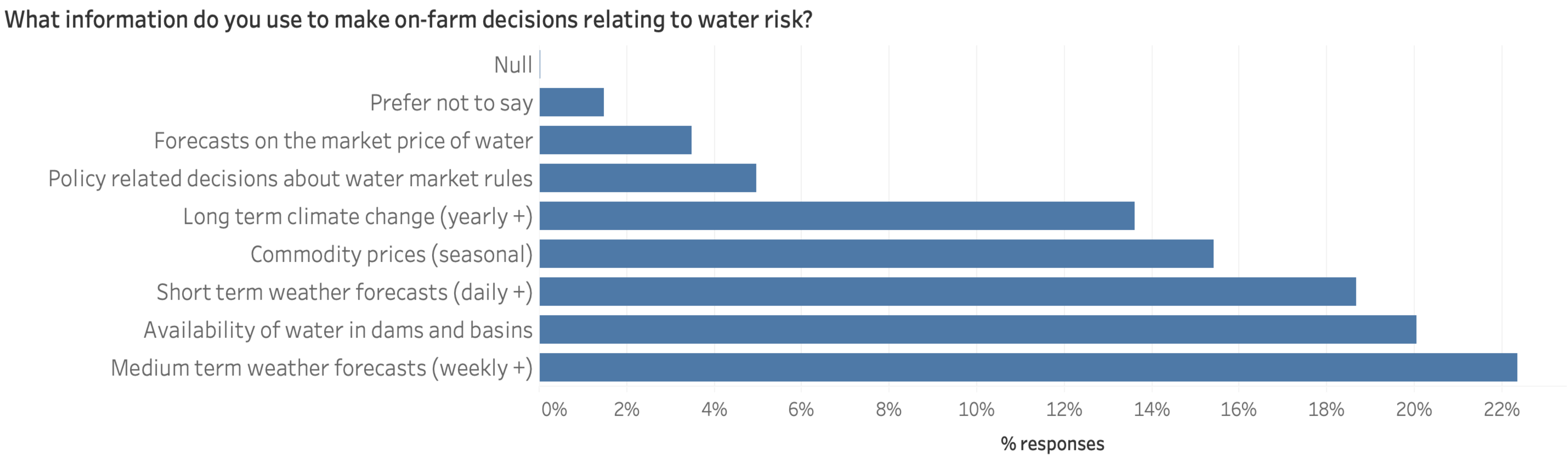

Figure 36: Information sources to manage on farm water risks

Use of on-farm technology

Only 25% of farms use on-farm technology such as micro-climate sensors or weather stations to inform decision making processes. When asked what data was most valuable just under 40% of responses said rain gauge data. Soil moisture and temperature data were the next most important.

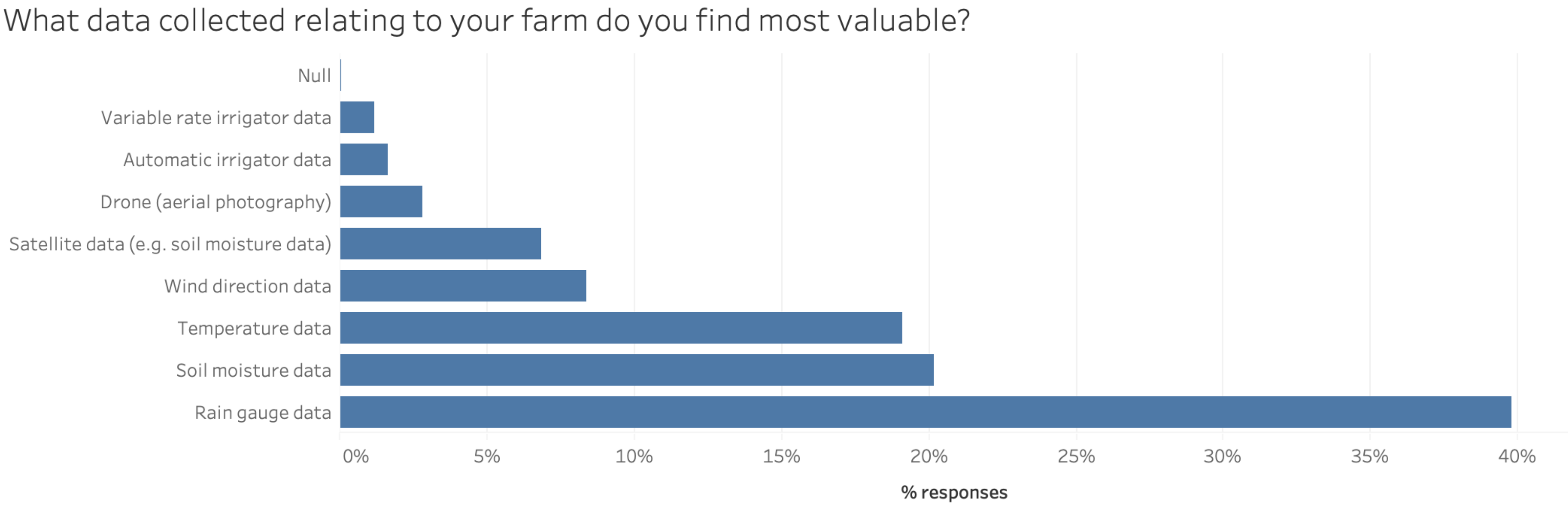

Figure 37: Information sources to manage on farm water risks

Barriers to using digital technology

The chart below ranks the largest barriers for respondents to incorporate on-farm digital technology. The biggest response is up-front costs, implying a need for finance. The next most important barrier is the perception that the technology is not cost-effective, closely followed by a technical barrier.

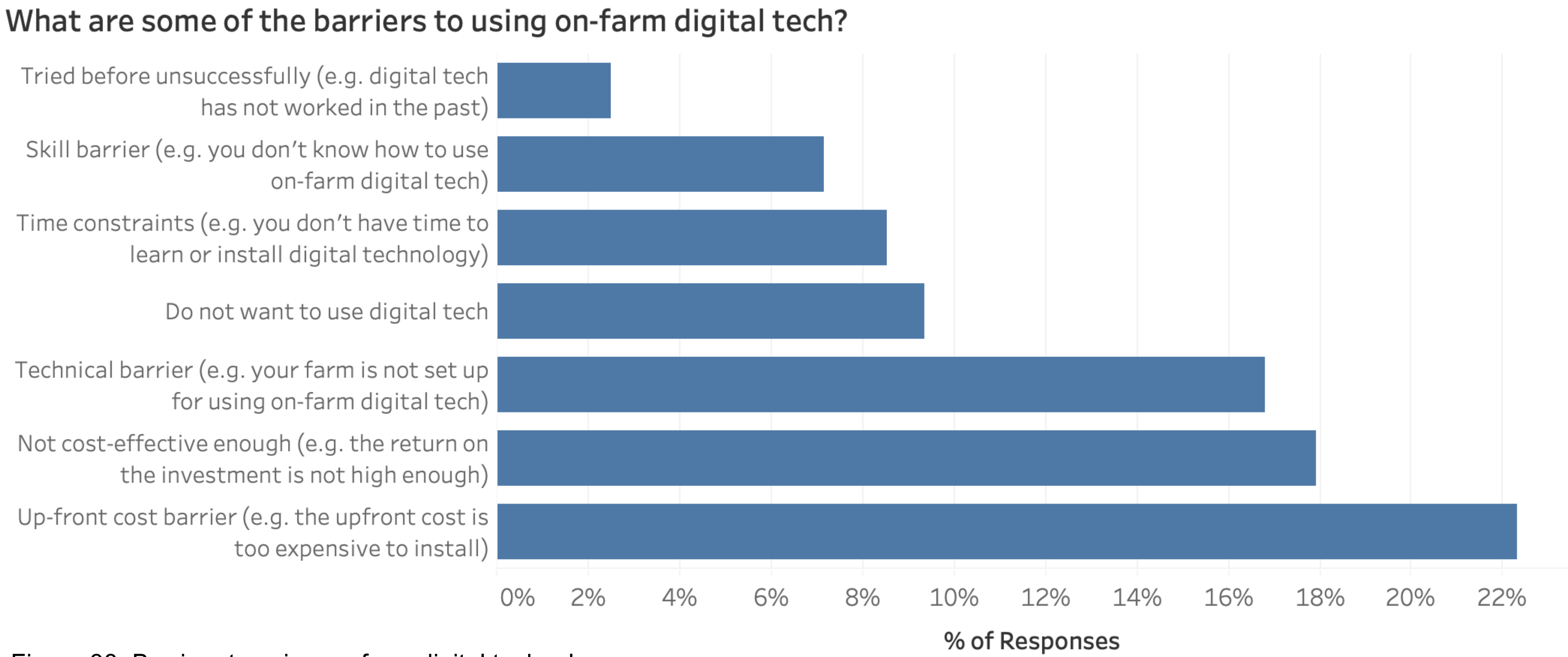

Figure 38: Barriers to using on-farm digital technology

Water risk management and outcomes

Roughly 18% of respondents had previously applied for a loan to pay for a project that would mitigate water risk. However, when respondents were asked whether better water risk management strategies led to better financial outcomes, the mean response was just 47 out of 100. Because the mean response was under 50 it means that strength of opinion tends to disagree that better water risk management leads to better financial outcomes.

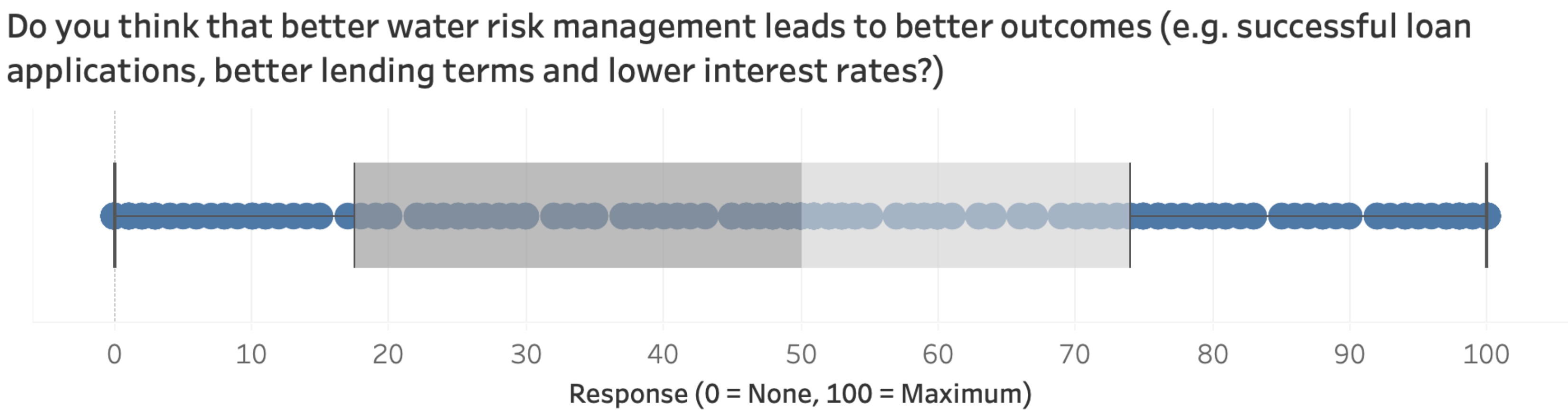

Figure 39: Does better water risk management lead to better outcomes?

Funding water risk management

Participants were asked how they presently fund water risk management strategies. Over 70% said they self-fund through own savings and farm-revenue. Only 13% of responses said they received funding from commercial banks. When asked if they anticipate applying for a loan to mitigate water risk in the future, 18% said they would.

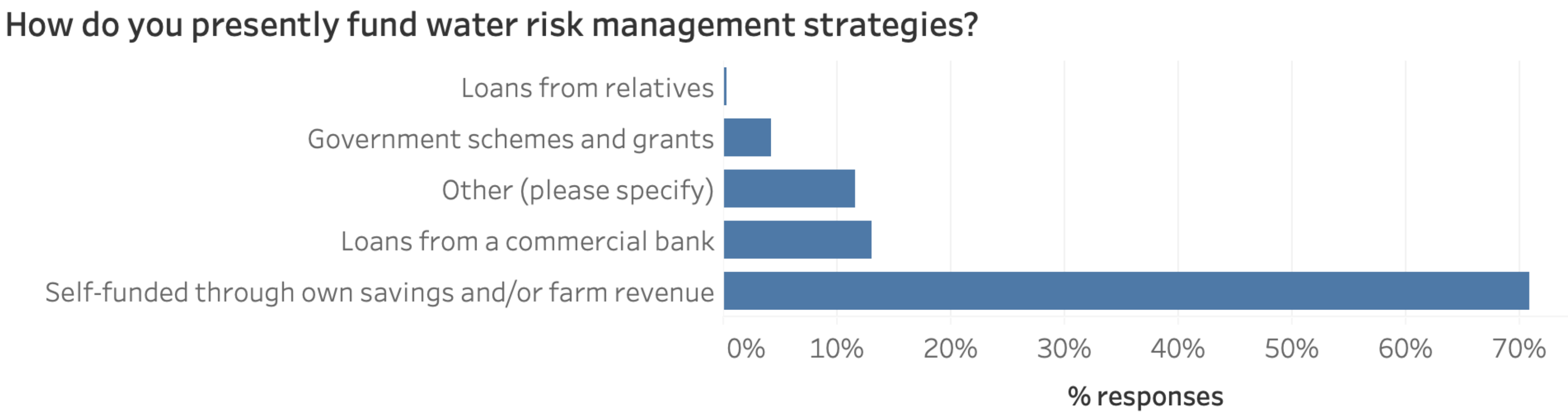

Figure 40: Does better water risk management lead to better outcomes?

Ranking of on-farm risks

Respondents were asked to rank their on farm risks in order of most important to least important. This has been separated into irrigators and non-irrigators. The risks considered most important have a value of rank one. The chart below shows the average value across all responses where the least important risks are on the left, and the most important risks are on the right. As shown weather related risks are the most important, followed by commodity price risk. Water risk is considered the third most important and climate change the least important.

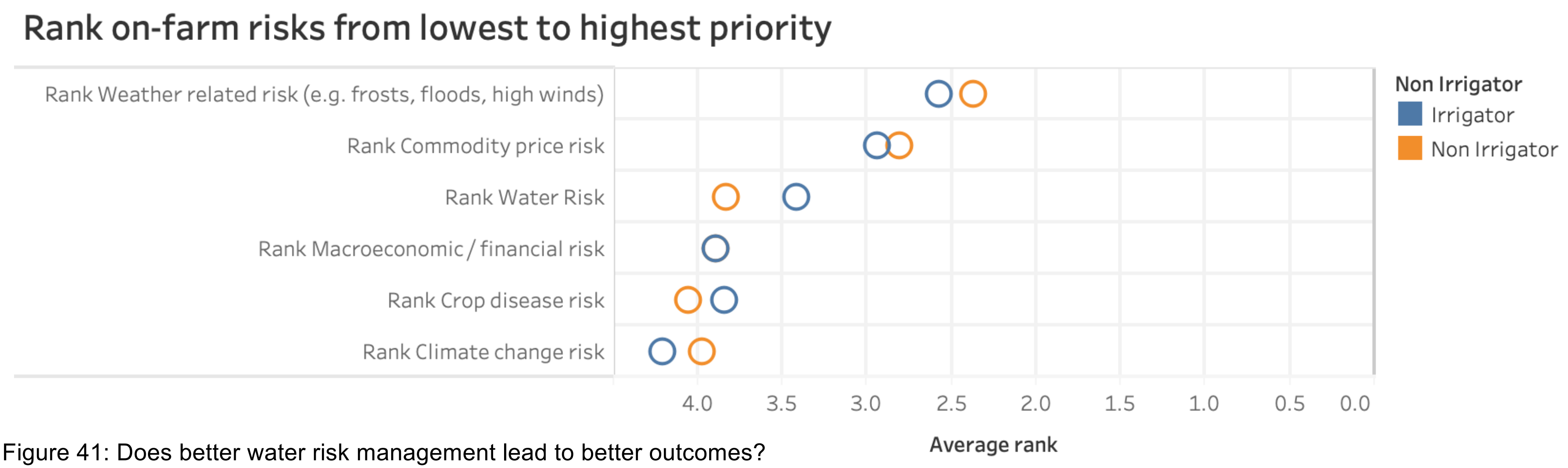

Figure 41: Does better water risk management lead to better outcomes?

Ranking of on-farm risks

The map to the right shows the mean profit per hectare for different post-code areas across Australia. Profit is estimated as self-reported turnover minus operational expenses.

Profit by hectare

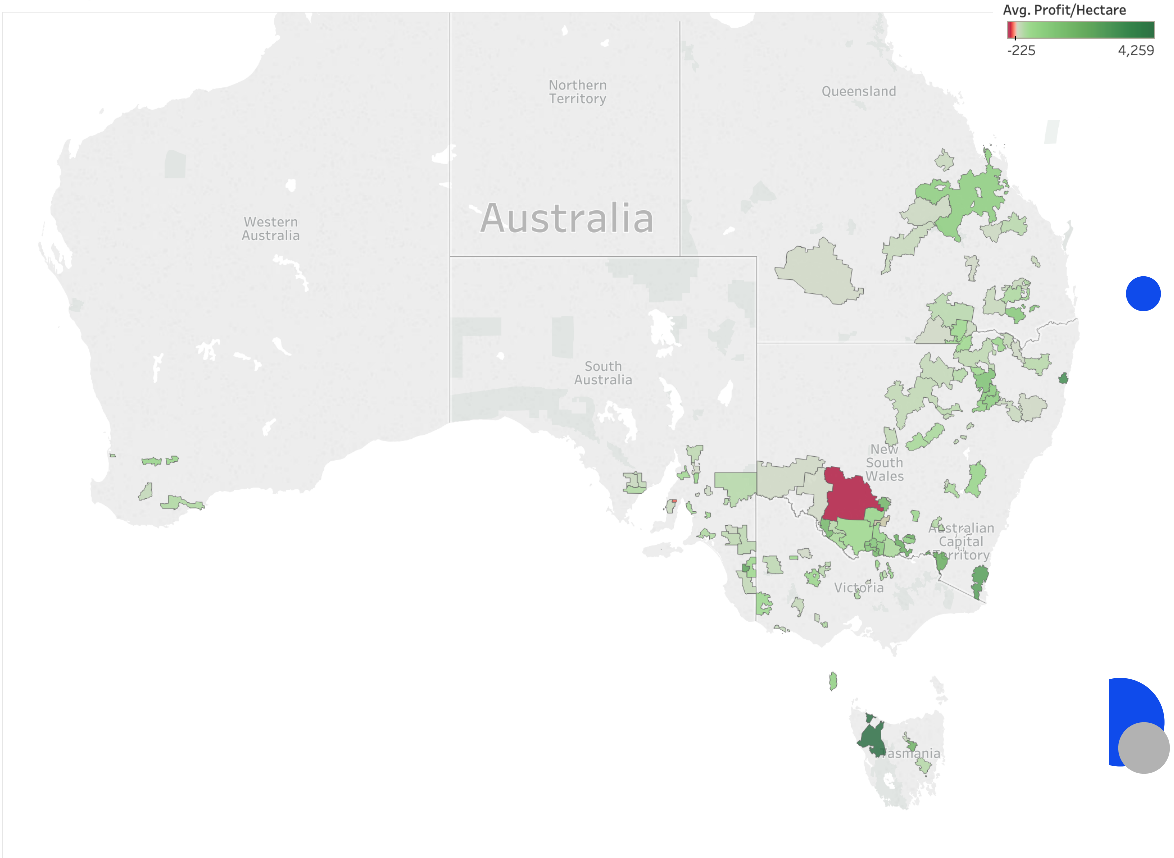

Figure 42: Mean profit per hectare by

Importance of water risk

The map to the right shows the self-reported mean value for water risk by postcode. Darker colours indicate water risk is considered more important in that region by respondents. What we see from this chart is that water risk varies considerably and one postcode to the next. Even neighbouring postcodes have very different responses on the importance of water risk for them. This shows that water risk is predominantly a local problem and determined by the local situation of the farmers in the area.

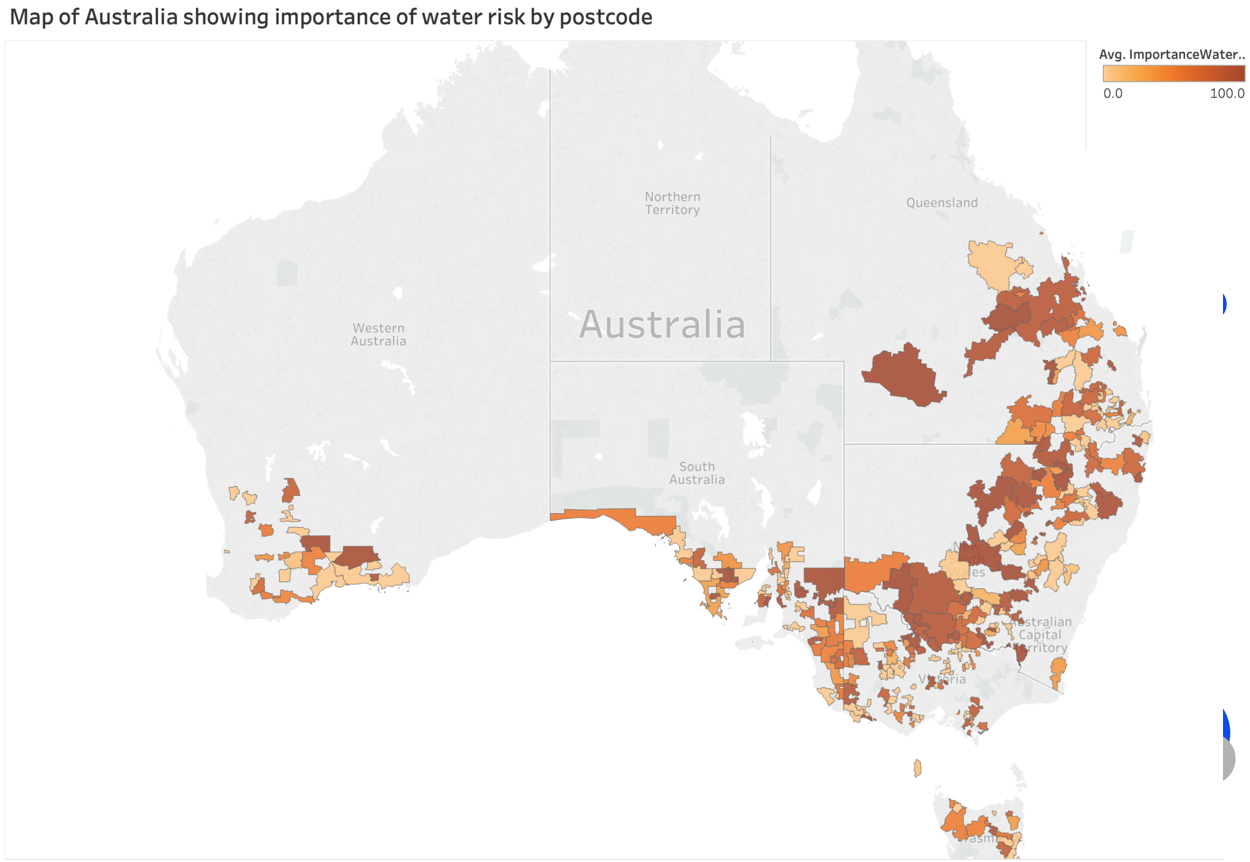

Figure 43: Mean profit per hectare by

Water Risk in Australia Survey Results

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