Erosion control, irrigation and fertiliser management and blueberry production: Grower interviews

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Erosion control, irrigation and fertiliser management and blueberry production: Grower interview results

Introduction

There is concern over the potential for sediment and nutrients from blueberry farms to contaminate streams, lakes and marine environments in northern New South Wales. The extent to which nutrients and sediments are discharged from blueberry farms depends on the practices growers employ to manage irrigation and fertiliser, and to limit erosion.

In an earlier report (Kaine and Giddings 2016) we described the irrigation, fertiliser and erosion control practices growers employ, and the factors governing their choices in regard to these practices. The descriptions were based on an analysis of interviews with ten industry experts. The main finding was that since blueberries are a high value crop but irrigation and fertiliser constitute a small fraction of the costs of production, growers would only be strongly motivated to adopt erosion control, irrigation and fertigation technologies if they improved yields. The validity of this finding is tested here using data gathered in interviews with a representative sample of blueberry growers .

The theoretical framework underpining the study is described in Kaine (2004) and Kaine and Johnson (2004).

The sample of growers[1]

A convergent interviewing process (Dick 1999) was employed to ensure the reliability of the data gathered in interviews with growers. We interviewed 14 growers on the North Coast of New South Wales. The area under blueberries ranged from 2.5 hectares to 162 hectares. The growers had been producing blueberries for between two years and 20 years. Most grew at least one other crop such as cucumbers, raspberries, blackberries and macadamias.

Kaine and Giddings (2016) classified blueberry growers into four segments with indicative of the potential for soil erosion and the emission of nutrients (see Figure 1). To begin growers were divided into those who have field-based production systems and those that have substrate-based production systems. The risk of soil erosion in regard to the latter is relatively low because these systems are only practical in relatively flat country and the volume of water that is applied each irrigation is small. However, in the absence of water recycling the risk of nutrient emissions is relatively high in hydroponic systems, as a 30 per cent leaching fraction is required to ensure the nutrient solution does not overly increase the level of salts in the substrate.

[1] Insufficient resources were available to interview a *statistically* representative sample.

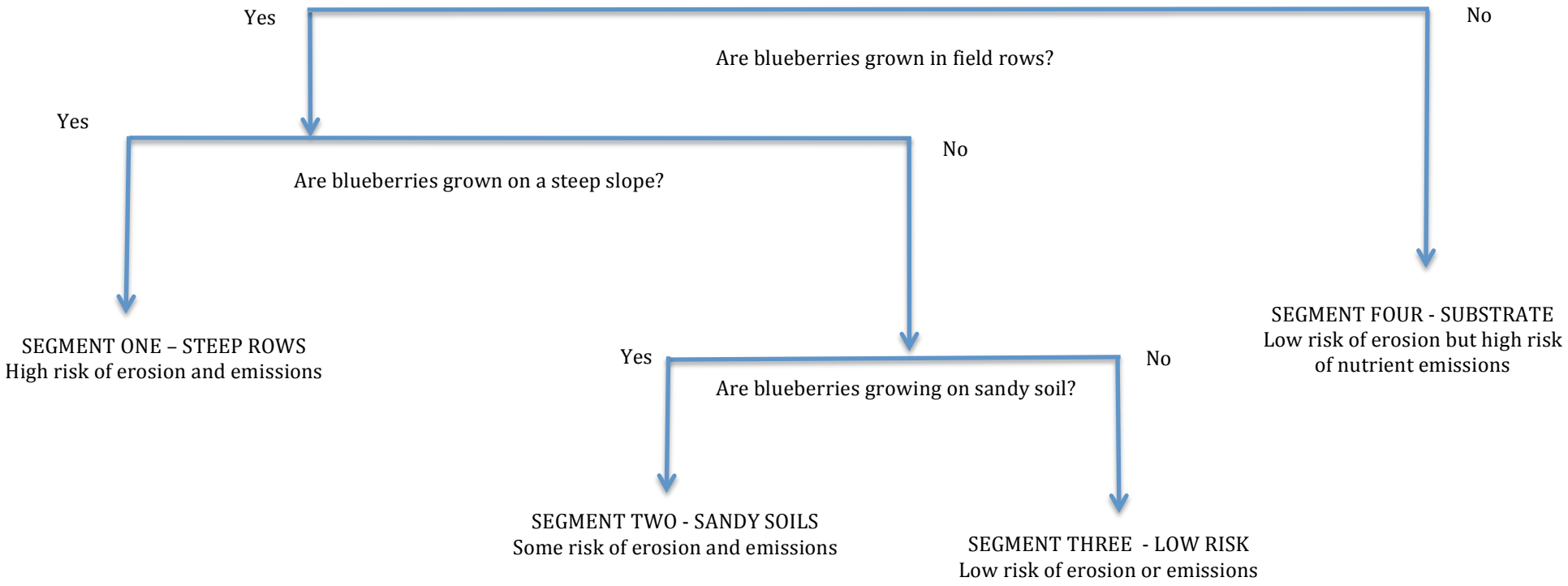

Figure One: Context diagram for erosion and nutrient emission risk
(Adapted from Kaine and Giddings 2016)

Field–based growers were then divided into those that had steeply sloping country and those that did not. Those that had steeply sloping country were considered as being at risk of erosion and the emission of nutrients because of their topography. Growers that had flat country were sub-divided into those that had sandy soils and those that did not. The former were considered as being at some risk of erosion and nutrient emissions because of their soils while the latter were classified as low risk.

Our sample of growers covered a variety of soil types and topographies ranging from flat country with sandy, well-draining soils through to extremely steep country with poorly draining, clay soils. All of the growers we interviewed had field-based production. Of these, 43 per cent were growing at least some of their blueberries on steep slopes (see Figure 2). Only one grower, with sloping or flat country, had sandy soils (see Figure 3). This means 50 per cent of the growers we interviewed were in the segments we considered at risk of soil erosion or nutrient discharge (segments one and two). Approximately 21 per cent of growers also had blueberries in substrate.

As expected, for most growers labour associated with pruning, picking and pest control constituted 50 per cent or more of production cost. Fertiliser and irrigation costs were a small fraction of production costs for most growers (see Figure 4). This means growers will change their production systems and practices primarily for two reasons: to reduce labour costs and to increase yields. They are unlikely to change systems or practices to reduce other production costs simply because the resulting savings would have a limited impact on profitability.

Erosion control and blueberries

Field production

As stated earlier, all of the growers we interviewed grew blueberries in field rows. The aligning of the rows along, rather than across, a slope creates situations where rainfall runoff is channeled between the rows. When rain is intense the channeling of runoff can result in rapid erosion, creating gullies in between or bordering the rows leading to the deposition of sediment in farm dams and nearby streams. In extreme cases rows may be damaged and plants washed away. The gullies are a hazard for machinery and a safety risk for labour. Erosion of this nature is most likely on steep slopes and sandy soils.

All the interviewees used weed mats to reduce weed infestation. While 64 per cent of growers used mulch, some had abandoned the practice as inefficient and costly. To further reduce the risk of weed infestation most growers kept a narrow margin bordering the mats clear of vegetation by spraying with herbicides. The size of this margin varied with most growers seeking to keep the margin clear of machinery tracks to avoid erosion. One grower was making a concerted effort to keep this margin particularly narrow by spraying the rows by hand.

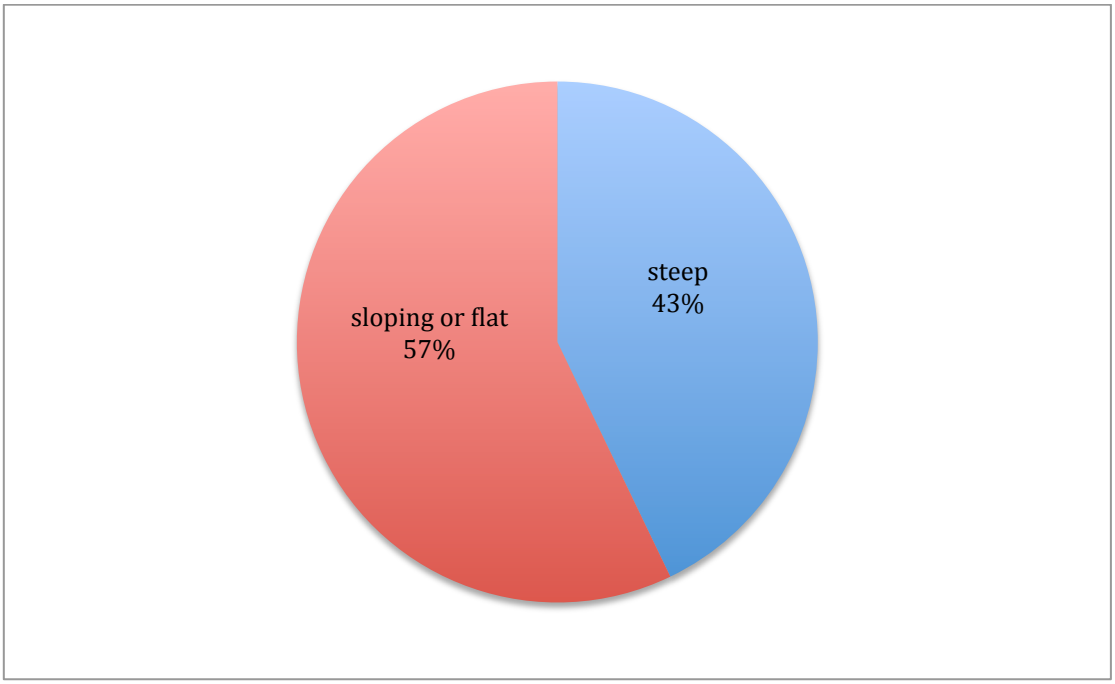

Figure Two: Topography
(Percentage of interviewees)

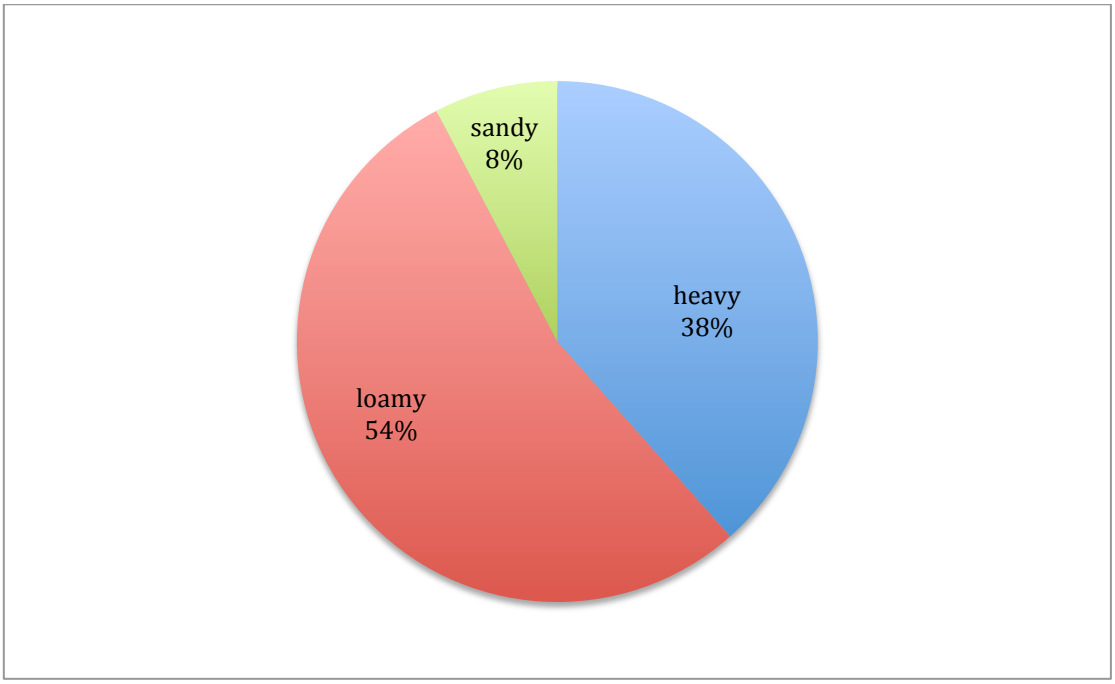

Figure Three: Soil type
(Percentage of interviewees)

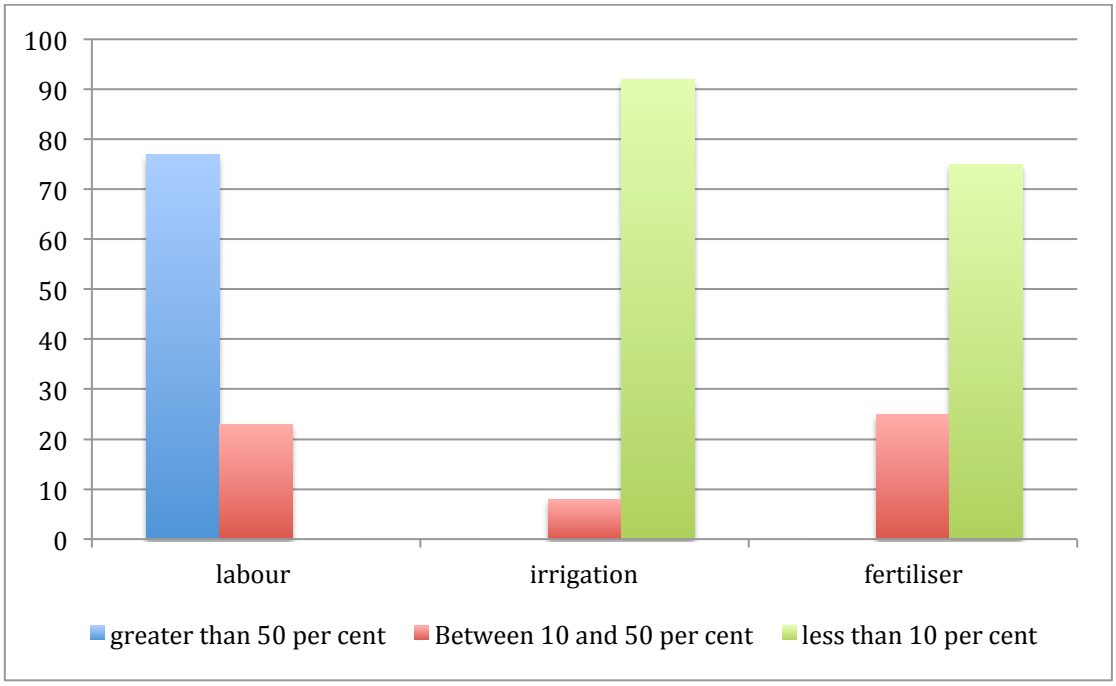

Figure Four: Production costs
(Percentage of interviewees)

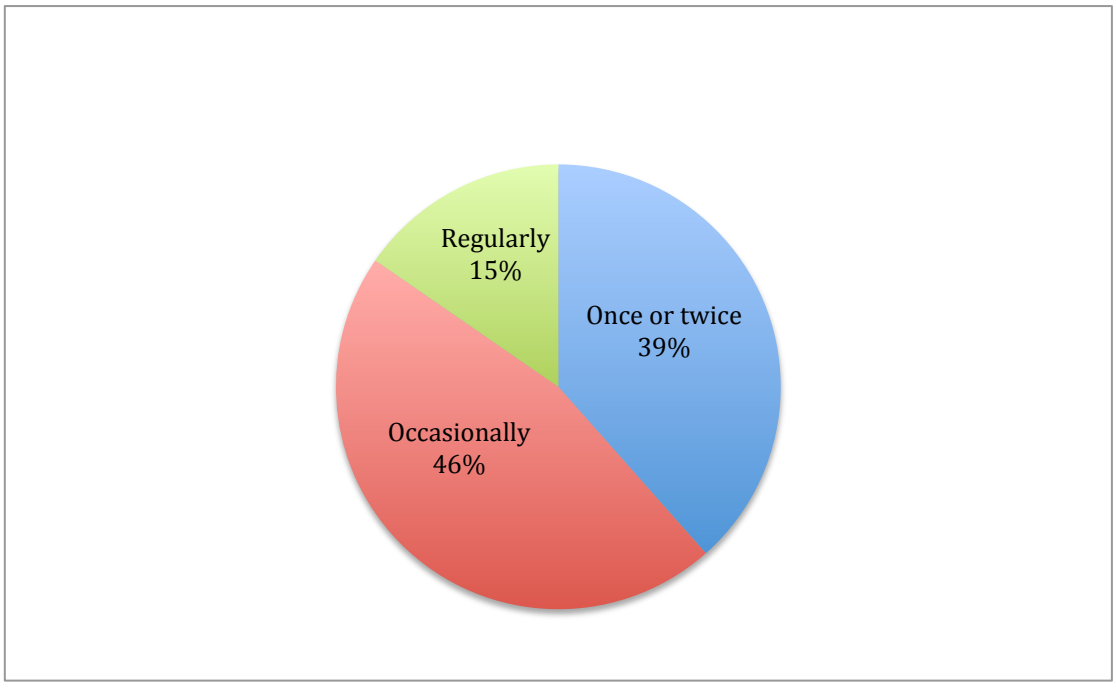

Figure Five: Frequency of erosion
(Percentage of interviewees)

Some growers expressed an interest in technology that would enable them to spray margins accurately using machinery.

Virtually all of the growers we interviewed had experienced problems with erosion, however these problems were infrequent and usually minor in nature (see Figures 5 and 6). Growers reported they were most likely to experience problems with erosion when intense rainfall occurred after field rows had been constructed but insufficient time had passed for grass cover to establish between the rows. Only one grower reported a continuing problem with erosion, and this was primarily due to the topography of land surrounding their property.

All the growers we interviewed had installed drains, bunds, banks or sediment traps. While some had installed them when developing their fields, most had been forced to install them after they had experienced problems with erosion (see Figure 7).

Hydroponic production

Three of the growers we interviewed were growing blueberries hydroponically in substrates contained in pots under cover, or in bags in the field. There is very little risk of erosion with hydroponic systems but there is some risk of nutrient emissions.

Half of the growers we interviewed were planning to move to hydroponic production. Some were investigating hydroponic production because they believed this method offered the promise of higher yields without greatly increasing water consumption. Others were considering switching to hydroponic production to overcome growth and yield problems they had experienced when replacing aged blueberries in field rows.

Since hydroponic production is not possible on steep slopes this method of production cannot be employed to avoid the growth and yield problems growers have been experiencing when replacing old blueberry bushes in the field. Consequently, growers are likely to progressively abandon blueberry production on steep slopes. Some growers indicated they were unsure how abandoned fields could be best used. Note that 21 per cent of growers were planning to expand production by establishing new orchards in a different location with sloping or flat country to avoid the problems of growing berries on steep country.

Conclusion

On the whole erosion is a minor problem for blueberry growers. Erosion is most likely when growers are developing fields. At this time erosion can damage the layout of fields creating delays and increasing the costs of establishment. Growers may be responsive to efforts to promote the adoption of technologies and practices to prevent erosion at establishment such as installing drains, constructing bunds and installing sediment nets or traps.

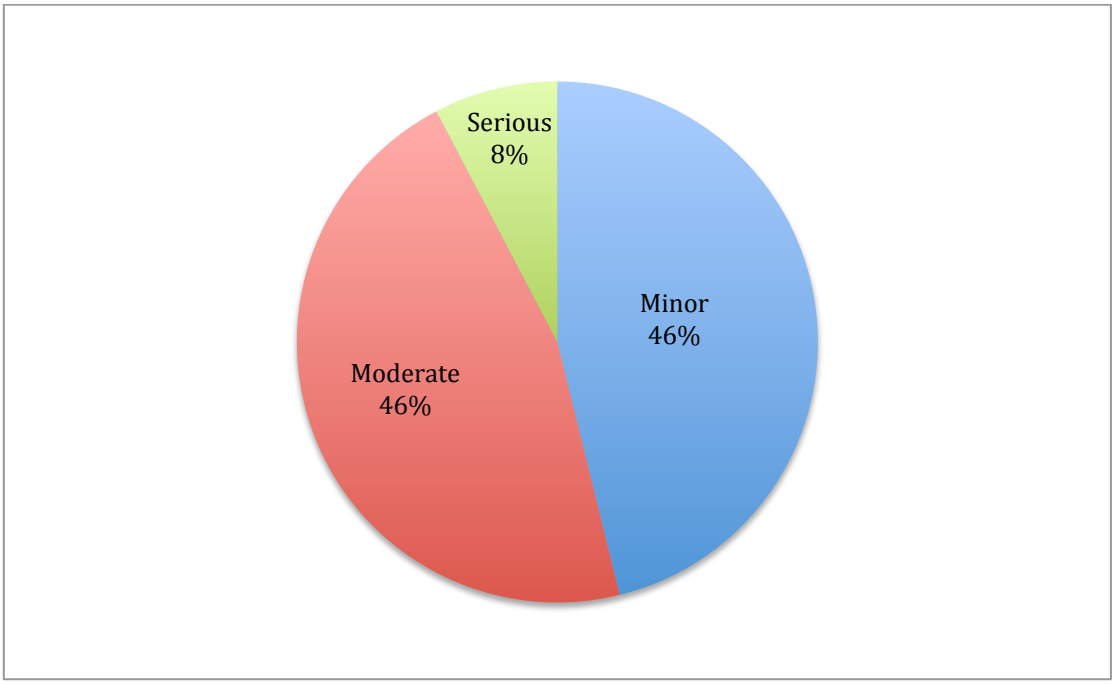

Figure Six: Severity of erosion
(Percentage of interviewees)

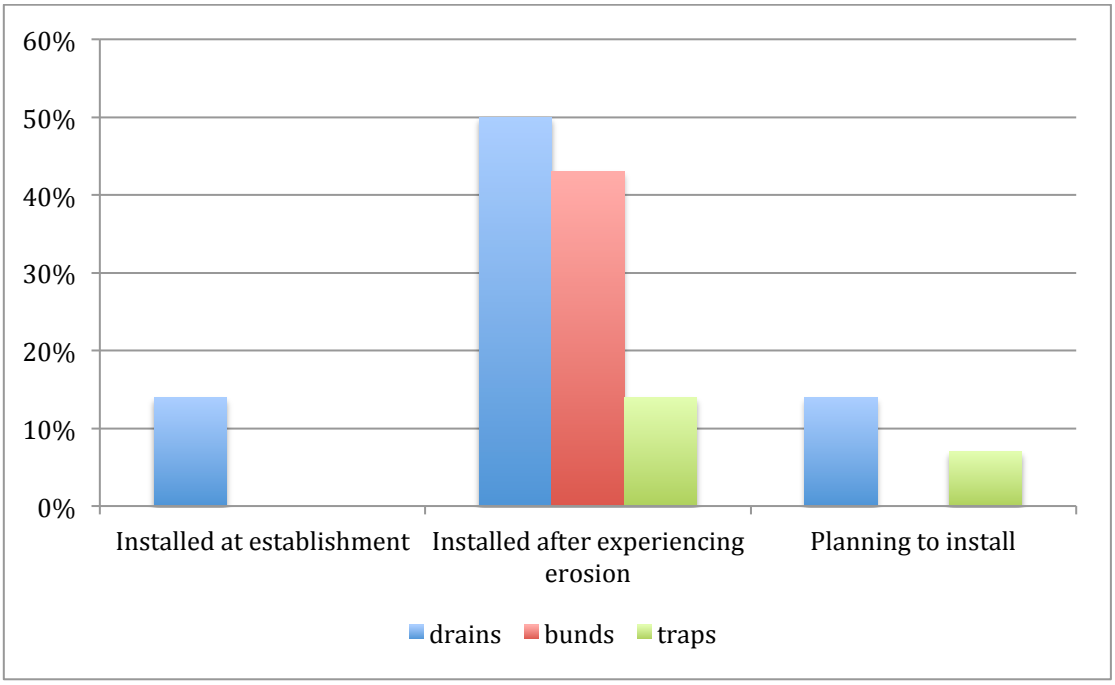

Figure Seven: Erosion management
(Percentage of interviewees)

Irrigation and fertiliser management in blueberries

Field production

On steep slopes water pressure varies in drip lines resulting in the uneven application of water along rows. Plants at the top of the row may receive too little water while plants at the bottom of the row may receive too much resulting in lower yields in both instances. The installation of pressure compensating drippers and drainage plugs at regular intervals along lines can improve the consistency of water pressure, within limits. Installing laterals and converting to shorter drip lines can also achieve more uniform pressures.

The majority of growers we interviewed had experienced uneven pressure in their drip lines (see Figure 8). In all cases this problem had been solved by either installing pressure compensated drippers or, in some cases, shortening rows.

Originally, blueberries were irrigated once or twice a week for up to three hours at a time. This schedule had an unfavourable effect on yields as the berries suffered from too little water between irrigations and too much water during irrigations. The waterlogging of plants meant that at irrigation water, and accompanying nutrients, passed rapidly through the root zone.

Nearly all of the growers we interviewed were irrigating for much shorter periods, much more frequently (see Figures 9 and 10). Typically, plants were watered most days each week in summer for between ten to thirty minutes. Fertiliser was applied to the plants each irrigation in summer. The shift to more frequent, shorter irrigations has probably substantially reduced the extent to which irrigation water, and accompanying nutrients, moves beyond the root zone.

Half of the growers reported that they had experienced problems with blocked drippers. A few growers noted that they installed double dripper lines to ameliorate the risk from blocked drippers as well as to get a more even wetting of the root zone. Only 30 per cent of the growers we interviewed flushed their lines more than three or four times a season.

Most growers rely on harvesting rainfall runoff for irrigation water. In particularly dry seasons some of the growers we interviewed had almost exhausted their irrigation supplies. Two growers had gone so far as to reduce their irrigation of harvested rows. Three of the growers we interviewed used reclaimed water to irrigate their berries. One had experienced a problem with elevated salinity.

Blueberry yields are quite sensitive to over or under-watering. As a result, growers are likely to be responsive to efforts to promote the adoption of practices such more precisely matching the frequency and duration of irrigation to plant requirements on the basis that those practices will increase yields. Greater precision in irrigation may also allow growers to either expand production, or reduce the risk of running out of water in dry seasons. Growers may also respond favourably to guidance on irrigation design, both supply and layout, when developing in new orchards.

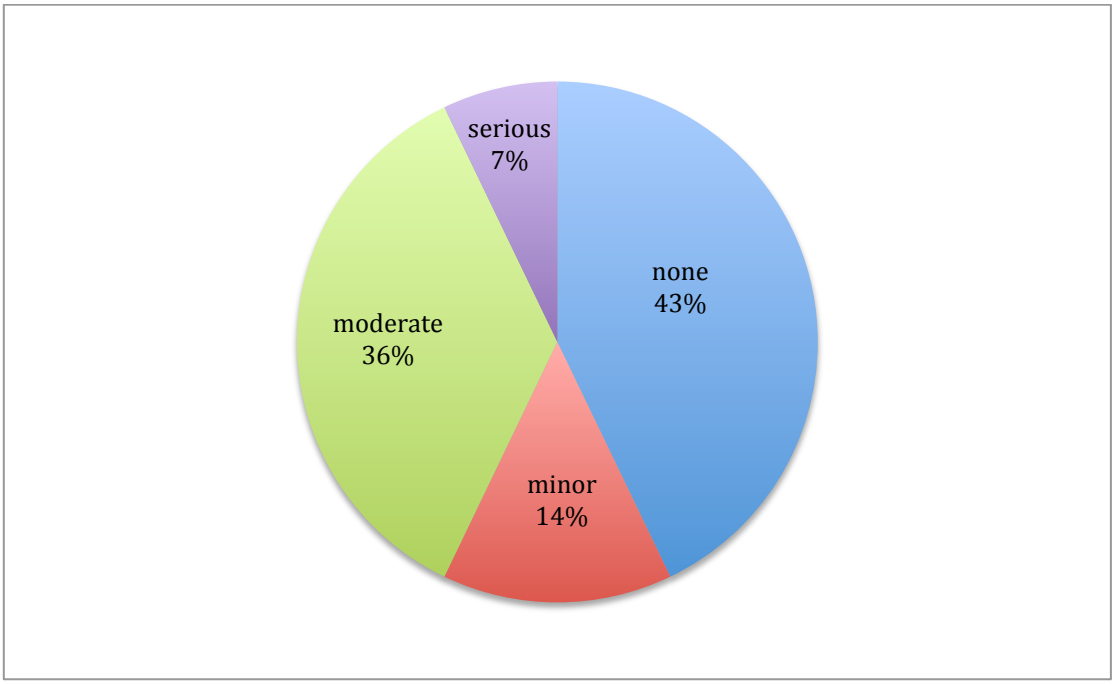

Figure Eight: Problems with uneven irrigation pressure
(Percentage of interviewees)

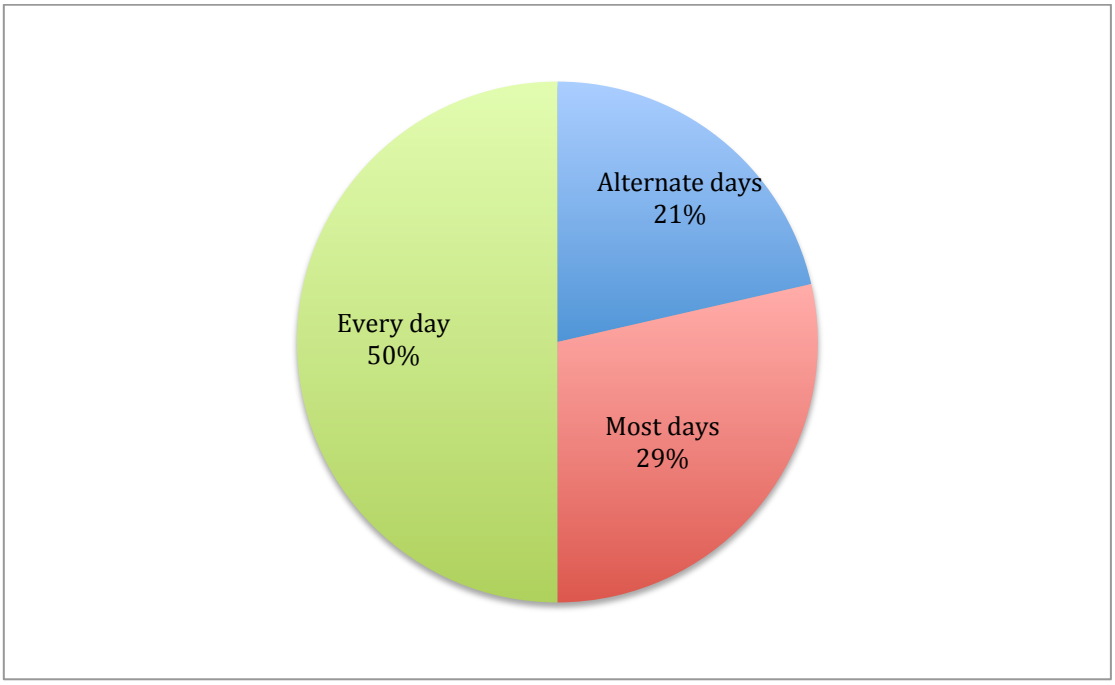

Figure Nine: Frequency of irrigation in summer
(Percentage of interviewees)

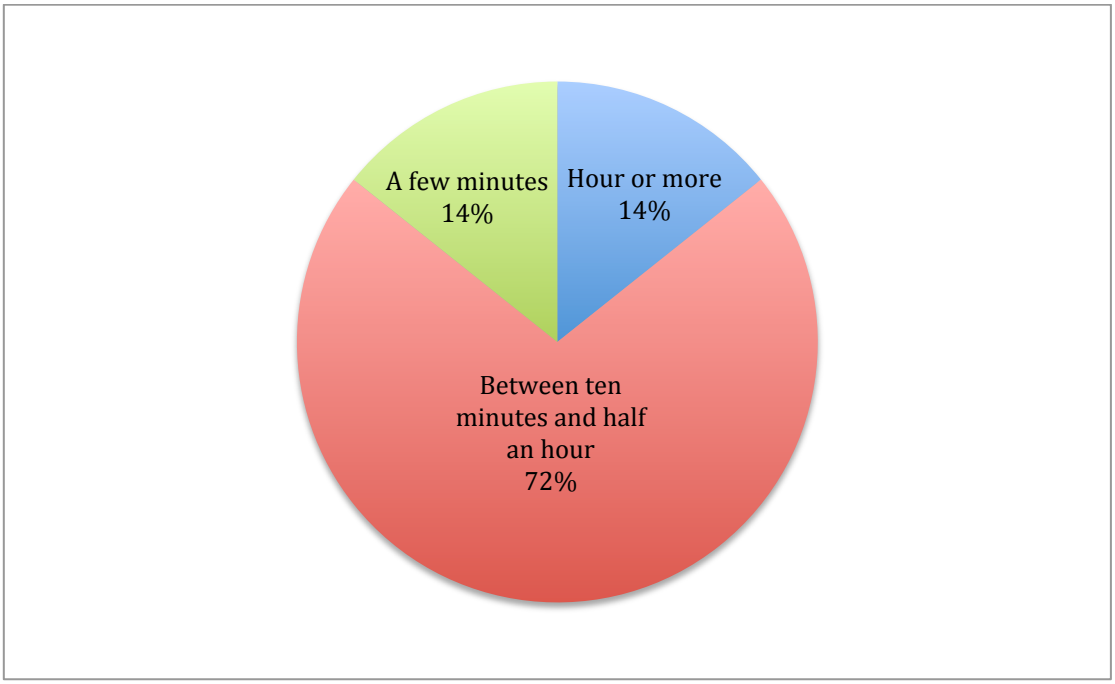

Figure Ten: Duration of irrigation in summer
(Percentage of interviewees)

Hydroponic production

Pulse irrigation is applied to blueberries grown in substrate. The porosity of the substrate means the penetration of water through the substrate is quite uniform and predictable. This means wetting of the substrate can be tightly controlled. Usually, fertiliser is applied each irrigation. Precise management is required to ensure the risk of excess nutrient emissions is kept to a minimum when leaching to remove salts from substrates. This is especially the case when reclaimed water is used for irrigation.

With hydroponic systems water and nutrients are primarily, if not completely, supplied through the irrigation system. Consequently, the supply of water must be dependable, and irrigation and fertiliser schedule must be tailored to plant requirements. This means irrigation systems must be correctly designed and properly maintained, and irrigation carefully managed to avoid losses in production and, in the absence of water recycling, to minimise the risk of excess nutrient discharge when leaching to remove salts from substrates. Consequently, the growers we interviewed with hydroponic systems had sophisticated, automated irrigation systems. These systems relied on continuous soil moisture and weather monitoring to schedule irrigations.

Conclusion

Given irrigation and fertiliser constitute a small fraction of the total costs of blueberry production, cost savings will not motivate growers to adopt water saving practices. However, since yields are quite sensitive to over or under-watering growers are likely to be responsive to efforts to promote the adoption of irrigation technologies and practices that will increase yields. For example, technologies such as pressure compensated drippers and reducing block sizes (row length) will be attractive to those growers that still have pressing need to improve the uniformity of their irrigation systems.

Growers that are seeking to increase the efficiency of their water use to either increase yields, expand production from limited water supplies, or reduce the risk of exhausting their supplies in dry seasons, may be interested in practices such as soil, weather and nutrient monitoring to allow more precise matching of irrigation schedules to plant requirements. They may also respond favourably to guidance on irrigation design, both supply and layout, when developing in new orchards.

Growers may also be interested in information on the potential for more frequent flushing, and more advanced filtration systems, to reduce blockages in drip lines.

Summary and conclusions

Summary

Using information from interviews with ten industry experts, Kaine and Giddings (2016) that the major factors influencing the risk of water and nutrient emissions, and the risk of erosion, from blueberry farms were the topography and soils of orchards. They suggested that the potential for erosion was highest

on steep slopes or flat country with sandy soils. They suggested that the potential for excessive discharges of water and nutrients was also highest on steep slopes.

Kaine and Giddings (2016) proposed that growers would be strongly motivated to adopt erosion control and improved irrigation and fertigation technologies and practices if they improve yields. They argued that growers would only be weakly motivated to adopt such practices if they only reduced the costs of erosion control, irrigation and fertigation.

These findings were validated using data collected by interviewing 14 blueberry growers from the North Coast of New South Wales. The sample covered a variety of soil types and topographies ranging from flat country with sandy, well-draining soils through to extremely steep country with poorly draining, clay soils.

The growers confirmed that the costs of erosion, irrigation and fertiliser were a minor proportion of production costs. They agreed that, on the whole, erosion is a minor problem for them. In their experience erosion was most likely to be a problem when fields were being developing as, at this time, erosion can damage the layout of fields creating delays and increasing the costs of establishment. Consequently, growers may be responsive to efforts to promote the adoption of technologies and practices to prevent erosion when fields are being developed. Such practices include constructing bunds and banks, installing sediment nets or traps and, if necessary, constructing inter-row drains.

Given irrigation and fertiliser constitute a small fraction of the total costs of blueberry production, cost savings will not strongly motivate growers to adopt water saving practices. However, since yields are quite sensitive to over or under-watering growers are likely to be responsive to efforts to promote the adoption of irrigation technologies and practices that will improve the efficiency of water use. Growers may wish to improve efficiency to increase yields, expand production from limited water supplies, or reduce the risk of exhausting their supplies in dry seasons.

Conclusions

The findings reported here suggest that blueberry growers will be interested in extension activities providing information in about:

- Technologies such as pressure compensated drippers and reducing block sizes (row length) where they have pressing need to improve the uniformity of their irrigation systems
- Practices such as soil, weather and nutrient monitoring that enable more precise matching of irrigation schedules to plant requirements
- Irrigation design, both supply and layout, when developing in new orchards.
- The potential for more frequent flushing, and more advanced filtration systems, to reduce blockages in drip lines.

- The management of irrigation and fertiliser in hydroponic systems, including techniques for managing salts and reclaimed water in these systems.
- The design, installation and management of irrigation recycling systems for substrate-based production.

In addition, some growers expressed an interest in technologies to more accurately control the width of the sprays used to control weeds along the margins of rows.

The key criterion growers will use to assess the value of attending an extension activity is the potential for it to help them to increase yields. Therefore, extension activities should be designed and promoted around the theme of irrigation technologies and practices to improve yields and profitability. In principal, the content of extension activities could be tailored to target the particular needs of growers in each of the four segments identified in this study (e.g. irrigation management on steep slopes for growers in segment one). Applied research to demonstrate the affect of the various technologies and best management practices on yields and profitability may have merit to support extension activities.

Kaine and Giddings (2016) suggested that the potential for erosion and the emission of water and nutrients from orchards was greatest on steep slopes. The indications are that growers are likely to progressively abandon blueberry production on steep slopes. This is because the problems growers have been experiencing when replacing old blueberry bushes cannot be avoided by converting steep fields to hydroponic production. Many of the growers we interviewed were planning to expand production by establishing new orchards in sloping or flat country to avoid the problems of growing berries on steep country.

This suggests that growers will:

- Support efforts to identify the cause of poor growth and yields when replacing old blueberry bushes in field rows.
- Be interested in information on alternative crops for abandoned fields on steep slopes.

Blueberry production using hydroponic systems is likely to expand over time. The risk of erosion with these systems is relatively low, however the risk of excess nutrient emissions is relatively high. Therefore, hydroponic systems must be correctly designed, properly maintained, and irrigation carefully managed to avoid losses in production and to minimise the risk of excess nutrient discharge when leaching to remove salts. This is especially the case in the absence of irrigation recycling. This suggests the information needs of growers converting field rows to substrate production may differ from those establishing new orchards and, therefore, the content of extension activities should be tailored accordingly.

References

Dick, B. 1999, *Rigour without Numbers: The Potential of Dialectical Processes as Qualitative Research Tools*, Interchange Chapel Hill.

Kaine G (2004) Consumer Behaviour as a Theory of Innovation Adoption in Agriculture, *Social Research Working Paper 01/04,* AgResearch, Hamilton, New Zealand

Kaine G and Giddings J (2016) Erosion control, irrigation and fertiliser management and blueberry production: Grower interviews, Report to Coffs Harbour Landcare, Hauturu, New Zealand

Kaine G and Johnson F (2004) Applying Marketing Principles to Policy Design and Implementation, *Social Research Working Paper 02/04,* AgResearch, Hamilton, New Zealand