The influence of family and personal domains on change decisions on irrigated dairy farms

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Abstract. Research was conducted to identify the influences on change decisions in Victorian irrigated dairy farms. This qualitative research included the development of a conceptual model that draws on farm control, value chain, image theory and path dependence. An important finding was the influence that the family and personal domains of the farmer could have over farm decisions, even when the issue at hand did not relate to the farm (such as when a farmer directs limited family resources to a child's school fees rather than a farm development plan). this finding has relevance to the way extension, research and development and policy should seek to influence farm change decisions. Key Learning: The family and personal domains of the farmer can influence the capacity of the farmer to make changes to the farm, even where the family or personal issues are not related directly to the farm.

Keywords: path dependence, farm family, climate change adaptation, constraints.

Introduction

Australian agriculture faces the highest rate of income variability in the OECD (Martin 2013). This suggests that Australian agriculture can be described as a vulnerable industry to other sources of income variability. One potential source of income variability is climate change, given Australia has been identified as one of the world's most vulnerable regions to climate change impacts (Head et al. 2014). The vulnerability of farms to climate change lies in the potential for increased variability in critical inputs, such as temperature and rainfall, which producers must manage if they are to maintain viable businesses (Intergovernmental Panel on Climate Change 2012).

Managing input variability entails capturing benefits while minimising negative consequences to farm output quality and quantity (Meinke & Stone 2005). Increasing variability in inputs implies a need for change in the farm. For example, it is expected that in response to climate change primary producers will need to adapt or change their farms to a much greater degree than currently undertaken (Nelson et al. 2010; Anwar et al. 2013). However, the constraints on their capacity to adapt or change are not well understood. Cowan (2014) conducted research to describe as comprehensively as possible the set of constraints on decisions in northern Victoria irrigated dairy farms, thereby beginning to address this gap in knowledge. Constraints are contextual factors that reduce the feasible options available to the individual making the decision.

The vast majority of farms in Australia are small family businesses (Martin 2013). König, Kammerlander & Enders (2013) found that being a family limits business flexibility and adoption decisions in family firms and Nalson (1964) found that decisions being made on the family farm regarding production and consumption changed as family circumstances changed. As well, research by Kaine (2008) identified that farmers make innovation adoption decisions in a manner more akin to consumers than as businesses.

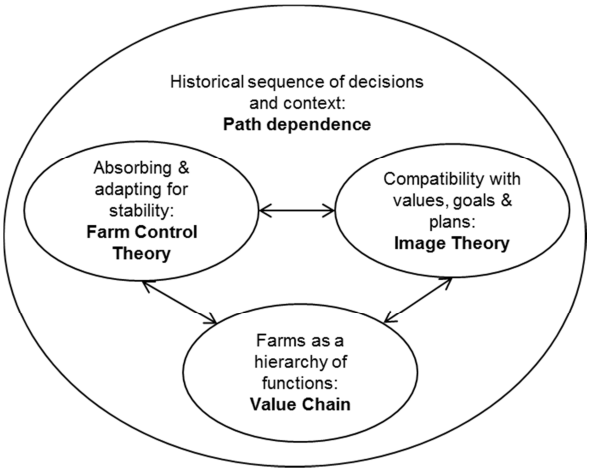
Overall, these findings suggest that family and personal circumstances may be a constraining factor in farm business decisions, such as adaptation decisions. This paper describes insights from research conducted by Cowan (2014) to identify and describe the set of constraints on farm decisions. The focus here is on findings associated with the influence of the primary producer and farm family on farm decisions, even where the family or personal issues are not related to the farm. This has relevance to our understanding of how producers manage change (such as adaptation to climate change), innovation and action in their farm businesses.

This paper is structured to describe 1) a conceptual model for identifying constraints on farm decisions, 2) the methods employed to gather and analyse data regarding decision-making on dairy farms, 3) the results regarding sources of constraints relating to the family and personal domain, and 4) to discuss implications from the findings that are relevant to how we support change, innovation and action in farms as extension practitioners.

Theoretical approach

Identifying constraints on farm decisions required the identification of potential sources of constraints. An integrated model incorporating a comprehensive set of potential sources of constraints on farm decisions was therefore developed for this research (see Figure 1). Potential sources of constraint were identified across four areas: farm and environment interactions; farm component relationships; the producer; and current context built on previous decisions. The sources of constraints across these four areas are described next.

Figure 1. A conceptual model for understanding the constraints on farm management of variability



Source: Cowan (2014)

Interaction between the farm and environment: Farm control

Farms can be described as purposeful open systems which are considered in relation to their interaction with elements of the environment to achieve goals (Ackoff & Emery 1972; Dillon 1992). A potential source of constraint on farm decisions is grounded in the producer's efforts to manage the interaction between the farm and environment to enable the achievement of the farm business purpose, which is fundamentally adequate profit (Argenti 1989).

The interaction between the farm and environment can be seen most obviously in relation to the dynamics of the production system. Inputs (e.g. fertiliser, water, labour) flow into the farm and are transformed through the biophysical production system into outputs. Output quality and quantity are influenced by changes in inputs. Maintaining the flow of inputs is critical for enabling the production of farm outputs at sufficient quantity and quality. From a systems perspective, the on-going capacity of the farm to adequately produce outputs in the face of variable inputs reflects a 'steady-state' and is an indicator of system stability or equilibrium.

Understanding how producers manage variability in farm inputs has been the focus of an area of applied general systems research which is described here as farm control theory (Kaine & Cowan 2011; Cowan, Kaine & Wright 2013). Here we highlight a few points from Cowan, Kaine & Wright (2013) and Kaine & Cowan (2011) that are of central relevance for considering how managing variability in inputs constrains decision-making (see Table 1).

Farmers configure their farms so that the day-to-day operation, i.e. farm behaviour, is able to *absorb* input variability so that it does not lead to variability in outputs. For example, a producer of an irrigated farm regularly uses an irrigation allocation, scheduling practices and existing infrastructure to manage access to irrigation water.

However, when the existing farm configuration is not able to adequately manage the flow of inputs the producer must change something about the farm, i.e. *adapt* it, to improve management so that there are no negative consequences for farm output. For example, were the irrigator not able to access water when needed, the individual would likely face losses and may elect to install a dam to increase farm water storage.

At times, it is not possible to make changes (adaptations) to the farm to preserve the business, which means the farm will fail and disappear or transform into a new system. This aligns with the concept of 'structural adjustment' often used in reference to the exit of farms from agriculture. For example, if the irrigator were unable to improve access to irrigation water, the crops relying on this water will fail. If this pattern were to persist the farm business would fail.

Fundamentally, farm control theory indicates that constraints limit the set of behaviours available to the farm in day-to-day operations undertaken to maintain steady-state (i.e. for absorption) and limit the capacity to make alterations to the production system (i.e. for adaptation). This becomes an issue when variability threatens to push farm behaviour away from steady-state or unexpectedly shocks the system out of steady-state. Hence, the constraints of concern here are those that impede the capacity of the producer to respond to variability, as they represent limitations to absorption and adaptation.

Table 1. Systems concepts used in farm control theory

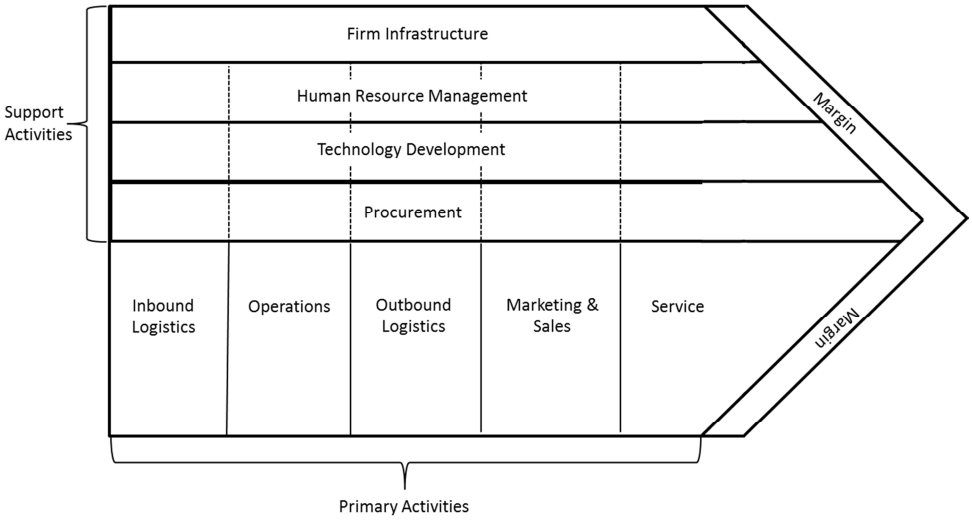
Systems concept	Definitions
Behaviour	The observable aggregate responses of the system to stimuli
Open system	Open systems are those that interact with the environment through responsiveness to feedback
Purpose	The reason a human-made system has been created, relating to the achievement of goals. In farm businesses, the purpose is to generate increasing net equity.
Stability or steady-state	A description of the capacity of the system to maintain system behaviour within acceptable limits, in the face of perturbations from the environment.
Variability	The degree of change in components of the environment that interact with the farm, as a function of the frequency of change, degree of difference involved in (i.e. magnitude of) each change, and degree of irregularity in the overall pattern of change.
Absorption	The capacity of the existing system structure to manage interactions with changes in states of the environment such that the behaviour of the system remains within acceptable limits (i.e., near a steady state)
Adaptation	Purpose-preserving changes made to farm system structure to return the system to a state where it can absorb variability.
Adjustment	System failure or transformation. Exiting from agriculture.

Source: adapted from Cowan (2014)

Interaction among different aspects of the farm: Farms as value chains

The interaction among the aspects of the farm was identified as another potential source of constraint on decisions. Porter's conception of a firm as a value chain (see Figure 2) was used to distinguish different functional aspects of a farm and the relationships among these aspects (Porter 1985). While Porter (1985) used this model of a firm within value chain analysis, an approach to analyse the competitive advantage of a firm, in our research the value chain model was used to define activities and linkages of a firm that could be applied to farms.

Figure 2. A value chain



Source: adapted from Porter (1985)

The activities of a firm were classified by Porter (1985) as either primary or support activities. Primary activities are those 'involved in the physical creation of the product and its sale and transfer to the buyer as well as after sale assistance' (p. 38). The five primary activities are:

inbound logistics, operations, outbound logistics, marketing and sales, and service. Support activities are those that 'support the primary activities and each other by providing purchased inputs, technology, human resources and various firm-wide functions' (Porter 1985, p. 38). The four support activities are: procurement, technology development, human resource management and firm infrastructure.

Activities in a value chain are interconnected by linkages, which Porter (1985) describes as 'relationships between the way one value activity is performed and the cost or performance of another' (p. 48). Linkages within farm businesses can be seen in the day-to-day decisions about the scheduling of flood irrigation and management of grazing rotation. For example, flood irrigation may be scheduled to ensure that it does not overlap with the stock grazing rotation to reduce the risk that stock might damage pasture in newly-watered paddocks.

An important element of the value chain model that offers insights here is the fundamental distinction between support activities and primary activities within the model of a firm. Primary activities are those involved in the physical creation and distribution of a firm's product. Support activities have the potential to influence all of the primary activities. Given the functional hierarchy in firms (Miller 1965), support activities are higher-order constraints when compared to primary activities. This suggests that decisions associated with changes to support activities could entail more significant impacts because they are more far-reaching when compared to changes within primary activities.

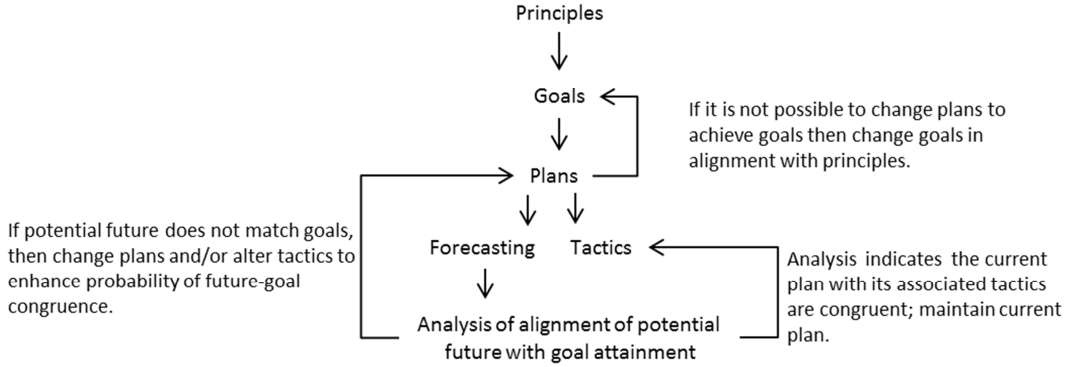
Viewing farms as value chains has another benefit here. This framing of farms includes consideration of constraints on accessing inputs through the procurement function and the intersection between the farm and family through the human resource management and infrastructure (notably finance) functions. These dimensions of constraints are missed within the farm control theory focus on the production system.

The producer as a source of constraint: Image theory

Ninety-four per cent of farms in Australia are micro businesses within which one or two people make all of the management decisions (Fragar et al. 2008; Martin 2013). This suggests that understanding the influences on an individual's decision making matters to farm decisions. Image theory was used to consider how a producer's store of knowledge influences decision making (Beach & Connolly 2005). This store of knowledge is described in terms of a producer's value image (principles, morals and ethics), trajectory image (agenda of personal and farm goals) and strategic image (collective plans and associated or implied tactics for the farm business to undertake in order to more closely approximate the trajectory image). While image theory describes a number of elements in the decision-making process, central to this research was how the images may consciously and unconsciously filter out options during decision making based on non-compatibility with an individual's existing principles, goals and plans.

Hierarchy has implications for how farm-change decisions are considered within image theory. Generally, individuals are highly unlikely to change their principles. If a need for change to the farm is triggered then a change (e.g. adoption) decision can occur to either plans or goals. However, change is likely to be assessed at the strategic image (ie. within farm business plans and associated or implied tactics) before considering a change within the trajectory image (i.e. within farm and personal goals) (see Figure 3). This is because changes to goals will require changes to subordinate plans to align with the new goal and is likely to have a much greater impact across the farm.

Figure 3. Simple example of a decision hierarchy



Source: adapted from Cowan (2014)

Principles and goals relate to many facets of the producer's life beyond the farm, including the farm family (Gasson et al. 1988; König, Kammerlander & Enders 2013). A benefit of using image theory is that it enabled us to consider how producer evaluation of decision options may intersect with multiple domains of life, including the farm family.

Considering decisions in context: path dependence

Decisions are not made in isolation. Rather, decisions are made within a given context composed of the elements of the farm and environment that influence the operations of the farm business (Kaine 2008). Farm control theory suggests that variability management through absorbing and adapting are a part of this context. The value chain construct suggests that the hierarchy of functional activities are a part of this context. As well, image theory suggests that an individual's principles, goals and plans are a key element in this context.

What is not offered by these three sets of potential sources of constraints is a way to consider how elements interact with each other in the collective of farm decisions. Such consideration is offered through the concept of path dependence, which originated in economics to explain technology adoption processes and evolution in industry (Arthur 1989; van Driel & Dolfsma 2009) and has since spread to other fields such as irreversibility in natural selection and chaos theory (Roe 1995-1996; Liebowitz & Margolis 2000).

A farm business is not created at a single point, but instead is built through time as a dynamic process (van Driel & Dolfsma 2009). Path dependence theory allows consideration of how sequences of activities through time, as a dynamic process, influence the options available within a farm system. This means that path dependence constructs (see Table 2) can be used to reveal constraints faced by a producer that stem from the history of decisions made about the farm.

Path dependence can be described as a process of increasing sensitivity of a system to previous decisions, leading to an outcome of lock-in or irreversibility (David 1994; Greener 2002; Vergne & Durand 2011). Hence, path dependence is a description of the collective influences through time that lead a path to 'lock-in', an irreversible state (Greener 2002; Vanloqueren & Baret 2008; Vergne & Durand 2011). *Irreversibility* can be thought of as a description of the degree to which a system has been locked out of options (Antonelli 2006). All change comes at a cost to the system. As lock-in increases, the cost to change the path trajectory also increases.

The 'path' on farms is the critical production path at the farm business level. The critical production path is the interconnected sequence of activities or components that are essential for a set of outputs of a farm production system. The path includes not only what is being produced (output), but also includes how it is being produced; hence, the sequence of activities.

Path dependence begins with a decision to make a change to a system, such as a farm business, at a *critical juncture* or critical decision point (van Driel & Dolfsma 2009; Vergne & Durand 2011). A critical juncture describes a decision-maker's perception of an internal (on-farm) or external (off-farm) threat to or opportunity for the system that triggers a need to make a change to the current system configuration (van Driel & Dolfsma 2009).

At a critical juncture a decision is made to follow one path from among those available within the current set of options (van Driel & Dolfsma 2009). The selection of a path here implies an identified link between the decision and a desired future or goal. Subsequent decisions support the initial decision, decreasing the likelihood of altering paths (Wilsford 1994; Greener 2002). These subsequent decisions are determined by the outcome from the sequence of previous decisions and current context, which includes reinforcement mechanisms (Wilsford 1994; Greener 2002). For example, an irrigated horticulturist who decides to move from flood to spray irrigation is at a critical juncture. The decision to shift to spray irrigation is reinforced by subsequent changes in management practice such as using the sprays for fertilising crops and setting up automatic irrigation.

Reinforcement mechanisms, such as feedback (e.g. economies of scale and increasing returns) and externalities (costs or benefits borne outside of the farm such as nutrient runoff) play a key role in path dependence by reinforcing the current farm business trajectory (Arthur 1989; David 1994; Antonelli 2006; Holder & Lee 2007; Vergne & Durand 2011). As reinforcement mechanisms increase the degree of path dependence, the amount of change (and therefore resources) required to alter the path also increases, leading to irreversibility (Vanloqueren and Baret 2008).

Irreversibility indicates that, while altering the path is desirable, the cost of doing so is too great. Costs to change trajectories, also called switching costs, include those associated with changing system components and opportunity costs from both imbedded investment (sunk

cost) and efficiency gains due to high competency (Crouch 1981; Antonelli 2006; Vergne & Durand 2011). In a practical sense, path dependence reduces the decision options available to the producer, such as narrowing the range of acceptable behaviours within the system as technical efficiency increases. It also locks out options for altering the overall path of the farm business, such as adaptation to components of the production system and changes within value chain functions.

Table 2. Path dependence concepts

Path dependence term	Definition
Critical juncture	A decision point in which a change in the system or environment has triggered a need to make a change to the current system structure
Reinforcement mechanisms	Feedback and externalities that emerge from the outcome of previous decisions
Path dependence	A process of increasing sensitivity of a system to previous decisions which is reinforced by mechanisms, leading to an outcome of lock in or irreversibility
Irreversibility	A system state where the path is locked in and cannot be changed. Irreversibility indicates that while altering the path is desired, the cost of doing so is too great.

It was expected within this research that path dependence in farms would be most visible at a critical juncture, in which the producer perceived a threat to or opportunity for the business that generated a decision to alter the farm business path. From a critical juncture, it would be possible to identify subsequent changes to the farm system that reinforce the initial decision.

Path dependence provides a lens for describing the manifestation of the dynamic and cumulative impact of constraints defined within farm control theory, value chain and image theory. Hence, path dependence derives its meaning from these domains of constraints. As well, the impacts of the dimensions of constraints described within farm control theory, value chain and image theory can only be practically and meaningfully understood through the lens of path dependence. Considering constraints in isolation, such as through a comparative statics approach, does not reveal the influence of cumulative impacts from different sources of constraints that can be considered within this model.

Methods

The aim of data collection was to identify constraints in existing farm contexts, which were grounded in historical decisions. Producers were selected as the primary source of data as these individuals were presumed to be the most knowledgeable about their farm businesses. Importantly, it was the producer's perceptions of issues (e.g. threats and opportunities) pertaining to the farm that mattered, given that this person made the decisions about responding to these issues. That is, the producer's hierarchy of images determined the perceived compatibility of decision options for the farm business.

Data gathering

The qualitative data gathered in this research were drawn from personal interviews. Prospective participants in the interviews were sought using a purposive, theory-based sampling approach in which the constructs in the conceptual model were used to define the parameters for the sampling (Patton 1990). This was useful given the need to interview a small number of farmers who fit specific criteria. While the theories directed the type of data being sought, care was taken in the research process to ensure there was openness to emergence of the unexpected in the data gathering and analysis (Miles, Huberman & Saldana 2014). This included the use of open-ended questions during data gathering which enabled the interviewee to guide the direction of the interview and the use of open and descriptive coding in the analysis process.

North-central Victoria irrigated dairy farms were selected as the focal point of this research. These producers had experienced multiple years of drought and a policy change regarding access to the public irrigation system (Crase 2010; HMC Property Group 2010). It was expected that these obviously substantial changes in context would likely interact with farm businesses and offer relevant data regarding constraints on farms, such as creating critical junctures.

Interviews were conducted with 12 dairy producers and four producers who had changed from dairy production to another enterprise type (e.g. cropping). All 16 producers had actively managed their current farm for 20 years or longer. This 20 year minimum criterion related to an interest in ensuring the interviewee had sufficient experience on that particular farm to have a sound understanding of the history of decision making regarding the farm business.

Semi-structured interviews were used in which the interview was designed as a conversation guided by a broad structure and purpose (Kvale & Brinkmann 2009). Interviews were recorded and transcribed for meaning. The transcripts were converted into narratives about each farm, with names and other identifiers removed. The conversion of transcript data into a narrative enabled the researcher to combine interrelated data into historical sequences, a form of data that was amenable to coding. The narratives were 'second-order' transcripts that anchored all subsequent data analysis (Elliott 2005). Participant validation (Gibbs 2007) of the narratives was sought to make sure the participant was confident that the narrative reflected the individual's farm story. Issues associated with ensuring data quality and maintaining confidentiality of interviewees are considered in detail within Cowan (2014).

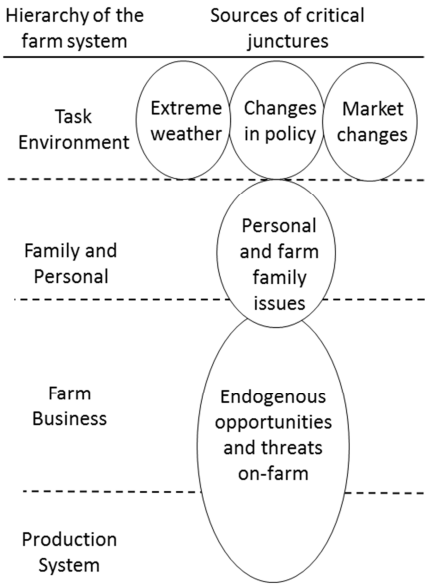
Process of analysis

Using the integrated conceptual model (Figure 1) as the guiding framework for analysis, the farm narratives were coded where constructs of constraints were identifiable. The coded data were then analysed to consider patterns of intersections across constructs and mapping sequential decisions stemming from critical junctions. Following these two steps of analysis, the usefulness of the conceptual model for understanding farm constraints was considered. Details regarding the analysis process, including tools used to manage research validity and reliability are available in Cowan (2014).

Results

By considering a farm as a hierarchy of systems with the production system sitting within the farm business, which is beneath the farmer and farm family and the task environment, useful insights began to emerge regarding influences on farm decisions. While a full analysis of the intersections of constructs of constraints is available in Cowan (2014), emphasis here is on elements that starkly point to a constraint in the farm – sources of critical junctures. Below is a figure that offers a visual interpretation of the extent to which sources of critical junctures appeared to intersect within the hierarchy of the farm system (see Figure 4). In this figure the ovals are not intended to represent an interpretation of scale or size.

Figure 4. Visual representation of the intersection between sources of constraints and the hierarchy of the farm system



Recalling that a critical juncture is the path dependence construct describing a trigger for changing the trajectory of the farm business path, identified sources of critical junctures were clearly influential on farm decisions. In this research 264 sections of data in the farm narratives were coded as critical junctures and were classified across six broad types. These were extreme weather, such as drought and flooding, policy changes, market changes, changes to the personal or family context, and identified endogenous opportunities or threats on-farm (See Table 3). What was unexpected within this research was the large number of critical junctures that stemmed from the realm of the personal and family realm.

Table 3. Sources of critical junctures identified in the farm narratives

Source of critical juncture	Description of source of critical juncture	Number of critical junctures*
Extreme weather events	Any weather events that influenced changes to the farm business; e.g. drought and flood.	25
Policy	Compulsory changes to rules or policies; change in policy context that offer an opportunity for the farm business.	20
Markets	Changes in the market create threats or opportunities for the farm business	14
Personal and family context	Changes to farm ownership, management, succession planning, available family labour; change in personal and family goals including marriage and children; episodes of family tragedy	91
Identified opportunity in the farm (or margin)	Business development opportunities relating to the land area, land development, herd and dairy; enterprises change for improved business margins.	63
Identified threat in the farm (or margin)	Threats associated with current farm use of land, labour, herd or dairy; current enterprise seen as a threat to the business.	59

* Eight sections of data were identified with two sources of critical junctures, as they described two sources concurrently. Hence, the total number of critical junctures in the table of 272 is eight greater than the number of physically coded data segments.

The source of 91 critical junctures described as relating to family and personal context, entailed changes to personal and family circumstances in a way that altered farm business decisions. Broadly these can be described as relating to personal and family goals, including marriage and children; episodes of family tragedy; or changes to farm ownership, management, succession planning and available family labour.

Personal and family goals

Some critical junctures were triggered by changes to personal and family goals. Decisions made to enter into farming were identified as critical junctures and were underpinned by personal goals. For example, Matt's father 'wanted to change from his pre-war career in the railroads to farming, as his family was from a farming background' (Narrative 13). Changes to off-farm activities or businesses that led to alterations on the farm were also classified as critical junctures associated with personal goals. For example, Lachlan 'became involved in another business off-farm that was essentially a seven-day-a-week business', which reduced the time he could put into his farm (Narrative 12). Some goal changes related to moving toward retirement. For example, Matt decided to focus on 'reduc[ing] their debt and refinanc[ing] their loan…[as he] was in his early 60s and didn't want to "keep going flat out"' (Narrative 13). Some of these critical junctures were derived from changes in personal or family goals related to decisions to get out of dairy farming. For example, 'Paul and Patricia were just "marking time" and by 2008 they'd "had a complete gutfull"' of dairy farming and converted to cropping (Narrative 16).

Getting married and having children were sources of critical junctures within the farm narratives. In some cases getting married and having children drove decisions regarding the need to expand or otherwise alter the farm. For example, 'Harry had a growing family and was looking to expand his farm business so that he could support his wife and children...' (Narrative 8). In other cases, marriage of the son was a trigger for passing on the management of the farm. For example, '[t]he day that Owen was married the farm was signed over to his name' (Narrative 15). There were also examples where triggers for change were identified by the need to match farm business goals with family goals relating to children. For example, Edward 'would come home after being on the road for a couple of weeks and his children wouldn't know who he was' (Narrative 5).

The desire to match the farm to family goals can be seen in Neil's decision to convert to pipes and riser irrigation on his farm 'for the lifestyle' (Narrative 14). Neil and his wife 'wanted to decrease the amount of time that Neil was putting into the farm so that he could "spend a bit more time at home with the kids"' (Narrative 14). 'Growing feed and irrigation were the biggest jobs on his dairy farm, alongside milking the cows. He hoped to make those jobs easier to make dairy farming "quite a reasonable lifestyle"' (Narrative 14). Neil was concerned that the 'huge' hours invested in dairy farming 'could "get pretty tough on the family life"' (Narrative 14).

Family tragedy

The untimely death of a family member was identified by several producers as traumatic for the family and leading to impacts on the farm. These were identified as critical junctures because of their clear impact on decisions relating to the farm. These impacts include changing who makes the farm decisions, reducing production for a period of time and stalling in a decision to sell the farm. For example, John had to permanently take over all farm management decisions when his father '"just lost interest" in the farm in the mid-1960s after the tragic death of one of John's sisters' (Narrative 10). Dennis and Donna had 'been "thinking about moving on maybe to another farm or out of farming" [but] when they lost their son they just "weren't ready to move"' and several years later they were still on the farm 'plodding on' (Narrative 4). In recent years Edward and Ellen's 'three children were involved in an automobile accident and one daughter died. The other two children were also injured. Edward broke his leg at the scene of the accident and Ellen had broken her arm in the dairy a week earlier' (Narrative 5). Due to these circumstances, Edward and Ellen had to alter their farm by selling all of their dry stock, converting to once-a-day milking and hiring someone to manage the farm.

Changing family labour, management and ownership

There were a number of family-based critical junctures that directly influenced available farm labour for the business. Some of these related to children returning to work on the farm, influencing business growth decisions based on having more farm help and increased pressure to support an expanded workforce. For example, '[a]s Frank had just left school to work on the farm, Frank's father decided to purchase the block so that they could increase the farm size and milk more cows' (Narrative 6). At times the decision to work on the farm was not made for farm business reasons, such as when 'Mark, came to work on the farm in the very late 1960s, after being retrenched from his job as a mechanic' (Narrative 13). Other examples of critical junctures that stemmed from changing labour related to decisions by individuals that reduced available farm labour. For example, when 'Frank's younger brother decided to leave the farm' in 2008, it 'turned the farm into a predominantly one-man operation' by halving the workforce (Narrative 6).

Overall, it was apparent that the role of the family as a farm labour force could strongly overlap with the family as a support network. This can put pressure on the farm business to match the labour available to business needs. It can also put pressure on the farm resources to generate sufficient income for the family.

When labour altered due to a family member's decision to leave the farm, at times the significance of this related to issues of succession planning and farm ownership. There were several instances in the narratives where such unexpected changes resulted in changes in farm ownership. For example, when Paul's brother left the farm in the mid-1990s, Paul had to borrow 'about 60 per cent of the value of the farm' to pay off his brother and father to take over ownership (Narrative 16). At times there was a significant impact on succession planning from the decision to leave. For example, Matt and Marie were forced to sell the dairy business after their 'son announced that he was leaving the farm for personal reasons' just after considerable investment had been committed in the dairy farm based on the plan that the son would be taking over the business (Narrative 13).

Discussion

In the research to identify and describe a comprehensive set of constraints on farm decisions we have found that the farm family and farmer's personal circumstances can have a significant influence on farm decisions. This is seen most clearly within the critical junctures that originated out of family and personal context. At times these critical junctures were the by-products of changing circumstances that were not directed at the farm, such as family tragedy, the decision of a family member to leave the farm or the need to direct family resources toward off-farm priorities (e.g. school fees). There are a number of implications of these findings that are relevant to how we support change, innovation and action in farms as extension practitioners.

In many ways the dairy businesses analysed in this research *could* appear homogeneous. Broadly, the dairy production systems were similar, comprising feed production and distribution, milk extraction, as well as herd and lactation management. Given the centrality of the production system to the achievement of business purpose, one could easily infer considerable homogeneity across the farm businesses. However, this would conflict with the substantial diversity in farms that was found to stem from the producer and family.

In reality, the farmer's family and personal circumstances were major sources of diversity in production path decisions. The diversity of paths stemming from heterogeneous family and

personal circumstances means that there is also diversity in path dependence across farms. Hence, very 'similar-looking' farms can have very different degrees of path dependence and an option that may be possible for one farm may not be possible for another.

Given the importance of family and personal circumstances to characterising the diversity of constraints on farms, this means that the trajectory image is central to understanding constraints. This is because the trajectory image is the source of personal and farm business goals.

An implication for extension is that extension programs will be most successful when they are able to match innovations to the farm business and personal goals of the producer. This requires sufficient understanding by the extension practitioner of the producer's family and personal goals to identify matches. A suggestion that flows from this is that the relationship between the extension practitioner and producer needs to be developed to the degree that the producer is willing to discuss personal and farm business goals.

A second implication also stems from the need to match innovations to farm business and personal goals in the diversity of farm development paths. Matching innovations to diverse goals implies a need for a diversity of change options available to producers. Hence, extension programs designed to seek a particular outcome through technology change on farms will be more successful if greater flexibility is offered regarding the technology options. For example, orchardists often adopt a subset of integrated pest management (IPM) practices that meet their farm needs (Kaine & Bewsell 2008). An extension program seeking to increase the use of IPM in orchards may achieve better outcomes if this is acknowledged and specific farmer needs are targeted.

Finally, it is worth contemplating briefly the role of finances in the farm and family connection. An obvious place to see the intersection between the farm family and the farm business is within finances, as producers often have to manage competing business and family priorities for limited resources. While this is apparent, what can be gained from focusing on finances is limited. Gleaning useful insights from considering finances is hampered by a couple of factors. First, disentangling the family from the farm with regard to finances can be very difficult as financial resources generally describe the combined residual performance of the farm and the family. Second, in terms of variability management, the notion of finances is a fungible description of a farm's capacity for absorption and adaptation. Hence, it is fundamentally an aggregate description of constraints and does not help us to understand the underlying causes of constraints.

Understanding the underlying causes of financial constraints matters to the practice of extension as producers can often identify finances as a significant barrier to a change decision (for example, Drost et al. 1996). In such cases unravelling the underlying causes may help us to understand the true nature of cost constraints.

The extension approach employed may differ considerably when supporting a producer managing succession issues that may be impeding a change decision, when compared to the services that may support a farmer struggling to identify the costs associated with integrating a practice into the existing farm.

Overall, the idiosyncratic history of decisions on individual farms led to paths and path dependence that injected unique constraints over choices at a given point in time. Moreover, the micro-business character of the farms led to personal and family characteristics being prominent components of the decision-making context. The scope for the adoption of innovations, and the program design and delivery tasks facing proponents of innovation adoption, need to be informed by awareness of these findings with regard to irrigated dairy farms in Victoria. Cognisant of the small sample size involved in this research, a replication of these findings would add to their reliability. That said, generalisation beyond those farms to other family farms, and other micro businesses, would seem to offer fruitful research paths into the complexity and constraints pervading very small businesses.

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