ENVISAGING FUTURE DAIRY FARM SYSTEMS

Sub-Theme: Working With Global And Local Markets.

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Abstract:

Designing future farming systems which are resilient in an increasingly volatile and uncertain environment which is likely to differ considerably from that of today is challenging. This study is Phase 2 of a three phase project investigating future dairy farm systems in New Zealand. In Phase 1 (Scenario Planning Phase), three possible, plausible future scenarios plus a base scenario were developed. This Phase 2 study used farmer and industry workshops to conceptualise dairy farm systems for the three futuristic scenarios, with workshop participants working in groups using mental models to do this. Diverse farm systems were developed with some overlap between the systems in the different scenarios. The farm systems developed for the consumer-driven scenario and the highly regulatory scenario had similarities, but there was very little overlap between these two farm systems and the farm system for the third scenario (political chaos with trade dictated by governments). Farm systems were most diverse under the consumer scenario and least diverse under the political chaos scenario. The identification and description of these future farm systems will inform Phase 3 of this project (Quantitative Modelling Phase). The approach used to identify and describe conceptual models of future farm systems was useful.

Key words: dairying, farm systems, future, scenarios, New Zealand.

Introduction

Farm businesses are complex and operate in increasingly volatile business and natural environments. Farm business owners' and managers' goals and objectives, and the resources available to the business, also evolve over time in response to changing business environments and social norms, and the development of new technologies and knowledge. Therefore, farm systems in future will differ from those of today. However, it is uncertain what these future farm systems will be.

Predicting or designing future farming systems which are resilient in an increasingly volatile and uncertain environment can be challenging. Farm systems modelling approaches often extrapolate the future from the current situation, however, unless a short-time frame is used, this is a relatively simplistic approach given the uncertainty and volatility inherent in the industry. Scenario analysis which was developed by Shell to help with the strategic planning because of future uncertainty (Cornelius, Van de Putte & Romani 2005) is a useful tool in volatile and uncertain environments (Schoemaker 1993, 1995). This approach has been used in an agricultural context both overseas (Dairy Australia 2013; Demeter, Meuwissen, Oude Lansink & Van Arendonk 2009; OpenFutures 2012) and in New Zealand (Parminter, Nolan & Bodecker 2002).

The Centre of Excellence in Farm Business Management (CEFBM) adopted a scenario analysis approach in their Dairy Farm Systems for the Future project which aims to identify and evaluate some possible future New Zealand dairy farm systems in 2025 to 2030. This research had three phases. In the first phase, scenario analysis was used to develop three possible, plausible futures that dairying might operate under plus a base scenario developed from commonly used assumptions of the future. Since most of New Zealand's dairy products are exported, a global perspective was taken. The three future scenarios arrived at were: 'Consumer is King' in which a wide range of dairy products are produced in direct response to consumer demand, 'Regulation Rules' in which there regulatory requirements of dairy farm businesses are considerably greater, and 'Governments Dictate' in which dairy products are produced for a world where political chaos exists, markets are shrinking and trade is dictated by governments. While the scenarios developed were extreme in some aspects, soft signals already present suggest the future might have aspects of all three scenarios. These scenarios are reported in Shadbolt et al. (2015) and shown in Figure 1.

In this second phase of the project, farmer and industry workshops were held in the Canterbury and Manawatu regions to develop conceptual models of possible dairy farm systems for each region, for each of the future scenarios. Future farm systems were not developed for the base scenario since farm systems research generally takes this perspective, so work in this area has been done or is underway. The disparity in the possible, plausible industry scenarios resulted in a range of diverse future farm systems being proposed in this phase. This paper compares and contrasts the Manawatu dairy farm systems developed for the three futuristic scenarios.

The final project phase will extend these conceptual models, then develop quantitative models to explore farm systems performance and resilience, including across scenarios.

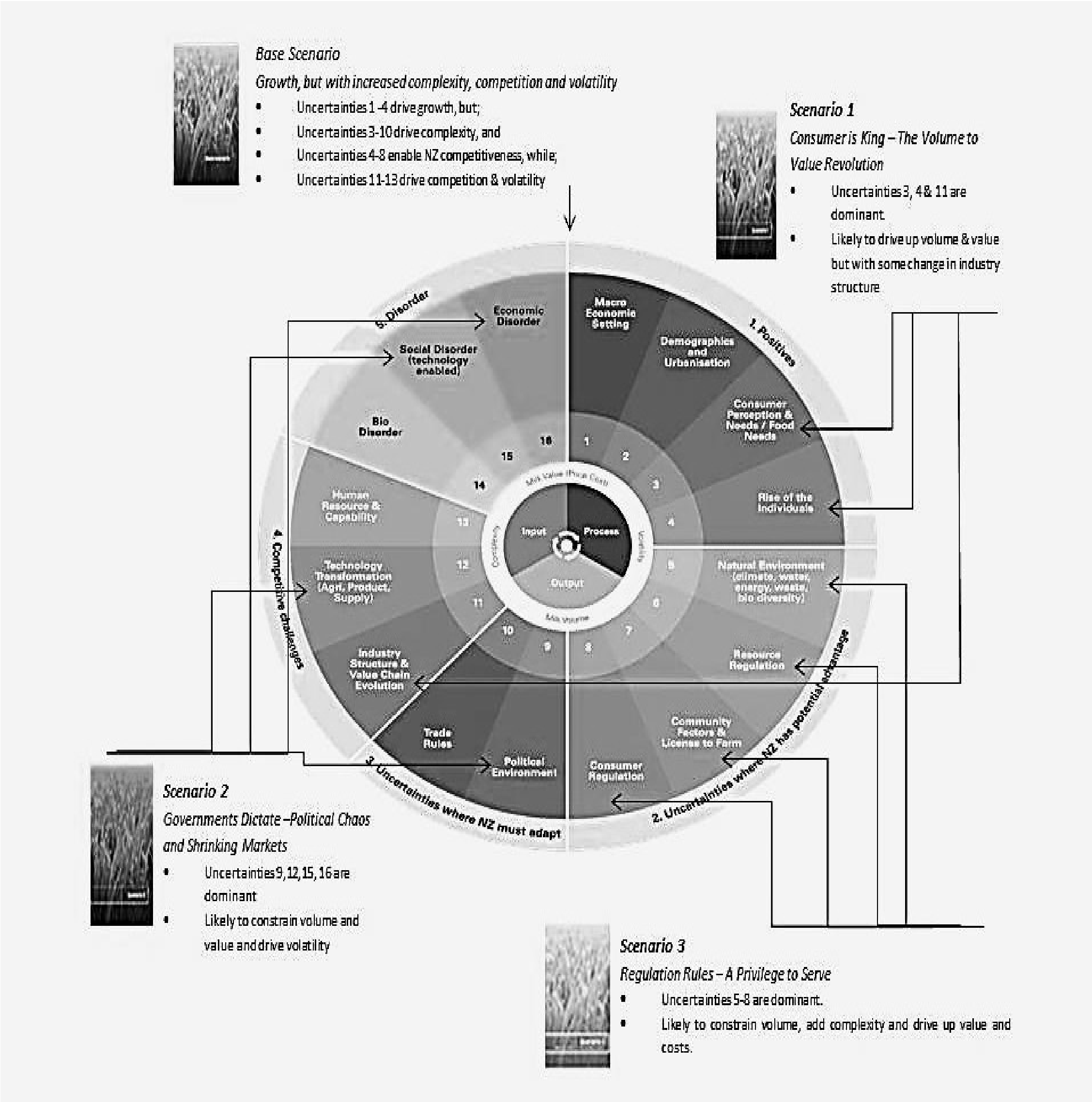

Figure 1: Futuristic dairy industry scenarios developed in the first phase of the project. Adapted from Shadbolt et al. (2015).

Method

Two one-day workshops were held at Massey University (Manawatu) mid-2015 to develop future farming systems for the futuristic scenarios described above. Experienced dairy farmers, who were well-informed on dairy farm systems and industry dynamics attended the farmer workshop. Professionals and academics from a range of backgrounds with expertise in dairy farm systems attended the industry workshop to add their ideas and knowledge to extend the farm systems developed by the farmers. Some farmers and academics from the farmer workshop attended the industry workshop, enabling group discussions to link back to the thinking at the farmer workshop.

The workshops required participants to come up with mental models of future farm systems. Mental models are used by people to reflect on their situation, make decisions and behave in certain ways, and provide a way to consider new experiences and information and store the concepts that are personally salient (Jones, Ross, Lynam, Perez & Leitch 2011). A process for eliciting and consolidating mental models was developed for the workshops to link peoples' values and management practices to farming outcomes in particular hypothetical situations (Jones et al. 2011). Team mental models, rather than individuals' models, were elicited from the knowledge and experience that the various group members could bring to a situation (Cooke, Salas, Cannon-Bowers & Stout 2000).

Methods for developing cognitive maps from mental models can be constrained by individual participants' abilities to focus on mental objects and concepts relevant to the presented situation, the concepts contribution to the situation and relationships between concepts; and the efficacy of the group process (Kearney & Kaplan 1997). To manage these constraints, participants invited were well-informed and expert in their fields; an experienced facilitator helped plan the workshops; techniques suited to eliciting information in a group situation were used; someone in each group understood the rationale and thinking behind the previous project activities and outcomes (i.e. a scenario development phase project team member with each group in the farmer workshop, and a farmer workshop project team member or farmer in each industry workshop group); and a World Café process was used in the industry workshop. This technique is an informal conversational process for groups (Brown & Isaacs 2008), which Fouche and Light (2010) evaluated and found to be effective for exchanging ideas and information, and for encouraging creativity through collective discovery, collaborative learning and knowledge creation. They also identified this as a powerful data collection technique.

Manawatu Farmer Workshop

The farmer workshop was attended by 10 farmers who were pre-allocated to one of three groups, sent information on one of the futuristic scenario, and asked to consider possible future dairy farm systems that could be viable for their scenario. A description of the current 'base case' or status quo farm for the North Island (Massey University dairy farm) was also provided to farmers (Massey University 2015), and revisited by the group at the beginning of the workshop to set the scene.

Farmers were then asked to work together in their groups to consider their scenario, and using post-it notes®, to write down the ideas, objects and concepts that could be part of an adapted farm system which could operate viably for their scenario, in 2025 to 2030. An academic who had worked on the scenario analysis phase was present with each group to help facilitate, make notes, and explain background as required. The workshop facilitator circulated around the groups. Sessions were recorded.

Farmers were asked for ideas about on-farm production activities, resources, technologies and human capabilities that they expected would be required for their system. Then each group worked together to connect their concepts together into a diagram showing hierarchical dependencies and inter-relationships for their primary system. In addition, they described how the farm system linked to the market and wider industry customers. In doing so, they were asked to consider internal consistency i.e. whether two ideas could co-exist in a system. In the Consumer is King and Regulation Rules groups, farmers could not agree on a single system, so two possible systems differing in size were developed.

At the end of the day, each group presented their dairy farm system and the wider group had the opportunity to provide additional input. This session was video recorded, with the recording later transcribed. The systems for each scenario were written up in table format by theme, and in a narrative form.

Manawatu Industry Workshop

The industry workshop was held a week later and attended by 24 participants (4 dairy farmers from the farmer workshop, 12 academics and 8 dairy industry stakeholders e.g. farm consultants, DairyNZ, Landcorp Farming, Fonterrra). Academics in the project team participated in this workshop. Participants worked in groups of four, with groups moving between the three scenarios. Group members were from different backgrounds. Numbers were sufficient that there were 6 groups, so two rooms, each with the three scenarios set out were used. Participants were provided with information on the scenarios in advance.

Three joined sheets of flip-chart paper with a description of one of the farmer-developed farm systems attached was provided on each group table for working on. A narrative of that system, and a table summary of the three industry scenarios were available for reference. For each system, groups were asked to provide critical comment, and suggest improvements or new ideas, and supporting services, R&D and technology needed to make this work. Post-it notes® were used to add ideas to a farm system with lines drawn to link ideas.

Groups contributed to the systems for all scenarios, spending 40 minutes on each scenario. When a group moved to the next system, one group member remained behind to link information between groups, sharing and explaining ideas from those who had previously contributed to the system and answering queries (World Café approach).

After lunch, participants had an hour to look at all systems, add individual ideas on post-it notes, and suggest new ideas for farm systems.

At the workshop conclusion, the last group with each system scenario presented the updated dairy farm system, and research, information, systems and services needed to all workshop participants. Group discussion provided further input, ideas and feedback on each dairy farm system. This session was video-recorded and results written up as previously described.

Results and Discussion

On the whole, the results indicate that there is considerable overlap in terms of farm system attributes and features between the Consumer is King scenario (CK) and the Regulation Rules scenario (RR), whereas the farm system under the Governments Dictate scenario (GD) stands out because it has very little overlap with the other two scenarios (Table 1). More specifically, the farm systems were most diverse under the CK scenario and least diverse under the GD scenario. This is primarily because the diversity of the animal production systems in terms of cow numbers, breed type, production and other factors is greatest under the CK scenario followed by the RR scenario, whereas it is largely homogenous under the GD scenario. Further, driven by more stringent regulation, cow numbers and stocking rate are quite low in the RR scenario; while a lowering in milk price and need for increased efficiency has pushed cow numbers and stocking rates up in the GD scenario. Cow numbers and stocking rates are on the low side, but highly variable under the CK scenario due to the significant consumer influence and higher margins.

Table 1: Systems Description - A comparative view across scenarios

Attribute	Consumer is King	Governments Dictate	Regulation Rules
System Overview	Farm size polarized, highly flexible & diverse systems, highly automated, diverse ownership structures, significantly increased production costs.	Large farms with high stocking rates, some horizontal integration with beef, high automation, largely corporate-owned or equity partnerships, decreased production costs.	Large farms with low stocking rates in designated dairying areas, highly automated, range of ownership structures, increased production costs.
Animal Production System	May not be seasonal, significant decrease in milk production, milk quality/type focus, range of cow breeds, close monitoring of animal health & welfare.	Seasonal system, significant increase in milk production, crossbred cows, less importance on animal health & welfare.	Seasonal system, slight increase in milk production, cows clean & good condition, strong focus on animal health & welfare, no bobby calves, close monitoring.
Pastures & Feed System	Grass-based system (promoted as NZ attribute), may be very specialized feeding systems e.g. feeds to give special attributes to milk, targeted use of nutrients.	Grass-based system with imported grain supplements, high yielding GM pastures, fully irrigated with on-farm water storage, pastures & soils absorb 100% of nutrients applied.	Grass-based system with maize and grain supplements, significant irrigation & drainage investment, water & fertilizer use tightly regulated.
Technology	Significant use of technology and data, complete automation at farm level, leasing of technology & IP licencing common.	Increased use of technology and data e.g. drones, robotic milk systems, precision ag.	Intensive use of technology and data e.g. drones, robotic milking systems, precision ag.
People	Highly educated and trained, technology-savvy staff. Specialist roles on large farms. Public relations function critical to communicate with customers. Good working conditions.	Well trained staff: one highly educated and trained manager, three technology-savvy assistant managers with good farm management skills.	Highly trained, well educated, technology savvy staff with specialized roles. Specialist administrator for environmental issues, compliance and PR. Staff well treated e.g. 40 hour week.
Auditing for Compliance & Market Guarantees	Significant contractual obligations, strong monitoring and third party auditing for markets & regulation.	Not very important	Strong monitoring systems with tight management control, regular third party audits.

Pasture based systems are the basis of all scenarios, but the drivers of the feed system are quite different between scenarios. In the case of the CK scenario, specialised feeding systems have evolved to ensure milk with special attributes is produced. Under the GD scenario, the use of genetically modified pasture has resulted in a significant increase in the quantity of pasture dry matter for feed produced. A strong constraint around the use of water, fertiliser and supplements has imposed significant constraints on feed supply in the RR scenario.

Driven by greater feed availability, milk production per hectare has increased significantly under the GD scenario, whereas there is a decrease in milk production in both the CK and RR scenarios. In the case of the CK scenario, this is primarily due to the higher margins and resulting shift towards value from volume, while in the RR scenario it is due to the greater constraints imposed on the farm systems, specifically around feed supply and cow numbers. Furthermore, more stringent standards and greater compliance needs have caused production costs to increase under the CK and RR scenarios, whereas a move towards less regulation and compliance, and a strong focus on keeping costs low because of low milk prices in the GD scenario has meant production costs have decreased.

The need for year round supply of product and greater system flexibility has meant the farm system under the CK scenario is no longer seasonal. In contrast, under both RR and GD scenarios, the farms remain seasonal. Moreover, due to the possibility of a farm system being a part of multiple value chains, sub-systems within a farm system are quite common under the CK scenario.

There is increased adoption of on-farm technology across all scenarios, with the use of drones, robotic milking systems and precision agriculture tools being common. However, the CK scenario has a much higher use of technology, and given the cost involved, Intellectual Property (IP) licencing and leasing of technology is common. Staff are educated, technology-savvy and well trained under all the scenarios, but the specific skills required vary between scenarios, with demands of both the CK and the RR scenarios being far greater than the GD scenario. For example, under the CK scenario, staff specialised in public relations and communication are essential, while under the RR scenario staff specialised in handling environmental issues and compliance is critical.

Due to the strong standards imposed by the market (consumers) and regulators (government), and the consequent need for credible proof that the standards are being adhered to, auditing for compliance and market guarantees are a significant requirement for the CK and RR scenarios. In contrast, a lowering of standards and less need for compliance measures has meant auditing for compliance and market guarantees are not an important feature under the GD scenario.

Conclusion

It was identified that the farm system would be most diverse under the CK scenario and least diverse under the GD scenario. Moreover, the farm systems under the CK and RR scenarios showed considerable overlap, however, there is very little overlap between the farm system under the GD scenarios and the other two systems. From a systems design perspective, this suggests that there will be greater flexibility to adapt farm systems from CK to RR or vice-versa if the business environmental conditions change, than there would be to adapt farm systems from the GD scenario to any of the other two scenarios.

These conceptual models that were developed play a critical role in the process of farm systems design through informing the development of quantitative models to further explore farm systems performance and resilience, including across scenarios. In the next stage of the project, it will be interesting to identify and explain in quantitative terms the commonality between systems, how well systems perform across scenarios, and the flexibility to adapt systems between scenarios. The research process, which involved developing team mental models of farm systems with industry and farmer groups, provided an effective method to arrive at conceptual models of farm systems specific to pre-determined scenarios.

References

Brown, J & Isaacs, D, 2008, 'The World Café: awakening collective intelligence and committed action', In M. Tovey (Ed.), *Collective Intelligence: Creating a Prosperous World at Peace* (pp. 47-54), Oakton: Earth Intelligence Network.

Cooke, NJ, Salas, E, Cannon-Bowers, JA & Stout, R, 2000, 'Measuring team knowledge', *Human Factors*, Vol. 42, pp. 151-173.

Cornelius, P, Van de Putte, A & Romani, M, 2005, 'Three decades of scenario planning in Shell', *California Management Review*, Vol. 48, no. 1, pp. 92-109.

Dairy Australia, 2013, '*Horizon 2020 Project - Future Scenarios for the Australian Dairy Industry*', Retrieved from http://www.dairyaustralia.com.au/~/media/Documents/Industry%20overview/About%20the%20industry/Current-industry-issues/Copy%20of%20Horizon%202020%20Report%2017april2013%20final.pdf

Demeter, RM, Meuwissen, MPM, Oude Lansink, AGJM & Van Arendonk, JAM, 2009, 'Scenarios for a future dairy chain in the Netherlands', *NJAS - Wageningen Journal of Life Sciences*, Vol. 56, no. 4, pp. 301-323, doi: /10.1016/S1573-5214(09)80002-X

Fouche, C & Light, G, 2010, 'An invitation to dialogue: The World Café in social work', *Quantitative Social Work*, Vol. 10, no 1, pp. 28-48, doi: 10.1177/1473325010376016.

Jones, NA, Ross, H, Lynam, T, Perez, P & Leitch, A, 2011, 'Mental models: an interdisciplinary synthesis of theory and methods' *Ecology and Society*, Vol. 16, no. 1, p. 46.

Kearney, AR & Kaplan, S, 1997, 'Toward a methodology for the measurement of knowledge structures of ordinary people: the conceptual content cognitive map (3CM)', *Environmental Science and Behaviour*, Vol. 29, no. 5, pp. 579-617.

Massey University, 2015, '*Massey No.1 Dairy Farm Fact Sheet'*, Massey University, Palmerston North.

OpenFutures, 2012, '*Dairy 2020 - Scenarios for a sustainable UK dairy industry*', Retrieved from http://www.forumforthefuture.org/sites/default/files/project/downloads/dairy-2020-scenarios.pdf .

Parminter, T, Nolan, I & Bodeker, P, 2002, 'Use of scenarios in industry consultation: Dairy InSight's Future Focus project', In, *Proceedings of the Agricultural and Resource Economics Society (Inc.) Ninth Annual Conference* (pp. 164-170), Lincoln University, Lincoln, New Zealand: Agribusiness and Economics Unit.

Schoemaker, PLH, 1993, 'Multiple scenario development: Its conceptual and behavioral foundation', *Strategic Management Journal*, Vol. 14, no. 3, pp. 193-213. doi: 10.1002/smj.4250140304

Schoemaker, PJH, 1995, 'Scenario planning: a tool for strategic thinking', *Sloan management review*, Vol. 36, no. 2, p. 25.

Shadbolt, N, Hunter, S, Apparao, D, Dooley, E, Bicknell, K, Trafford, G, 2015, '*Dairy industry scenarios: Informing dairy farm systems for the future*', Client report for DairyNZ, Centre of Excellence in Farm Business Management, and KPMG, Retrieved from http://www.onefarm.ac.nz/system/files/resource_downloads/OneFarm%20Scenarios%20Report%20_FINAL_0.pdf

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