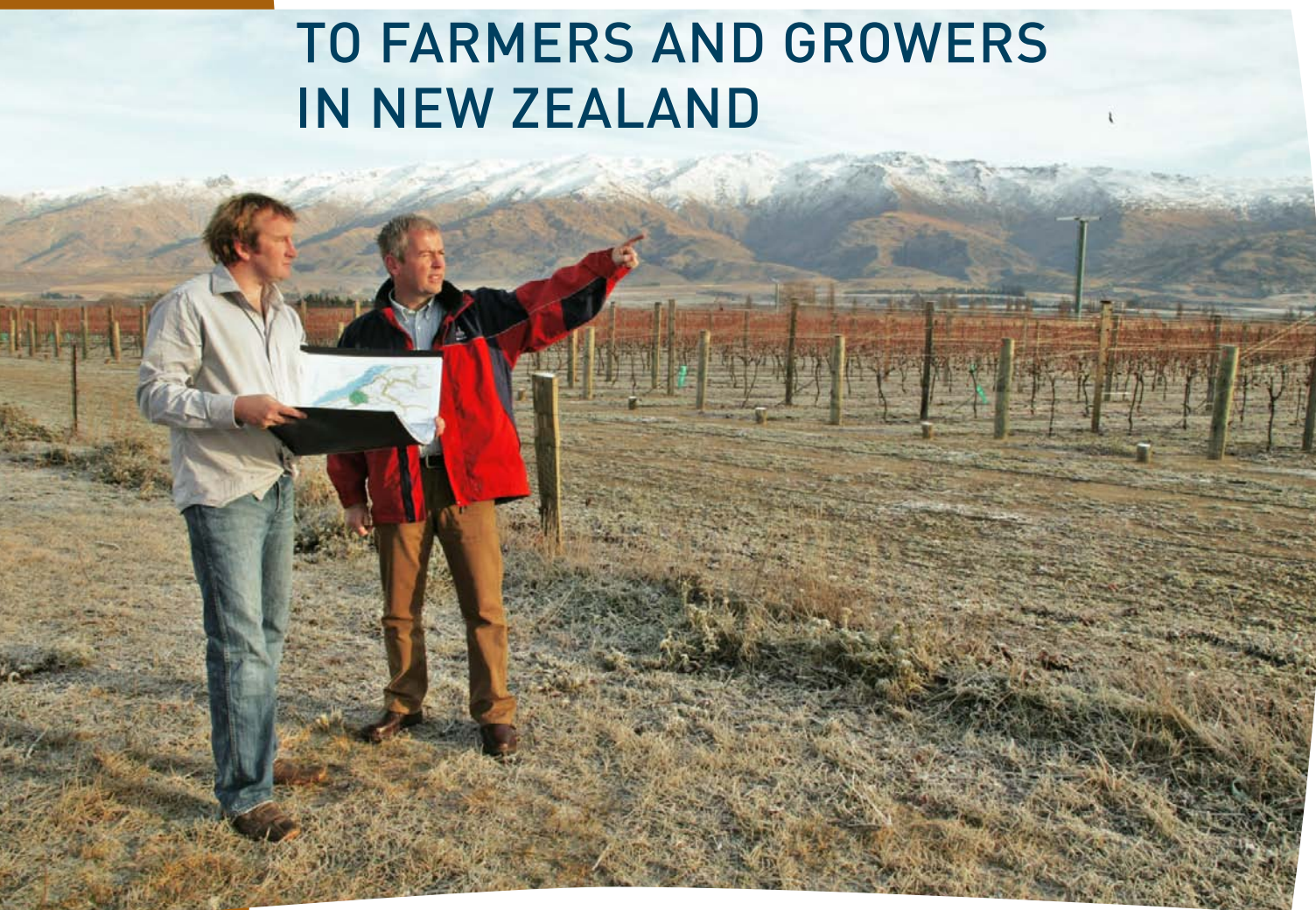




SURVEY OF TECHNOLOGY TRANSFER SERVICES TO FARMERS AND GROWERS IN NEW ZEALAND



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FOREWORD

Achieving excellence in the primary sectors is about how we manage our resources to ensure we derive maximum benefit from them both today and in the future.

New Zealand has many natural advantages, but ultimately our physical resources are constraining. The one resource that is not finite is our ability to innovate through the application of new knowledge. It is by leveraging this knowledge through technology transfer that we will continue to grow. The Government, in partnership with industry, is investing significantly in the primary industries, in people and the transfer of knowledge. The aim is to see improved economic and environmental outcomes.

This paper analyses the results of an online survey aimed at increasing our understanding of the current technology transfer system in New Zealand. While technology transfer, including the creation and application of new knowledge, is a two-way process, the survey specifically addressed the supply of support services to primary producers. Survey results show that there are a wide range of organisations interacting with producers and supplying new ways of doing and new technologies.

Many of these suppliers of knowledge are quite specialised and are tightly focused on one part of the farming system. The survey results confirm that the technology transfer system is fragmented, thinly spread and that, overall, the number of people involved in technology transfer appears insufficient to deliver on the Government's goals around economic development and environmental performance.

Julie Collins
Acting Deputy Director-General Policy
Ministry for Primary Industries



Photo: MPI Sustainable Farming Fund project.

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INTRODUCTION

For the New Zealand economy to continue to grow and do so sustainably within environmental limits, technology transfer will be increasingly important. Farms are becoming more complex and sophisticated. They are becoming larger and employing more staff and more technology. As production intensifies, farms have the potential to impose greater impacts on the environment. MPI is concerned that New Zealand's ability to generate and transfer knowledge and technology may not have kept pace with its goals around economic development. Also, the technology transfer system may not optimally address the requirement to match increasing productivity with the need to manage the sector's environmental footprint.

MPI's interest centres on whether we can enhance the technology transfer process to improve the long-term performance and sustainability of farming. Technology transfer and the resulting application of knowledge is a key component of the process. A better understanding of the current system may highlight areas for improvement to ensure that we maximise the returns from New Zealand's considerable investment in research and development.

This paper analyses the results of an online survey aimed at increasing our understanding of the current technology transfer system in New Zealand and proposes a series of next steps. While technology transfer is a two-way process, the survey looked specifically at the supply of support services to farmers and growers. It has not considered the demand for such services.

“The challenge for all of us interested in building and enhancing technology transfer and extension systems is to identify how farmers want to learn.”

Comment from survey respondent



Photo: MPI Sustainable Farming Fund project.

BACKGROUND AND CONTEXT

WHAT IS TECHNOLOGY TRANSFER?

The term technology transfer is used loosely in public discourse even though in academic literature it is tightly defined. In this paper, the term “technology transfer” encompasses the wide scope of activities leading to adoption and practice change and includes extension services and the diffusion of knowledge, in addition to adoption of new technologies.

“Technology transfer must be based around needs – if the client cannot see the need or have the need demonstrated then it will not proceed.”

Comment from survey respondent

Technology transfer is defined as the process of introducing new ideas, tools, processes and practices enabling change in individuals, communities and industries involved in the primary sector and with natural resource management. It encompasses those people who provide information and advice that supports individuals and firms to achieve their business objectives.

Technology transfer is about giving people the confidence to try and ultimately succeed in doing things differently.

WHY IS TECHNOLOGY TRANSFER IMPORTANT?

Practice change is crucial across the primary sectors if New Zealand is to unlock innovation and increase productivity and profitability within sustainable production systems. This is vital to New Zealand’s export performance and long-term economic growth.

The primary sectors sit at the heart of New Zealand’s largest economic opportunities. While New Zealand is blessed with natural resources, it takes skill and knowledge to transform these natural resources into economic wealth.

New Zealand also faces increasing scrutiny from discerning markets along with environmental challenges as evidenced by our water quality issues. Managing the environmental impact of agriculture, forestry, horticulture and fisheries is becoming more urgent.

To remain a world leader in primary production as a country we need to continue to explore, define and adapt to meet new opportunities. New knowledge and new ways of acting on that knowledge will be important but the knowledge has to be disseminated, picked up and applied and this is the technology transfer process.

“There is an urgent need to work with farmers to assist them in adjusting to new policy imperatives especially in regard to land use and water quality issues.”

Comment from survey respondent

New Zealand farmers and growers have demonstrated their resilience and adaptability over the last three decades of structural change. Yet, there is concern that our ability to generate and transfer knowledge and technology may not have kept pace with the globalising agro-economy. There is large variation in performance across farms and this variation is perhaps getting larger as highlighted in the 2011 Red Meat Strategy.

There are huge gains to be made in productivity from better management. Lifting the average performance of pastoral farmers to that of the top 25 percent of farmers would increase exports by \$3 billion annually, and this is just using existing technology. Over the last two to three decades, government investment in supporting the primary industries has focused heavily on science to support research and development. The responsibility for the uptake and extension of the products of research and development has largely been left to other actors in the sector (industry-good bodies, consultants, universities, etc.).

The challenge facing New Zealand's primary sectors and those operating in the technology transfer space is how to work with farmers and growers to identify what knowledge is needed and how to help ensure it is adopted more widely so that productivity is increased or costs decreased (including external costs).

RECENT HISTORY OF TECHNOLOGY TRANSFER IN NEW ZEALAND

New Zealand has a long history of developing and adopting technology and farming practices to meet our needs. As a country we recently celebrated 130 years since the first shipment of frozen meat through the adoption and adaptation of refrigerated shipping. We have also shown our ability to address unique New Zealand challenges through approaches such as micro-nutrient supplementation in the Central North Island, aerial topdressing of hill country, and developing low cost but efficient pastoral farming systems that leverage our temperate climate.

While New Zealand's history of technology transfer stretches back to the 1800s, it is the last thirty years that are most relevant to understanding the current situation. In the 1970s and 80s the Advisory Services Division (ASD) of the Ministry of Agriculture was aligned with the Research Division of the Ministry. In the late 1970s, ASD helped lift production through extension of new knowledge. Being aligned with the scientific community, ASD was a key component in the uptake of scientific knowledge. For example, ASD worked closely with scientists to refine and promote rotational grazing, internal parasite management, and soil testing. It was not a linear process; advisers also helped provide information back to researchers about the challenges farmers and growers were facing and helped embed research into farm systems.

ASD had over 300 advisors and worked actively with farmers both on a one-to-one basis and within group situations, its scale allowed specialisation so that there were specialised advisors, for example in animal breeding. ASD had the scale and systems to train new graduates and continuously up-skill existing staff. Many of the farm advisors practicing today had their start in the ASD. In the late 1980s, as part of the wider public sector reforms, the Government removed any direct support to farmers and reduced its indirect support for farming. ASD began charging for services. In 1996, the business that became Agriculture New Zealand was sold to Wrightson Limited, New Zealand's largest stock and station firm.

While ASD had a significant presence they were not the only source of support for farmers and growers. Many of the other players active today, such as private consultants, fertiliser companies, stock and station agents and Dairy Board consulting offices (now DairyNZ), were active 30 years ago.

With the restructuring and subsequent sale of ASD, other providers including private firms moved to partially fill the vacuum. Consultancy firms such as AgFirst, Macfarlane Rural Business, Baker and Associates, and many others specialise in on-farm and on-orchard consultancy. Input suppliers also provide advice. Fertiliser companies Ballance and Ravensdown are now major providers of nutrient management advice and, through the Fertiliser Association, co-funded with MPI and AgResearch the development of Overseer®, which has become the nutrient planning tool of choice for the pastoral industry.

“It would seem that tech transfer represents a huge opportunity to lift NZ ag performance, however getting buy in from clients in particular getting them to pay for advice is the challenge.”

Comment from survey respondent

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Purchasers of farm and orchard produce have also become more involved in technology transfer. Some entities such as Heinz Watties have had a long history of providing technical advice to growers. As firms have become more vertically integrated, and with the development of longer term relationships between farmers and growers and the purchasers of their produce, greater information and advice is provided to growers via these avenues. Some meat companies that had often been tolling operations have changed how they operate; ANZCO, for example, has producer groups which aim to integrate the demands of the customer with the needs of the producer. The FarmIQ Primary Growth Partnership (PGP) programme is another recent example of how things are changing. This PGP programme seeks to improve the sustainability of returns for all participants across the red meat value chain by understanding what customers want and tailoring farm systems to deliver what customers desire.

“One on one and small discussion groups probably elicit the fastest behaviour change. But shouldn’t underestimate the value of the larger gatherings in terms of networking and sowing the seed of ideas that people then act on later after further exposure to a concept.”

Comment from survey respondent

In 1990, the Commodity Levies Act (CLA) became law and enabled primary industries to form industry-good bodies and levy members to undertake industry-good activities. An industry-good activity is defined as an activity which is financially beneficial to New Zealand farmers and growers but would not be undertaken by individuals or groups of farmers or growers because it is either too expensive for them to do on their own or the benefits could not be captured exclusively by those making the investment.

This has encouraged the establishment of industry-good bodies such as DairyNZ, Beef and Lamb NZ, Horticulture New Zealand, the Seafood Industry Council (SeaFic), Aquaculture New Zealand, and the New Zealand Forest Owners Association. Many, but not all, of these organisations utilise the provisions of the CLA to fund their activities, including technology transfer in some cases.

Throughout the period rural media (both specialist publications and farming sections in mainstream media) have had an important role in disseminating new ideas. Traditional print media is embracing the internet and web-based farming and growing resources are widely available from industry-good bodies and many other sources.

OTHER CHANGES IN THE INNOVATION SPACE

In the 1990s, the research divisions of MAF and the Department of Scientific and Industrial Research (DSIR) were restructured into Crown Research Institutes (CRIs) and expected to return both a science and a financial dividend to the Crown.

Since their inception the CRIs have undergone a number of modifications. Some of these changes have been internally driven (such as the merger of two CRIs to form Plant & Food Research) and others have been centrally driven (such as the recent reforms which have resulted in refinements to the accountability, expectations and funding for all CRIs). As part of these recent reforms there was a clear expectation from the Government that CRIs have to focus more on outcomes and therefore on the transfer of technology and knowledge as well as the creation of new knowledge.

In 2009, the PGP was established. Two aspects of PGP are very relevant to technology transfer. The first is that it is a partnership with individual actors in industry with the key “path-to-market” criterion that focuses directly on how the PGP programme will result in economic growth. The

second very relevant aspect of PGP is that the initiative can and does fund activities right across the value chain, from the creation and transfer of new knowledge right through to activities near market. As a result many PGP programmes have an element of capability building.

WHO IS CURRENTLY SUPPORTING FARMERS AND GROWERS?

Current farming and growing operations

Farm and orchard businesses have evolved. A good example is the dairy industry where farm and herd sizes have increased. In 1990/91, the average herd size was 164 cows. In 2010/11, the average herd size was 386 cows. Mechanisation and digitalisation have increased, as has contracting out for operations such as hay and silage making. This means there is also greater specialisation, with occupations such as herd manager becoming more common. There has also been a growth in specialised support services such as irrigation schedulers.

Multiple people working in an operation means that the audience for advice and how it is taken up may vary. For example, herd health advice may be best directed specifically at the herd manager. However, as farmer workers look to develop their careers the opportunity to train and up-skill will become increasingly important.

Farmers and growers have to pay greater attention to factors other than increasing outputs, such as effluent management. Compliance with resource consents means that well designed and operated effluent systems are a must on commercial dairy farms. The importance of good animal welfare and herd health, especially with larger operations, is also gaining prominence as industry guidelines come into effect (for example, guidelines around the use of induction of dairy cows).

“We need a much larger resource of well trained, accredited people to assist landowners to increase productivity while farming within limits.”

Comment from survey respondent

There is increasing recognition of environmental limits and the need to farm within these limits. This has been highlighted by the 2011 report by the Land and Water Forum and the Government's National Policy Statement that requires regional councils to set and manage catchment water quality and quantity limits. Farmers are paying greater attention to the loss of nitrogen and phosphate from their farm systems.

However, this survey did not explore the motivations for farmers and growers to change their practices.

Current state of technology transfer in New Zealand

To better understand who is actively supporting farmers and growers currently, MPI undertook a high level survey of individuals providing technology transfer services to ascertain who is involved, what areas they are involved in, how they are operating (e.g. one-on-one or through group activities) and how they are being funded (for example, through client fees or third parties such as industry-good bodies or government). The attachments set out the full range of questions and responses.

A detailed analysis of the survey results follows, but in summary, there are in excess of 2000 FTEs supporting farmers and growers, about 20 percent of whom identify themselves as consultants, with the majority working for commercial firms supplying inputs to farmers. Most work one-on-one with farmers and growers and the majority work in the production/technical areas.

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Many of the players such as private consultants, fertiliser companies, stock and station agents and Dairy Board consulting offices (now DairyNZ), have been active in this space for a long time. While it

“Usually need one-on-one regular contact to drive behaviour change.”

Comment from survey respondent

may appear that the range of supporting agencies providing advice to farmers has changed little over time, we have little information about the services these organisations offered in the past and the types of services offered may have changed and become less focused on working with individual farmers. For example, there may be a greater focus on working with groups and field days rather than one-on-one.

WHO IS SUPPORTING FARMERS AND GROWERS?

There were 311 original responses to the survey which were refined down to 212 valid responses. Where there were multiple responses from an organisation for the numeric analysis the responses that best reflected the entire organisation were used.

From the responses, it was estimated that around 2100 Full-Time Equivalents (FTEs) are actively working to support the farming community, although not all are farmer facing in that some will be supporting other people who directly interact with farmers and growers¹. Those who identified themselves as a consultancy firm accounted for an estimated 381 FTEs or just under 20 percent of total FTEs. Commercial firms supplying inputs to farmers and growers accounted for 669 FTEs, or approximately one-third of all those supporting farmers.

Industry-good bodies only accounted for 133 FTEs and research organisations for 189 FTEs. There were also an estimated 323 FTEs from financial and legal institutions. Regional councils and universities each had around 90 FTEs actively involved in technology transfer (see Table 1).

The diversity of organisations that are involved in technology transfer reflects the diversity of functions and expertise needed to run a successful primary industry business. Pastoral production systems, for example, are complex, requiring expertise in nutrient management, and plant and animal husbandry all the while dealing with climatic and other variation. Likewise the business component of the enterprise requires expertise in people management, marketing, and financial and legal expertise.

Despite the richness and diversity of various organisations participating in the technology transfer processes, the level of support remains reasonably thin given the limited number of consultants available to over 30 000 commercial farmers and growers. MPI considers that this level of professional support is unlikely to be sufficient going forward, as farming and growing systems are likely to only increase in sophistication and complexity necessitating the need for more expert advice.

¹ The FTE figures need to be treated with caution and as estimates only. Estimating the FTEs actively involved in technology transfer is difficult, especially for large diverse organisations such as universities. It is also difficult to gauge how complete the survey coverage was of those involved in technology transfer.

Figure 1: Range of organisations as a percentage of responses

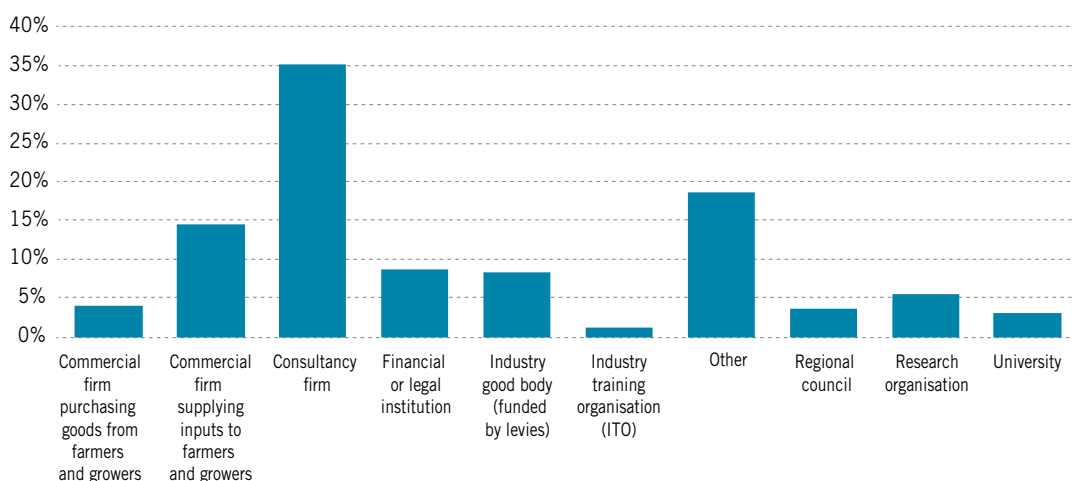


Table 1: Full-Time Equivalents (FTEs) by organisation type

	Number of responses	Average number of FTEs	Total number of FTEs
Commercial firm purchasing goods from farmers and growers e.g. meat or dairy company	8	6.25	50
Commercial firm supplying inputs to farmers and growers e.g. fertiliser company, veterinarian	30	22.3	669
Consultancy firms	72	5.29	381
Financial or legal institution	17	19	323
Industry-good body (funded by levies)	16	8.3	133
Industry training organisation (ITO)	2	6.5	13
Other	37	4.2	154
Regional council	7	12.5	88
Research organisation	11	17.2	189
University	6	15.2	91
Total	206	11.7	2091

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WHAT SECTORS ARE RESPONDENTS WORKING IN?

The majority of respondents work with dairy and/or sheep and beef farmers (63 percent and 56 percent respectively). In addition, 39 percent of respondents said that they also worked with the horticulture sector, with a similar number in arable and 31 percent with the forestry sector. Seven percent of respondents also did some work in fisheries. A number of respondents also indicated that they worked in other sectors, such as organics (refer to Figure 2 and Table 2).

Respondents estimated that around 17 percent of their work involves working with Māori, which is in line with the estimate that Māori agribusiness enterprises provide 8 to 10 percent of the national milk solids production and carry 10 to 15 percent of national sheep and beef units².

In summary, while the effort may be thinly spread respondents are active across all the primary sectors.

Figure 2: Sectors that respondents work with

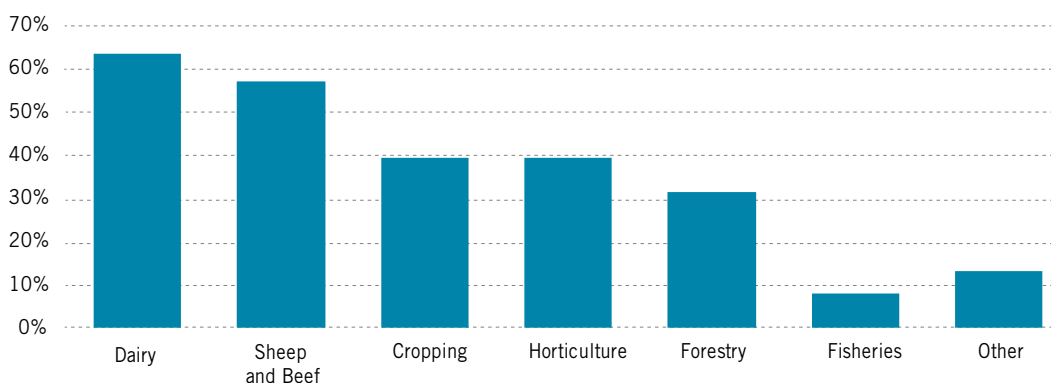


Table 2: Sectors that respondents work in and percentage of work involving Māori

Respondents working with	Number of respondents	Percentage of respondents	Work involving Māori
Dairy	133	63%	15%
Sheep and Beef	119	56%	17%
Cropping	82	39%	16%
Horticulture	82	39%	14%
Forestry	65	31%	21%
Fisheries	15	7%	19%
Other	26	12%	17%

² Ministry of Agriculture and Forestry (2011); *Māori Agribusiness in New Zealand: A study of the Māori Freehold Land Resource*.

SOURCES OF FUNDING

Sixty-five percent of respondents stated that they received no external funding for technology transfer. That is, they were funded directly by clients or by their own businesses (as in those selling inputs to farmers and growers)³. Of the remaining 35 percent (71 respondents), funding sources were quite diverse (see Figure 3 and Table 3).

While care should be used in interpreting the revenue information, it is clear that sources of revenue other than fee paying clients are very important.

Figure 3: Revenue sources for those who receive external funding

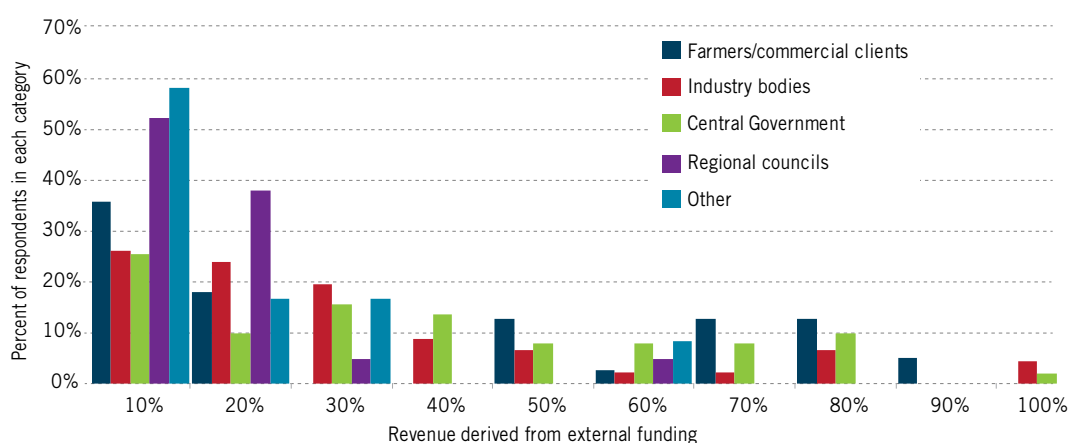


Table 3: Revenue sources for those who receive external funding

	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Count
Farmers/commercial clients	14	7	0	0	5	1	5	5	2	0	39
	36%	18%	0%	0%	13%	3%	13%	13%	5%	0%	100%
Industry bodies	12	11	9	4	3	1	1	3	0	2	46
	26%	24%	20%	9%	7%	2%	2%	7%	0%	4%	100%
Central Government	13	5	8	7	4	4	4	5	0	1	51
	25%	10%	16%	14%	8%	8%	8%	10%	0%	2%	100%
Regional councils	11	8	1	0	0	1	0	0	0	0	21
	52%	38%	5%	0%	0%	5%	0%	0%	0%	0%	100%
Other	7	2	2	0	0	1	0	0	0	0	12
	58%	17%	17%	0%	0%	8%	0%	0%	0%	0%	100%

³ This question may be open to interpretation. While the question was designed to understand if they received any funding other than from fee paying farmers and growers, in hindsight we realise that some may have considered external bodies who contracted them, such as regional councils or industry-good bodies, to be clients. Thus the figure that 65 percent of respondents do not receive any external funding should be considered an upper bound.

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DIVERSITY OF WORK

Most respondents work in multiple areas, such as finance, production, environment, people management, and whole-of-farm systems. For example, 54 percent of respondents said they do some financial work, and 47 percent of respondents said they do some people management work. However, the level of effort in a particular area can be relatively low (see Figure 4 and Table 4).

Over three-quarters of respondents said that they or their organisation worked in the production and technical area, with 30 percent of these respondents spending 70 percent or more of their time working in this area. This result reflects the makeup of the respondents, with 15 percent of respondents identifying themselves as commercial firms supplying inputs to farmers and growers, who would be expected to focus on production.

The diversity of work undertaken by most organisations and people involved in technology transfer reflects the complementarity of their work. To be effective in providing farm systems advice, it is essential to have a good understanding of the production system along with the financial implications. However, while 64 percent of respondents said they do some farm systems work, only 8 percent of those who do farm systems work spend 70 percent or more of their time doing so. This suggests that many individual practitioners of technology transfer services may have a particular, possibly narrow, area of expertise. These results confirm what MPI has heard from DairyNZ and others about the lack of whole farm systems approach to advice. It may also reflect that few people in the servicing sector have the necessary farm systems expertise.

Without the ability to take a whole systems approach there is a risk that farmers and growers will not get the tailored advice they need and that they may either fail to act on the advice, or that the advice may result in sub-optimal change, especially when dealing with complex biological systems.

All this suggests some fragmentation in the technology transfer system, which can make it challenging for both providers of technology transfer services and farmers and growers to stay up-to-date with the latest developments across a wide range of areas. A number of respondents also raised concerns about the relevance of Crown Research Institutes (CRIs) to their jobs, suggesting a disconnect between those whose primary function is the creation of new knowledge and those whose primary function is the dissemination of knowledge. However, it is not clear how the nature and content of services available to farmers and growers may be reflecting specific demand, as the work to-date has not considered the demand for advisory services.

Figure 4: Areas of focus

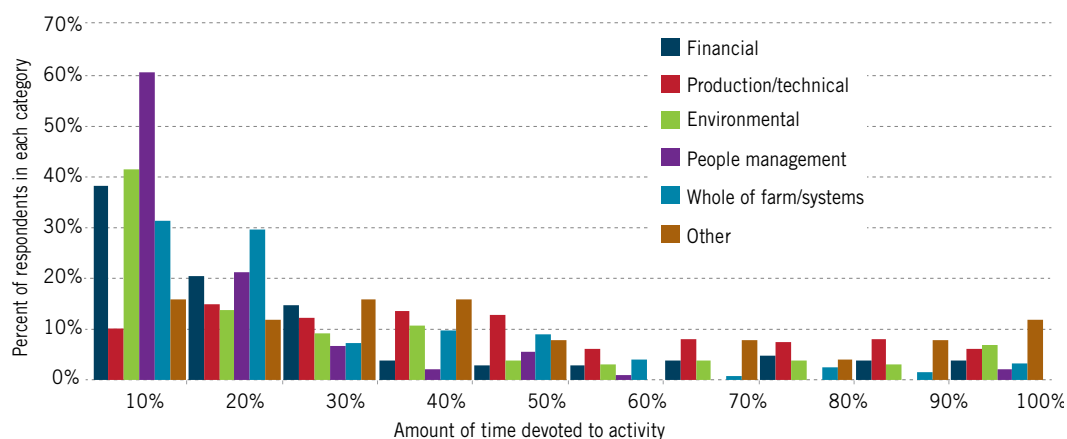


Table 4: Areas of focus

	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Count
Financial	39	21	15	4	3	3	4	5	4	4	102
	38%	21%	15%	4%	3%	3%	4%	5%	4%	4%	100%
Production/technical	15	22	18	20	19	9	12	11	12	9	147
	10%	15%	12%	14%	13%	6%	8%	7%	8%	6%	100%
Environmental	54	18	12	14	5	4	5	5	4	9	130
	42%	14%	9%	11%	4%	3%	4%	4%	3%	7%	100%
People management	54	19	6	2	5	1	0	0	0	2	89
	61%	21%	7%	2%	6%	1%	0%	0%	0%	2%	100%
Whole of farm/systems	38	36	9	12	11	5	1	3	2	4	121
	31%	30%	7%	10%	9%	4%	1%	2%	2%	3%	100%
Other	4	3	4	4	2	0	2	1	2	3	25
	16%	12%	16%	16%	8%	0%	8%	4%	8%	12%	100%

HOW THOSE WORKING IN TECHNOLOGY TRANSFER ARE WORKING WITH FARMERS AND GROWERS

One-on-one remains the most popular way of working with clients. Eighty-three percent of respondents (156 of the 189) stated that they or their organisation spent time engaging one-on-one with clients. Fifty percent of these respondents spend 70 percent or more of their time in one-on-one engagement (see Table 5).

For the 75 percent of respondents who work with small groups, the majority only did this for a small part of their time. For 70 percent of respondents who work with small groups it accounts for less than 30 percent of their time. Many farmers, however, value discussion groups and field days for the interaction with others, including the social aspects, because their work can be rather solitary.

A number of comments were made that one-on-one consultancy remains the best way to support practice change and that other forms of interaction, such as small group, field days and mass media needs some form of follow up. One-on-one activity is also the most resource intensive and also the type of advice for which a large proportion of funding should be from the recipient as they are likely to benefit most from the tailored advice.

It may be possible to augment what is currently being done in group and mass communication areas and this should be an area for further exploration. For example, linking mass extension to one-on-one engagement or the use of modern information and communication tools such as podcasts may stimulate interest in research and new ways of doing things and enable the messages to reach those who are unable to attend field days or refresh and reinforce messages from mass extension events.

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Figure 5: How respondents are working with farmers and growers

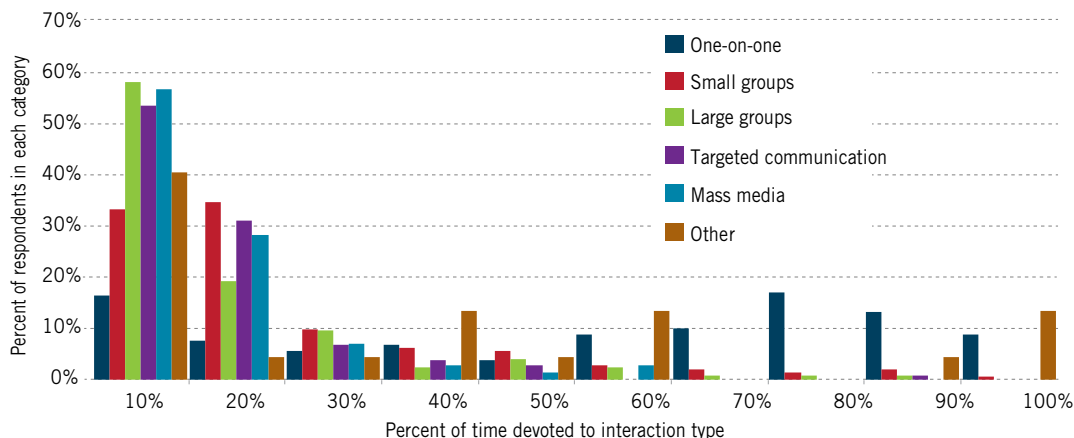


Table 5: How respondents are working with farmers and growers

	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Count
One-on-one	26	12	9	11	6	14	16	27	21	14	156
	17 %	8 %	6 %	7 %	4 %	9 %	10 %	17 %	13 %	9 %	100%
Small groups	47	49	14	9	8	4	3	2	3	1	140
	34 %	35 %	10 %	6 %	6 %	3 %	2 %	1 %	2 %	1 %	100%
Large groups	72	24	12	3	5	3	1	1	1	1	122
	59 %	20 %	10 %	2 %	4 %	2 %	1 %	1 %	1 %	0 %	100%
Targeted communication	55	32	7	4	3	0	0	0	1	0	102
	54 %	31 %	7 %	4 %	3 %	0 %	0 %	0 %	1 %	0 %	100%
Mass media	40	20	5	2	1	2	0	0	0	0	70
	57 %	29 %	7 %	3 %	1 %	3 %	0 %	0 %	0 %	0 %	100%
Other	9	1	1	3	1	3	0	0	1	3	22
	41 %	5 %	5 %	14 %	5 %	14 %	0 %	0 %	5 %	14 %	100%

HOW ARE CONSULTANTS OPERATING?

To provide further inference about what farmers and growers are demanding advice on, the data were analysed just for those who identified themselves as consultants (see Tables 6 and 7), as opposed to technology transfer providers associated with a particular product such as fertilisers or financial services.

Seventy-two, or around one-third of the responses received, were from those who identified themselves as a consultancy firm and they accounted for an estimated 381 FTEs or just under 20 percent of total FTEs supporting farmers and growers (see Table 1). Two-thirds of the consultants said they receive no external funding other than directly from clients. The clients, however, are likely to be quite diverse, probably including industry-good bodies and central and local government.

Two-thirds of consultant respondents provide some financial advice and 72 percent of consultants provide some farm systems advice. This is higher than the general results (54 percent and 64 percent respectively), and it is not unexpected as farm consultants have generally specialised in these areas. A relatively small percentage of consultant respondents spend more than 70 percent of their time focusing in one area, although this will vary from person to person. For example, only 23 percent of consultants who provide production advice, compared with 30 percent of total respondents who provide production advice, spend 70 percent or more of their time doing so. This reinforces the earlier comments about the diversity of work undertaken by most respondents.

One-on-one work is even more important for consultants. Ninety percent of consultants work one-on-one with their clients, and 60 percent of the consultant respondents working one-on-one spent 70 percent or more of their time doing so.

Table 6: Area of focus by consultants

	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Count
Financial	14	13	12	3	1	2	2	0	1	0	48
	29%	27%	25%	6%	2%	4%	4%	0%	2%	0%	100%
Production/technical	4	9	11	11	11	1	6	2	4	2	61
	7%	15%	18%	18%	18%	2%	10%	3%	7%	3%	100%
Environmental	29	7	4	3	3	1	0	2	2	1	52
	56%	13%	8%	6%	6%	2%	0%	4%	4%	2%	100%
People management	29	9	2	0	3	1	0	0	0	1	45
	64%	20%	4%	0%	7%	2%	0%	0%	0%	2%	100%
Whole of farm/systems	14	19	4	4	5	1	0	2	1	2	52
	27%	37%	8%	8%	10%	2%	0%	4%	2%	4%	100%
Other	2	0	2	1	0	0	2	0	0	2	9
	22%	0%	22%	11%	0%	0%	22%	0	0%	22%	100%

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Table 7: Consultants' ways of working

	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Count
One-on-one	5	4	2	4	2	9	7	12	11	8	64
	8%	6%	3%	6%	3%	14%	11%	19%	17%	13%	100%
Small groups	16	20	5	3	6	1	1	0	1	0	53
	30%	38%	9%	6%	11%	2%	2%	0%	2%	0%	100%
Large groups	30	9	2	0	2	0	1	0	0	0	44
	68%	20%	5%	0%	5%	0%	2%	0%	0%	0%	100%
Targeted communication	21	7	0	1	0	0	0	0	0	0	29
	72%	24%	0%	3%	0%	0%	0%	0%	0%	0%	100%
Mass media	10	5	0	0	0	0	0	0	0	0	15
	67%	33%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Other	3	0	0	2	1	2	0	0	0	2	10
	30%	0%	0%	20%	10%	20%	0%	0%	0%	20%	100%

“Farmers are busy. Organisations need to work together to deliver messages.”

Comment from survey respondent



Photo: MPI Sustainable Farming Fund project.

CONCLUSIONS FROM THE SURVEY

It does not appear that the technology transfer system is “broken” in the sense that there is a range of services available and organisations are active across the full spectrum of the primary sector. However, the survey confirms that the technology transfer system is fragmented and thinly spread. Therefore, it is highly likely that the technology transfer system can be significantly improved.

Overall, the number of people involved in technology transfer appears insufficient to provide effective support across the primary industries. There is a need to improve the connectivity between the people involved; ensure those involved are highly skilled; attract more people into the profession; and stimulate the demand for professional services if New Zealand is to achieve its goals around economic development and environmental performance.

CONNECTIVITY

One theme throughout the responses to the survey was diversity: diversity of work undertaken; diversity of sectors being worked with; diversity of organisations involved in technology transfer; and diversity of revenue streams. This reflects the diversity and complexity of functions and expertise needed to run a successful primary industry business, as the production and business systems of most primary sector operations are very sophisticated.

This diversity has both strengths and weaknesses. The advantage of having multiple types of organisations supporting farmers and growers is that there are multiple ways to influence practice change.

This diversity also creates challenges. Many different types of people go up the farm drive, and while hopefully having the farmer’s interest at heart, many have a relatively narrow area of expertise. It also creates challenges in trying to stay up-to-date in latest developments across a range of areas. The strong possibility of a disconnect between CRIs, whose primary function is the creation of new knowledge, and those whose primary function is the dissemination of knowledge gives credence to the sense that the system is more fragmented today than 30 years ago.

There is a need to take a whole of system approach and remain farmer centric. Without this there is a risk that farmers and growers will not get the tailored advice they need and that they may either fail to act on the advice, or that the advice may result in sub-optimal change, especially when dealing with complex biological systems.

One area worth exploring is better linking of CRIs with rural professionals. MPI is discussing these results with CRIs, the Ministry of Business, Innovation and Employment (MBIE), industry-good bodies and consultants to explore ways to improve linkages.

It may be possible to augment what is currently being done in group and mass communication areas and this should be an area for further exploration. For example, linking mass extension to one-on-one approaches or the use of modern communication tools such as podcasts which may enable the messages to reach those who are unable to attend field days or refresh and reinforce messages from mass extension events. Modern communication technologies such as Skype, and particularly in combination with developing automated analytical technologies (for example, soil moisture sensors) may also allow one-on-one communication and provision of advice without needing to always be on farm.

“When I stop learning new things to assimilate and pass on to clients, then my days as a consultant are numbered.”

Comment from survey respondent

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UP-SKILLING AND ATTRACTING MORE PEOPLE INTO THE PROFESSION

It is important that those supporting farmers and growers have the necessary expertise and are knowledgeable about current best practice. Looking for better linkages between CRIs and rural professionals will be a good start. However, many consultants belong to small practices (fewer than 5 people) and they face challenges in staying up-to-date, and bringing new people into their businesses.

A 2006 survey by the New Zealand Institute of Primary Industry Management (NZIPIM) of its members showed that 55 percent of members were over the age of 50 and only 14 percent were under 40 years of age. Since then there is a sense that increasing numbers of younger people have been attracted into the profession, but there is still an urgent need to attract more young people before the well-established consultants retire.

A number of primary sector entities, such as NZIPIM, are looking at ways to reduce barriers for people to access the latest knowledge. Larger firms can potentially “carry” new staff by utilising them in particular areas while they develop trusted relationships and build up their advisory expertise. Some consultancy firms have also developed relationships and memorandums of understanding with other firms as one response to better meeting client expectations over a wide range of issues.

The primary sector has also recognised the need to take a more structured approach to training and professional standards. DairyNZ has initiated a programme to train and certify people involved in design of dairy effluent systems. The fertiliser industry is developing a certification regime for nutrient advisers and NZIPIM is also looking at its accreditation regime. While some of these initiatives are still in their early stages, they potentially bode well for the future. Done well they can help ensure high quality advice to farmers and growers and hopefully help stimulate demand from farmers and growers for professional advice. MPI will monitor and continue to encourage these developments.

STIMULATING DEMAND FOR PROFESSIONAL SUPPORT

The MPI survey did not look at demand for professional support. While it is not something that MPI is likely to be able to directly influence, we are maintaining an interest in this area and considering where indirect influence is warranted.

There are currently a number of initiatives underway to better understand this. DairyNZ, in conjunction with the Centre of Excellence in Farm Business Management, is undertaking an analysis of where dairy farmers obtain their information and what professional support they use. AgResearch have just been awarded science funding for a project looking at co-learning and co-innovation to achieve impact, which looks at how farmers today undertake practice change and how they may be assisted to do so.

In addition to connecting parties together and promoting a “one-system” view, there will be an opportunity for MPI to consider the package of work underway to determine where there may still be information or activity gaps and how to fill them.

LIST OF COMMENTS FROM RESPONDENTS⁴

Respondents were invited to add any additional comments they wished to make with regard to the technology transfer/extension system, for example, around its adequacy, overlaps or gaps, new developments or initiatives etc.

MAF and CRIs have largely ignored the value of the media in technology transfer and have spent up large on “Comms” that is 90 percent PR. They have also done away with field days and many of the people and activities that used to pull in people who wanted to be informed, and have left it to commercial vendors who push their own particular products and barrows at the expense of common sense and sustainability. There have been no really effective initiatives and consequently numerous gaps. Surely you didn’t need to ask that question.

The NZ Pipfruit industry has virtually stopped funding production based R&D and tech transfer, passing that role onto Supply Groups and individual growers. Most industry funding is now around market access. While market access is critical I personally believe that production and systems improvements are also required and that these probably require high level funding through government initiatives.

User training needed to upskill water users if overall water efficiency is to be optimized.

Personally I feel that the majority of funding is preferentially allocated to Crown Research Institutes. In many situations funding is not available to other organisations despite their capabilities. Some institutes do not easily share resulting information as they see it as is their competitive advantage and a lead to more funding, or they are looking to commercialise the research for themselves. Frequently their information does not get to those who need it or would benefit from it. Innovators are generally practical people “at the coal face”, scientists are validate the innovators ideas - somewhere in-between the information/practicality is lost or not returned in a workable, affordable solution. Some CRI’s for example are stifling innovation by not linking to other external research groups who have the capabilities to provide superior tech transfer because they see them as competitors.

Lack of capability on-the-ground, poorly coordinated across industries/sectors, no real leadership either from industry or govt.

My role doesn’t involve paying clients as described in previous questions but I am often involved with talking to groups about the field I work in and also wider tech transfer or extension related activities.

Need for overarching scheme to promote collaboration, demarcation, and use of all tech transfer personnel – corporate, cri, univ, farm advisors, etc. Need training to upskill techniques, technical knowledge. Need common commercial and societal objectives for focused and measurable outcomes.

Extension is relatively poorly funded and the development [integrating new ideas or technology into existing farm systems] does not seem to be well understood and done.

The dairy industry has got a lot better at targeting technology/extension effort in recent years.

I felt the lower end of percent was not sensitive enough, I do run field days and newsletters etc but below the 10 percent threshold, required by the survey.

Technology transfer in the sheep and beef sector is very poor. Non-commercial technologies are not promoted because of the lack of scale in organisations like Beef & Lamb NZ.

DairyNZ doing excellent work in this space.

The challenge for all of us interested in building and enhancing technology transfer and extension systems is to identify how farmers want to learn. There is an abundance of existing knowledge, tools and systems available, but not all farmers are using the technology available to them. Recent reports and studies have identified improving skill and behaviour change as a critical issue, but what is missing is the understanding of farmer decision making and what drives a farmer to adopt a new technology.

Farmer lead experiential science i.e. on farm, real time needs greater attention rather than institutional and/or commercial entity driven.

⁴ Some comments have been edited to remove identification of individuals. Otherwise they are reprinted as received.

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A large portion of my technology for my business comes from my own reading of technical books and papers which I then put into practice. This then becomes my intellectual property. This I believe is what makes my business successful and not just following the leader as it were. I have been involved in organising and running a seminar for about 100 people. This cost me a lot of money and in the end ran at a substantial loss. The other aspect of that was the fact that one-third of the attendees were from competitive firms. The best Technology transfer I am involved with is on-farm one to one with the farmer who wants to improve their own profitability.

Demographics are very important here as past a certain age most people tend to stagnate. Average age of farmers is late 50's – old dogs new tricks. Next generation are a better bet to focus energies as they are the ones who are more likely to bring new methods/processes etc into businesses.

Many young consultants lack practical experience that limits their ability to communicate their ideas to clients. Many scientists & researchers are not good at communicating their ideas to clients. They need to talk in client's language. Clients generally value advice more if they pay for such it.

I believe that with the use of more smaller groups of rural people you will gain buy in and ownership of the process and solutions. Big over lording gate keepers is not the way forward. Try and get farmer driven initiatives cheers.

Earlier question didn't recognise 1.8 staff. Also – percent interested question (12?) far too vague. People may be interested but still do nothing. Our surveys show approx 20 percent of farmers are likely to change current practice if shown something different. I'd have thought this is the guts of what you want to know. Our group has a unique place in the Tech Transfer system in NZ – surprised our model is not recognised and supported.

The strategic prize for NZ is to transfer our production systems offshore, not to sweat our NZ biological system by tipping more N on our paddocks.

I am currently involved in developing standard operating procedures for on-farm demonstration

I see my role as tech transfer/extension integral to adding value and maintaining clients. When I stop learning new things to assimilate and pass on to clients, then my days as a consultant are numbered. DairyNZ have lifted their game in this regard, but more research and sharing of results is required.

Because of the lack of science and funding in this country for the last 20–30 yrs there is a big gap of knowledge loss to help new/young farmers/workers understand how cattle/sheep work, what they require in nutrition to survive let alone milk, reproduce, grow to full potential. So many of the basics is not being done on farms today and we are seeing more and more animal welfare problems that just shouldn't be a part of farming today. There is too many bandaids going on to fix problems in farming after the fact and not enough knowledge being passed on to help prevent a lot of the issues before they become problems.

I generally find that farmers here in NZ are poorly served by the current system resulting in desperately low production, very high debt, very low returns on capital employed through actual farming activity, very poor fertility, excessive numbers of poor yielding animals that need to be culled. The Institutes are closed to real progress and spend far too much time on job protection and not enough on focusing on farmers real needs. There is far too much commercial influence in the information given out. Record keeping by farmers is generally bad. The knowledge base is poor. Many of the institutes and TT providers are trying to dumb down farming to over simplistic Indices like 'Breeding Worth' which is resulting in many farmers not understanding the basics. I would estimate that 80 percent of farmers I meet do not value the output of DairyNZ and Meat & Wool. Too much of current research is focused on Phds rather than the problems faced by the industry. There are training issues with young people coming into the industry with insufficient skills in nutrition, economics and soil science. It is time for a radical review.

Currently involved in a major innovative project aimed to reduce problems of fatigue in the dairy sector for DairyNZ.

The project that I managed for the Organic Dairy and Pastoral Group had as its aim to grow the organic dairy sector through information and technology transfer. We used a form of experiential science – farmers and researchers working together in a research team. The whole team is positive about this approach.

ECAN has strong desire and need to work collaboratively with others in primary industry to ensure most effective and efficient transfer of info and resources. Seems to be capability gap in getting staff with range of skills/knowledge/experience and balance of all aspects of primary industry consideration (\$', social, environmental etc). Can we get some joint training so those working in primary sector and those within agencies or local government are collaborating and sharing knowledge? So often we are talking at cross purposes which mitigate any of the gains we could make if we co-operated.

Difficulty in getting farmers along to fielddays.

Private enterprise is driven out of a more balanced overview of the whole system than is government funded sectors, they are very financially savvy.

100 percent of our clients want logs that suit their specifications – saw millers, Pulp & plywood mill owners really don't want ideas, processes, or systems from forest growers (suspect this survey isn't aimed at us). By the same token we seldom use external consultants, rather rely on in house expertise and participate in research co-ops.

Technology transfer must be based around needs – if the client cannot see the need or have the need demonstrated then it will not proceed.

Some regions in NZ have very little contact with FAR extension activities.

Little resource available in forestry sector for tech transfer. Reliant on specialist staff within larger companies. Gap is in the medium to small growers.

Whole of industry coordination essential. Beef and Lamb NZ must define its level of activity. Sustainability of private sheep/cattle/deer consultancy sector requires serious consideration. Too much "free" advice available? New technology must not detract from the critical importance of doing the basics well.

There is an urgent need to work with farmers to assist them in adjusting to new policy imperatives especially in regard to land use and water quality issues. Field staff of commercial organisations have a role – train the trainers.

Research projects need to be 'owned' by some party. Disappointing to see some projects nearing completion waning, because they need ongoing support.

A very one sided, flawed and bias perspective is being presented on climate change, especially the role of ruminant methane.

As a very successful, I was often requested to talk at farm functions, now as technology developer/farmer I am excluded as seen as just a sales man.

In your survey, we only have 0.5FTE working in tech transfer, had to be a whole number. Knowing new technology and what is happening in horticultural industry is key to our business, if not clients would not come to us for advice. We do the tech transfer and part of our business as opposed to a specific set aside task.

For dairy it is the psyche of the cow, ie a herd animal, the habits of growing grass. The best marriage of these two and at the best timing of the grazes to get the grass regrowth to work for you, and how this works to enhance the bio life of the soil.

We find challenges when organisations such as CRIs work in the technology transfer space using public good science funding to subsidise their programmes and projects which effectively puts us at a disadvantage when trying to offer value for money to the same or similar client groups.

It would seem that tech transfer represents a huge opportunity to lift NZ ag performance, however getting buy in from clients in particular getting them to pay for advice is the challenge.

It is fractured and creaky. Your question 7 re Maori would not accept "unknown" - in working with industry bodies I do not think it is relevant.

Woefully inadequate given challenges Issues with double ups cross sectors Mixed messages – need a focus on agribusiness service providers to ensure they are up to speed.

I work with farmer based community groups helping with pest problems.

The concept of tech transfer is old school, as it implies one-way learning by clients. Focus (at least from researchers perspective) should be on shared learning, and learning by doing. The questions posed above assume the respondent is full-time engaged in 'tech transfer' whereas for most, it will be only a part of the project. So the answers to the percent questions are just referring to the 'tech transfer' component.

In the past there has not been enough focus on this as it is the important part of delivering research to the end user.

Internationally there seems to be a move towards a more collaborative and learning-based model in contemporary extension - in the areas of sustainability and innovation. This model recognises that information is key to learning and subsequent behaviour change, but learning will only happen if it is supported by a number of social processes. These include a shared understanding, bounded conflict and a supportive social environment. Ideally this learning will occur equally in agencies, farmers and other stakeholders. This, in turn, implies a need to ensure that the different interest

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groups have adequate capacity to participate in such processes. This model refers to both task (getting sustainable development and innovation on-the-ground) and process (creating the conditions for sustainable development and innovation) outcomes.

There is too little and it is diffuse – many people doing it are out of date and consultants tend to be too conservative and lacking the science knowledge to make a current contribution – they do a good job on the finance.

Duplication and ill focused on occasion.

The survey is fine for a consultant, but it does not make a lot of sense for a university staff member. Similarly, few if anyone would know what the University does across the board. I think you need to segment your survey for different types of organisations.

Needs to cover the following: 1. Be financial viable/increase profitability 2. Be at the cutting edge of new discoveries 3. Sustainable 4. Be able to be implemented by competent staff.

Transfer info needs to be in plain English for those who want a general overview but also at a more technical level in plain English for those farmers who want a greater depth of information in that area.

As technology gets more complex, farmers need more 1-1 or small group support on how to use the technology. Often this isn't provided by sales people (e.g to make good use of soil moisture meters).

Advantage in using a series of complimentary technology transfer/extension systems including targeted leadership learning projects that are developed for farmers by farmers. We believe that role models and discussion led by these farmers is a proven way of achieving good results regarding tech transfer.

There is insufficient funding for not for profit organisations who are working within our primary sector.

Usually need one-on-one regular contact to drive behaviour change.

Overlaps - Environmental advice is directly linked to increasing productivity on farm and that link is very important in those messages being received favourably.

Discussion groups are under used compared to field days. Uptake is limited by participation.

We rely on transfer through industry publications, but also consider the consultants that serve the industry either privately or through packhouses to be our main point of technology transfer to growers. It is not feasible to have direct transfer given our funding.

More resource close to farming groups required to support and bed in change, outside of any project funding cycle.

Possible problem with consistent information being provided to the primary industry due to organisational silos in certain areas. The NZ Landcare Trust is actively involved in getting organisations together to work collaboratively and to provide contact between primary industry and these organisations, but much work needs to be done.

Behind the transfer of technology is the fact we are wanting people to adopt new ways of doing things for which there will be barriers to adopting these behaviours. Reducing the barriers to adopting behaviours is probably just as important as the new way of doing things. Also it's not just Technology Transfer, but it's a two way communication - learning can and will happen both ways.

Most Govt and CRI websites are pathetic at enabling knowledge transfer of Govt-funded research projects.

SFF is a very successful vehicle that supports many of our tech transfer activities. It is difficult if not impossible to use communications and teaching tools installed in rural schools.

Working informally at present with MAF Irrigation Acceleration Fund on knowledge gaps in area of irrigated agriculture.

More in depth support needed for organic production specifically, as one-off field days etc aren't enough to help people shift their entire growing system.

Lack of professional development for extension capability in New Zealand. Lack of industry and government support for the professional organisation (APEN), eg through hosting an international conference in NZ in 2013. Lack of strategies to coordinate make the best use of extension capability in New Zealand - in industries, local government, CRIs and privately.

Targets/projects appear to lack a cohesive focus and integrated approach to extension across sectors. More emphasis is on "brand recognition" and "credit" for the sponsor than on behaviour change and measurable outcomes. Projects, particularly central govt sponsored, appear to have unclear outcomes, rushed timetables for delivery and appear uncoordinated. A consequence is that this approach constrains the development of a skilled and experienced pool of extension technologists.

There have been a number of surveys and studies, including farmer groups on this area, over many years. It may be an option to study their findings and results. I know a number of farmers who have been to a number of survey groups and The same results are there over the years!

The survey was limited and poorly structured and did not permit expansion of responses.

We conduct all of our research on grower vineyards and work closely with the industry in developing research ideas not just delivering the outputs. We have also started to measure the impacts that past projects have on the changes to industry practice.

We need a much larger resource of well trained, accredited people to assist landowners to increase productivity while farming within limits.

There are two things that drive farmers, cost and ease.

My interest is in the impact of the ETS upon both forestry and agriculture as there are pertinent to the groups farming businesses.

The results from the STIMBR research programme are made available to MPI to inform market access and to industry for their use/uptake.

Majority of technology transfer only adds to production costs majority of technology transfer doesn't address root causes of problems, only treats symptoms Majority of technology transfer focuses on technological fixes rather biological/ecological relationships majority of technology transfer focus is production efficiencies, or input substitutions rather than system design.

The collaborative model for freshwater should be used for fertilizer, soils, and farm systems. As long as science research is financially linked to big business the 'new ideas' people don't get a look in for mainstream decision making.

This whole field is completely misunderstood. There is very little that the farming sector does not know about new technology. The problem is there is no new technology to transfer! Farmers regularly sort through what is available and discard it for a variety of reasons which are valid for their particular systems. If you honestly believe that the NZ economy can be saved by tech transfer to the nations farmers you will find that you are sadly mistaken. The great hole is in technology worth transferring.

To some extent the survey questions do not fit with what we do.

There are lots of contributors with a range of different perspectives and part of the issue is about coordinating delivery and ensuring there is a common interest and strategy.

Beekeeper support in New Zealand is almost non-existent. Pollination underpins 50 percent of our food production in New Zealand – a contribution of \$5.1 billion to our GDP. It would be most appropriate to have a Department of Apiculture within the MPI to ensure cohesiveness in this very basic element of our food production in New Zealand. We need to protect the habitats for our bees to ensure we do not slide into a Colony Collapse Disorder (CCD) syndrome as is occurring overseas. There are many challenges and they need a coordinated approach – the MPI could do this.

Industry body activities and funding play a large role. Awareness and communication between groups and sectors can be poor resulting in inefficiencies, poor results and/or duplication. The servicing sector/advisors/influencers can be missed from extension processes resulting in poorer results.

Cost of Technology Protection is a major deterrent in Innovation Practice.

One on one and small discussion groups probably elicit the fastest behaviour change. But shouldn't underestimate the value of the larger gatherings in terms of networking and sowing the seed of ideas that people then act on later after further exposure to a concept.

A major re-envisioning is needed for ag extension in NZ. Many farmers aren't willing to pay for the new info they need and much of what is being provided, even paid for info/ advice, is product slanted and therefore of questionable objectivity. If MAF were to get 'back into the business' of providing technology transfer/extension, it should only do so

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on the basis of a core paradigm that ensures all info/advice is oriented toward the twin goals of increasing actual food quality (nutrient density) and soil humus production. If the information provided doesn't move all NZ ag production towards documentable increases in vitamin, mineral and antioxidant content with minimal use of pesticides in a product that sells at the pinnacle of world premiums, then the tech transfer does NZ agriculture, the economy and the environment a disservice. We're too small and too far from our markets to continue providing standard commodity products under the guise of a now defunct image of quality and sustainability. We are risking a serious and perhaps fatal loss of credibility in the market....whatever MAF comes up with has to be genuinely based on the science of producing nutrient dense food with the minimum of petrochemicals. The current paradigm of increasing fertiliser, vet medicine and chemical use will not only fail environmentally but we will lose our premium markets. Great!get back into tech transfer but please make sure it's actually advancing food quality and soil regeneration, instead of being based on selling more synthetic inputs.

These automated surveys are difficult to complete accurately for small organisations such as ours. We have 1 staff member plus some contracted hours and there is 1/3-1/2 FTE working on an extension project with local landowners – but the survey will not accept a number between 0 and 1.

Needs more coordinated effort nationwide, especially in the red meat (sheep, beef and deer) sectors.

Farmers are busy. Organisations need to work together to deliver messages and reduce incidence of date clashes for events aimed at similar market. DairyNZ has improved notices/invitations - there is a role for them to co-ordinate an industry event calendar for dairy industry.

I believe Monitor farm field days are inefficient at disseminating new technology etc and fail to attract the people who would really benefit from adopting new technology into their farming system. Alternative options need to be explored to see if there is a more effective way of improving on farm profitably through effective agricultural extension.

