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As applied agricultural scientists we serve....?

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INTRODUCTION

Removing the question mark and completing the title of this paper is fundamentally important to our professional futures, the future of agriculture and the well-being and economic prospects of New Zealand.

Currently the structure of research institutions and their sources of funding are being reorganised. The allocation of "public good science funds" (PGSF) into output classes has focused attention on the likely payoffs from research in different areas. The concept of research benefits, and who receives them, is further highlighted by the increasing pressure for industry groups to meet the costs of research where they are expected to benefit directly from the research. Conversely the PGSF will be allocated to projects where the benefits are non-appropriable to specific groups in society.

Against this background, funding for agricultural production research (including animal production) is scheduled to be reduced in favour of increased efforts in the processing and marketing areas (Science and Technology Expert Panel,1992). This means that as a profession we have not, to this point, convinced the public that it is important for our work to continue at its current level. An increasingly common response in this situation has been to call for more and improved "technology transfer" (e.g. New Zealand Dairy Exporter,1992). This implies that there is technology sitting "on the shelf", perhaps in the past proceedings of meetings such as this one. Further, if there was increased producer awareness, perhaps with some repackaging to better suit specific farm circumstances, then that technology would be picked up and used. There is, however, a growing view that we know very little about producers' circumstances, and that understanding more about how farmers learn and make decisions is a fertile ground for future research endeavour.

Despite these recent steps forward, the dominant view from scientists still appears to be "improve the technology transfer, get our results out there and adopted. As agricultural scientists we serve to increase knowledge, innovation and technology development, and if agriculture can just be made to pick it up and use it then everyone will see how relevant and useful we are, and our funding base will be secure."

I was invited here to focus debate on the philosophy inherent in that view, and I am happy to do so - even though I can think of many more sympathetic audiences to stand in front of!

THE ROLE OF SCIENCE

Science, however you define it, and within whatever theoretical framework you see it, is fundamentally important to the advancement of useful knowledge. Basic science is generally accepted as contributing to the advancement of knowledge and development of theory, whereas applied science is concerned with finding practical use for existing knowledge or theory (World Bank, 1985).

Mueller (1993) distinguishes between the problems that agricultural science works on as being either, problems produced from within, or "vicarious" problems. The problems from within include the accidental discovery of phenomena that require further explanation, further elucidation of the significance of these phenomena, exploration of the importance of findings in other science areas, and those problems that arise from "exploring the cause and effect chains of natural processes". The science issues that are confronted while these problems are being researched may range from basic through to applied. Vicarious problems are those where the agricultural scientist is contributing to solving someone else's problem as opposed to problems that science has defined from within. Research in these areas may also range from basic to applied.

As a brief aside I would like to distinguish between consultancy and science in the approach to solving vicarious problems. Science is concerned with obtaining solutions to types of problems that beset an identifiable part of the population. Further, the answers provided by science to these problems result from the application of some reproducible and tested methodology.

Consultancy, by contrast, is usually concerned with the specific problems of an individual client, and the method used need not be reproducible - it either solves that particular problem or not. For reasons of commercial expediency the consultant will usually strive to design solutions that have a more general application, or perhaps identify potential clients that will use, and pay for, that particular solution.

Now returning to science, and in particular the situation where agricultural science is cast in the role of "vicarious" problem solver and farmers are seen to be holding the problems.

Farmers are rational, purposeful people. They hold goals, and are constrained over a wide range of circumstances from moving towards those goals. Their problems can be defined in terms of where they want to be, where they are, and what is involved in getting from one state to the other. In this context it is possible to define farmers' needs and it follows that if agricultural scientists are to serve the needs of farmers then, they have to know about the diverse goals and circumstances of farmers. Without such knowledge they cannot define clearly what problems are to be solved. In that situation relevant solutions would only be discovered by chance, or worse, perfect answers would be devised for non-problems.

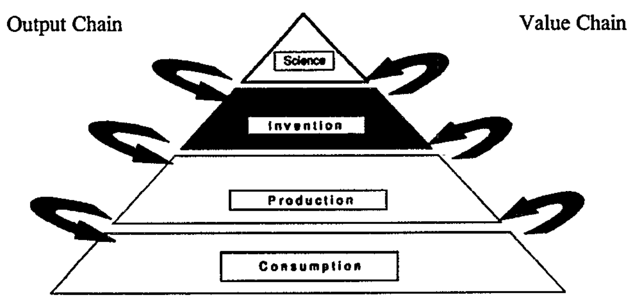
THE RELATIONSHIP BETWEEN SCIENCE, INNOVATION AND TECHNOLOGY TRANSFER

The philosophy and concept of needs-driven science, where knowledge of farmers' circumstances is central to the research process, calls to question how farmers' needs are made known to scientists, and how the products of science are transferred to farmers.

There are various models describing how agricultural science is organised in relation to the components of the technology development and transfer system. The normal paradigm, is hierarchical (see fig.1), and is often referred to as the transfer of technology model (e.g.Chambers and Jiggins 1987). Such models are abstracts of reality (Jiggins, 1993) and while they may be of some use for conceptualising the relationships that exist they do NOT represent how resources are organised and managed in reality.

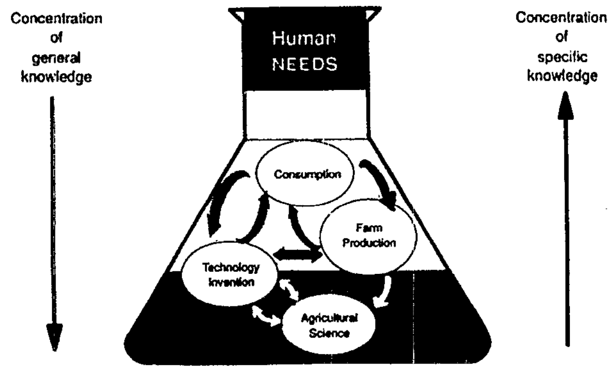
A problem exists, however, where those in agricultural science believe that this model explains where their contribution sits in relation to the whole process of technology production and consumption. Then the flows from, and to, the science sector (at the top of the pyramid in fig. 1) are at risk. Scientists who see themselves in this model, superior to and independent from other components of the overall process, are obliged to communicate only with other scientists. Output, and the rigour with which it is derived and tested become the key criteria, rather than the impact or likely usefulness of results. In this scenario it becomes the responsibility of others, lower in the hierarchy, to take information down from science, and communicate needs back up to science. Furthermore they must do this in a situation where science has no incentive to take part in either process.

FIGURE 1: Hierarchical perception of the knowledge system. (Source: Mueller, 1993)



Increasingly, in both developed and lesser developed countries, it is accepted that innovation and technology development is a more complex and less structured system than that just described (Turney, 1991). Mueller's "agricultural knowledge soup - (with lumps)" (see fig. 2) is a model that incorporates these complexities. Most importantly it explicitly recognises that the "soup" is for the sustenance of "human needs", and that all of the "ingredients" can interact and add to the "nutritive value". Specific knowledge gained through experience and informal experimentation is included as well as the general knowledge gained through the scientific process.

FIGURE 2: The agricultural knowledge soup (with lumps). (Source: Mueller, 1993).



Scientists who see themselves operating within the traditional model have a further problem in that the needs to be addressed by research are as likely to be social and economic as they are biophysical. The dominant theme of learning from, competing with, and being assessed by one's peers within the same discipline (be it social, economic or biophysical) means that there is little need, or incentive, to communicate effectively with the other disciplines. The soup metaphor, however, treats all the components as ingredients, and conceptually at least, lets the various disciplines interact with any of the components, rather than expect them just to communicate between themselves from positions at the top of their respective hierarchies.

THE BALANCE BETWEEN NEEDS-DRIVEN AND OTHER SCIENCE ACTIVITIES

There are at least two problem areas when attempts are made to achieve a balance between needs-driven research and other research activities.

The first relates to allocating scarce research resources to competing activities. How much, for example, should be allocated to those activities defined from within the practice of science (from basic through to applied), and how much should be allocated so that science can be applied to the needs of the farming community? The second relates to the question of how scientists are managed and motivated when they do not own the problems that they work on.

I cannot think of any way to establish, ex ante, the economic return from an advance in knowledge, since the return only occurs when the knowledge is applied for some purpose or other. Further, unless scientists have freedom to develop and own at least some of their intellectual effort then it is unlikely that new directions will be discovered. Effective management of research resources must, in such cases, rely heavily on the "chief executives" and their wisdom in the degree of freedom that they allow their staff.

By contrast, the application of science to solve well defined problems does lend itself to ex ante estimations of costs and benefits, provided that the baseline data for such estimates has been established. Where high potential pay-offs can be identified then presumably a strong case can be made to redirect research resources away from basic research endeavours and into areas where the pay offs will come from.

In these situations research staff would gain their satisfaction, and presumably their rewards, from carrying out science that results in the successful capture of the benefits rather than achieving science output that is reviewed and accepted by their peers.

Neither of these issues has been easily solved elsewhere in the world and that will also be the case in New Zealand. Given the difficulties outlined above then the question must be asked "is it worth attempting to make the case for needs-driven research?" In the New Zealand setting the continued importance of agriculture as the basis of our wealth and well-being means that the industry, including the farm production units, must be able to adapt and respond appropriately to whatever challenges the social, economic and biophysical environments provide. New knowledge, innovation and problem-solution will increasingly become important, and the challenge that we face within professional bodies such as NZAPS, is to harness the power of science to provide the knowledge and the solutions. Unless an informed public can see (not just be told) that agricultural science has an important role to play, then they will not pressure the policy makers into reversing their policy of reduced research funding.

THE FARMER FIRST RESEARCH PROGRAMME

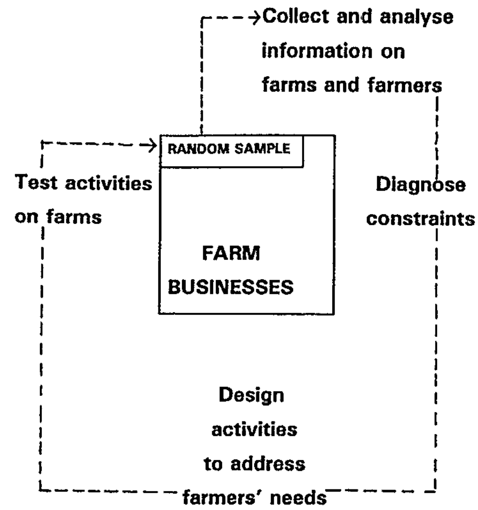
In New Zealand there is virtually no research generated information that will allow agricultural science to define the needs of farmers and thus begin the process of estimating the likely pay-offs (and costs) of meeting those needs.

In this situation research agendas are generated from within. Problem definition, for example, almost always reflects the disciplinary orientation of the researcher, and in the case of agricultural science the emphasis is often on increased production. Perusal of the abstracts of the papers and posters to be presented at this conference shows little evidence of the multidisciplinarity that might be expected to frame the "problems" in New Zealand pastoral agriculture. Similarly the work reported here shows little evidence of social and economic factors being considered at the problem definition stage.

The Farmer-First research programme (FFR) set up at Massey University has the primary goal of complementing traditional agricultural research in the design and testing of relevant and appropriate innovations and strategies for change in New Zealand agriculture. It is also attempting to test whether or not the (reproducible) methodologies used in the programme are in fact a useful addition to agricultural science.

The process being followed is presented in Figure 3. The programme involves two groups of collaborating farmers, chosen at random from two climatically distinct areas of North Island hill country (30 farmers per group, representing 10% of the population in northern Rangitikei and central coastal Hawkes Bay). A farm visit and semi-structured personal interview was carried out to describe the farm resources and production systems, and to establish the changing circumstances of the farm businesses through the past 10 years.

FIGURE 3: Farmer-First Research Programme at Massey University - The process



At this visit an initial attempt was made to establish the farmers' goals.

These data were analysed and then discussed with the farmers during a second visit. This allowed the farmers to be part of the process of checking for errors in both the data captured and how that data represented the farmers' viewpoint. Another semi-structured interview was used to further develop a clear statement on the farmers' goals. Set questions on the management and husbandry issues faced by the farmers at the time of this visit allowed differences between the farms to be more clearly specified.

Analysis of this information and a third visit has allowed the research team, including the individual farmers, to define the constraints faced by farm businesses across the spectrum of circumstances represented by this sample of the farming population.

The challenge now involves communicating these findings to those who set out to service agriculture, including agricultural science, so that promising innovations and strategies for change can be evaluated taking full account of the farmers who, because of their particular goals and circumstances, are likely to make such changes.

SOME PRELIMINARY FINDINGS

Methodologically this approach is young and the research team can not realistically expect to get it all right first time through. However, some of the initial descriptive results give cause to believe that this approach holds promise.

Farmers are generally more concerned with the security and well being of the farm family than they are with improvements in productive and economic efficiency. Even after those basic needs have been addressed only about 25% of the population appears to hold goals that relate directly to increased production and profitability. Half of the population holds goals that relate to achievement of self-satisfaction, while the other 25 % are most concerned with matters relating to the succession of the business assets. In all cases the importance of production and profitability are recognised. It is wrong to label farmers as either commercially oriented (the first 25% referred to above) or "lifestylers". More production and more profit will usually allow goals to be better achieved. However, the actions dictated by pursuit of technical or economic efficiency may well be, and often are, in conflict with the goals held by many farmers. Furthermore, the goals held by farmers are dynamic, and influenced by a range of factors, including family and business development.

This research may have identified a major constraint to how agricultural science, can assist agriculture respond in the future. Over 80% of the population sampled in this programme, use a framework for identifying and considering opportunities that appears to be quite different to the quantitative management/economic model taught and used within agricultural science. This is not surprising given the goal sets referred to earlier. However, even within the group that held production and profitability goals, not all farmers were committed to using such models.

Further analysis of the scope for improving farm situations through the wider adoption of quantitative models, and what is required to achieve wider adoption, is clearly an area for research. Developing a better understanding of the models used by farmers and adopting their use within our scientific culture may be a more promising solution. If agricultural science is to continue to impact positively with the farming community this area requires urgent attention.

CONCLUSIONS

There can be no doubt that New Zealand agriculture will continue to face enormous challenges with respect to market access, consumer preference, and environmental and resource sustainability issues. However, I believe that the economic sustainability of our farming systems is our most urgent and binding constraint. Processing and marketing research and development are undoubtedly keys to the future, but no more so than the ability and preparedness of farmers to contribute and respond to the solutions. There is our challenge as agricultural scientists. It is our problem, not just to do it, but to convince the public at large that we can, and will, harness the power of science to assist agriculture secure the future. This will require a more positive approach to "needs-driven" research.

Continuing just to do "good science", and laying the blame for the lack of uptake and relevance elsewhere, is a road to nowhere.

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