Response to Te Ara Paerangi Consultation

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Privacy - 9(2)(a)

March 2022

Key Messages

- The Government should make a **radical reform** of the Aotearoa/New Zealand Science system to address weaknesses outlined in Te Pae Kahurangi (lack of strategy, fragmentation, over governance, weak responsiveness to Maori, etc).
- To address challenges facing our biologically based industries and environment, the Government should establish a **single combined institution** to deliver more integrated research and have greater impact. Leadership should be by scientists to focus on priorities that matter; facilitating knowledge exchange and impact and providing ability to build careers for the brightest minds attracted to science.
- The new institution should be **forward looking and establish clear goals**, involving **science, policy, industry and society** (including Maori as full partners) to evaluate challenges, set goals and determine research priorities.
- The intense competitive funding model adopted with the CRI reforms has not served New Zealand well. A significant proportion of **base funding for core purpose and continuity** would provide the stability required for scientists to develop expertise of benefit to New Zealand. A level of **competitive funding** should be maintained **to encourage innovation**. Base funding should be provided for key scientists to allow full collaboration into international programmes.
- The new institution should be committed to **Open Science** for the **Public Good**. This will include transparent processes with open debate, accessible information and collections; necessary features vital for making collective decisions.

PERSONAL BACKGROUND

I joined MAF Agricultural Research Division as a junior scientist in the North South Island region in 1981, as a fresh from PhD studies at Lincoln University. From recollection there were about 30-40 scientists in the division with the bulk at the Winchmore Research Station, regional scientists at Nelson and Hokitika with a few, like me, in rented buildings (with rudimentary laboratories) at Lincoln University. In addition, MAF had a team of Advisory Officers travelling the region. We were administered by the Regional Director, Dave Joblin, who had a rather grumpy admin officer, Peter Bull, and a friendly secretary, Pat Challenger. We were located close to the DSIR with their buildings on the road to Lincoln. Budgets were delivered from Wellington as well as pay and any other vital resources.

I was employed as an applied entomologist with a fairly open brief. Initially a horticultural entomologist, I was drawn into work on grass grub which was a major pest at the time. Working closely with the advisory services was encouraged and would often lead to farm visits and field day

participation. Travel to other regions was encouraged for collaboration - and signed off by Regional Director, Dave Joblin, if a good reason could be offered. Resources were light, maybe as we were a small division. We had access to a pooled vehicle and small operating budgets. I think I had a word processor and maybe a computer was down the hall.

The New Zealand Encyclopedia Te Ara refers to the 1950s to 1980s as the "Golden Years" of New Zealand Agriculture. New technologies had opened up more land and called for more stock. Intensification opened the way for more pests. Silent Spring had been published, and we started to recognise the downside of overuse of chemicals. We came to work with a purpose – MAF had a clear mission – to support the agricultural sector. We had a clear role – to provide solutions to farmers that would allow production without unwanted side effects. The miracle of DDT, which had been introduced to combat pests in pasture in the 1940's was waning. Unwanted residues in milk had been detected and DDT banned from pasture use in 1970. Alternative chemicals were highly toxic and not wanted. There was an emergent consciousness of IPM and biological control and a clear field to work in. Science was collegial but competitive. Alternatives were challenged at the Weed and Pest Conference or specialist meetings with open and often confronting debates.

As young scientists we had spent 7-8 years at university developing an understanding of science, scientific method and a deep recognition of our specialist areas. With employment in MAF or DSIR we had a mission to apply our knowledge to real problems – pest invasions, crop and pasture damage, overuse of chemicals and chemical pollution. Farmers were interested in results, indeed calling for greater progress and we were frequently interviewed by the media and asked to give presentations to farmer and community groups. The results were impressive. From the 1960's to the 80's we moved from a situation where most than 80% of New Zealand's pastureland had been treated with persistent insecticides and orchards were doused weekly with chemicals to systems of minimal chemical use through implementation of Integrated Pest Management (IPM). These changes underpinned the claim of "Clean Green" New Zealand for promotion of tourism and "Pure" pesticide free produce that led export growth of agricultural and horticultural produce.

The winds of change blew in the 1980's. Neo-Liberal economics hit with Roger Douglas and "economic rationality" became the rule. MAF Advisory Services and Research were combined in 1987 to become MAF Technology and the era of user pays was ushered in. Farmers were confused, advisors disappeared, scientists had to dress-up and charge for their services and the sense of purpose and common links were broken. It didn't last. In 1992 the sector based CRIs were formed, and scientists separated into distinct units each with managers with their own views of the way the institutes would be run. The institutes would be competitive. Indeed, science would be driven by competition. Core funds were transferred to the Foundation (FRST) and scientist began an endless cycle of applications for funding into a pot that seemed to shrink with each new round of applications.

For some, and I was one, there were opportunities. Despite the silo-ing of staff into the CRIs it was possible to use the old linkages to build cross institute teams and launch effective bids. From a base of successful funding, it was also possible to add on commercial projects and international collaborations. But work inevitably followed the money and I have moved from entomology research, through microbial product development, even managing a sustainable beef project in Uruguay and back to my core of dealing with insects and their diseases. As the CRIs have progressed the old linkages and connections have declined and younger staff are increasingly sucked-in to endless rounds of project applications and boxed-in to projects which reduce interactions and damage the old, open science collaborations. In recent years, tiring somewhat of the treadmill of the New Zealand science system, I have worked more off-shore in development projects with other research organisations in Asia, the Pacific, and Latin America. I also maintain strong links with European and North American institutes and have a perspective of how science policy and funding work in very different environments.

I have to say I have had had an excellent career within the New Zealand science system which has been challenging, stimulating and rewarding. I can recognise the weaknesses identified in the Te Pae Kahurangi report and can see the difficulties now faced by young scientists starting their careers and impediments for turning research into impact. I appreciate the chance to contribute ideas that can make our science system better to meet the challenges of the future. I respond to the questions in Te Ara Paerangi with the comments below.

1. RESEARCH PRIORITES

Key Question 1: What principles could be used to determine the scope and focus of Research Priorities?

Principle - ***Research Priorities should be set to meet national goals***

National goals – the high-level objectives of the research organisation(s). Goals rightly should be set by the community (politicians, stakeholders and tangata whenua) with scientist input, but are surprisingly simple. We all want clean water, good air to breathe, to be ready for climate change, etc). The goal provides science with its purpose and direction and justifies the money spent on it.

Principle – ***Clear goals should determine the scope and focus of Research Priorities***

Science works best when there is a clear goal. The remarkable success of the Covid19 response and vaccine development shows this. Integrated pest management was successfully developed and implemented for the goal of pesticide reduction allowing consumption and export of "clean" agricultural produce. Animal breeding and management has increased farming efficiency and profit while decreasing the environmental footprint.

Principle – ***Public funded science must clearly prioritise actions for the public good***

Public funded science is paid for through the tax system and should have clear benefits for the public good. This is obvious for environmental and risk management research with broad outcomes (Climate Change research) or work in support of MFAT's ODA. Public funded science continues to support sector-based initiatives, but these should be clearly for the public good (improving product value for greater revenue and tax income; providing jobs and better environmental outcomes). The key should be to maintain critical thinking and transparent (open) processes. Public funding should not be captured for private benefit without release of information for the public good.

Principle – ***Research priorities must be forward looking and flexible***

Research priorities should be set using foresight as the outcomes may not be producing benefits for 5, 10 or 20 years. The Research Priority should set the direction but the workplan should be regularly reviewed to keep to the best pathway for outcomes.

Principle – **Each Research Priority must be allocated an indicative budget**

Without an indicative budget there is no way to develop an implementation workplan. What is the value of the goal? This should guide the allocation.

Key Question 2A: What principles should guide a national research Priority-setting process?

Principle – ***A national Research Priority-setting process must aim to achieve the National Goals***

The process should be open and inclusive of a wide range of stakeholder views.

The process should not be captured by an interest group, industry or institution.

Key Question 3: How should the strategy for each research Priority be set and how do we operationalise and implement them?

Each Research Priority needs a working team to develop strategy for implementation and management. These should be the key scientists selected to lead the Priority with institutional support for financial analysis and budgeting. The strategy and operational plan should be co-designed with stakeholders and tangata whenua, or developed with consultation, depending on the focus of the project.

3. FUNDING

Key Question 7: Core functions • How should we decide what constitutes a core function and how do we fund them?

The core function of publicly funded science should be to produce results leading to "public good". There are many interpretations of "public good" but the common theme of all the CRIs is to grow New Zealand's prosperity (enhance economic value) while providing beneficial social and environmental outcomes for New Zealand (Summary CRI Statements of Core Purpose, Te Pae Kahurangi p. 13). It can be argued how well the CRIs have succeeded with their missions and whether the balance between support for economic development and environmental protection has been achieved, but there is little doubt that there is common purpose and that better coordination to a common goal would be more effective than the current fragmented, competitive approach.

The common core function of all CRIs is administration of resources (infrastructure and staff), beyond this is management of knowledge (reports, publications, databases and cultural history*) and development of new knowledge to address current and future problems. These are the core functions that we need and should be covered by base funding. We can accelerate generation of new knowledge by testing new ideas to reach our goals through a competitive funding stream.

(*senior staff at the CRIs are a source of knowledge built through education and experience that is seldom available through synthesised reports. Seminars, workshops and discussions are the traditional way of knowledge transfer and consensus building. This component of knowledge resembles Mātauranga Māori).

Definition of what falls within core function will need to be resolved through discussion and debate. This needs to be broader than the Ministries, CRIs and Maori proposed by Te Pae Kahurangi (193) and include industry, university and citizen voices (including a range of working scientists). This is a big decision and too important to be left in the hands of bureaucrats. Base funding of core function will provide an infrastructure and knowledge base to best address the science discovery needs of the future.

Key question 8: Establishing a base grant and base grant design • Do you think a base grant funding model will improve stability and resilience for research organisations, and how should we go about designing and implementing such a funding model?

A base grant, reviewed on a regular basis (say every 5 years) for 'core function" activities will allow medium to long term planning and provide stable underpinning for the science system. The level of the base grant can be determined by, first, mapping costs and activities that fit with "core function" and are appropriate for revised national priorities. Gaps can be filled and redundancies, created by overlap, eliminated. If, as often happens, core function activities exceed the available budget some rationalisations will need to be made.

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Te Pai Kahurangi recognised the need for a new process for prioritising and funding of Environmental and Primary Sector based work. This is a good step as environmental issues are not restricted to the conservation estate and the vast majority of the New Zealand's lands are under the management of primary industry producers. TPK further concludes that "*opportunities to collaborate for national benefit sometimes appear to be thwarted by a combination of organisation-specific interests and different ways of operating*" and that the system "*does not work for efficient and effective use of scarce resources at the collective level"*.

Te Pai Kahurangi reports that the CRIs have a science revenue of nearly NZ$800M, 70% from public funds and employ 4000 staff across 7 organisations. This is excessive fragmentation. It is hard to see how there have been benefits for "the consumer" in competition between CRIs, the bulk of whose funds still come from Government. Internationally we are very small. EMBRAPA Brazil has 8000 staff in a single research organisation while USDA, with multiple functions, has 100,000 employees.

An important aspect of government is science diplomacy. MFAT have declared in its Policy Statement on New Zealand's International Cooperation for Effective Sustainable development (15) that "*New Zealand ODA will draw on and engage New Zealand's people, public sector and other institutions, resources and expertise*" in support of international development. CRIs, like AgResearch, have policy to engage in development issues and support MFAT's strategy, but little has been done. It is a far cry from DSIR's support of biodiversity studies and soil mapping which have left a solid legacy in the Pacific and a base for economic development. Initiatives from scientists to build pan-CRI collaborations for development assistance in Latin America and the Pacific have been rejected and support for Agricultural Diplomacy has been piecemeal. It is well recognised that a New Zealand Inc. approach is valuable for delivery of New Zealand obligations to ODA but the current CRI framework seems incapable of delivery. At a time when Australia, China and the United States all have programmes to curry favour with Pacific Island states it is unfortunate that New Zealand does not have a coordinated programme to provide support in agricultural development and environmental protection using the skills and experience of CRI scientists.

4. INSTITUTIONS

Key Question 9: How do we design collaborative, adaptive and agile research institutions that will serve our current and future needs?

This question puts the cart before the horse. Once we have goals, priorities and workplans we can determine the kind of institutions that will be necessary to implement them. Te Ara Paerangi describes how successive Governments have tinkered with the research system *"to improve connectivity and responsiveness, reduce fragmentation and establish a clear line of sight where it contributes clearly and effectively to national goals and challenges"* but have not achieved the "*system-level transformation needed".* However, in spite of the disfunctional science environment, the science community has delivered. With a better institutional structure, it could do more.

Collaboration is a necessity in modern science seeking to produce solutions to complex problems. Collaboration is inhibited when scientists are boxed into institutions, have a high workload generated by the business model of the institutions and have to juggle specific time bound projects as well as

compete for new funding. Te Pai Kahurangi correctly noted there '*is weak connectivity between researchers, organisations, businesses, the public sector, and internationally*" and identified *unproductive competition, competing strategies and lack of connection with Maori* as unwanted features of the current system. They are also consequences of the current fragmented CRI system and the business models adopted.

A major impediment to collaboration is the separation of scientists into different CRIs, each with an independent Board working within the constrictions of the Companies Act primarily for the good of the individual CRI rather than for the good of the whole. It makes sense as recommended by Te Pai Kahurangi to combine CRIs in common areas (e.g. Land based and environmental). It also seems essential to remove the organisations from the constrictions of the Companies Act and refocus publicly funded science on the Public Good.

Perhaps we can learn from the experiences of the past. When I started as a researcher with MAF in 1981 the connections with the farming community and public were strong. There were frequent interactions through field days, study events and open days. Science staff were well aware of the problems of the farming community. Issues were debated and, in those early days, we had a mission as the "Insect Task Force" to develop and promote a more ecological approach to pest management in farming. With a broad mandate, science teams were largely self-selected to meet the challenges with a mix of collaboration and competition that led to results and changed pest management from chemical dependency to more low input natural systems.

Spectacular results were achieved by working collaboratively and with industry. In his book *Farewell Silent Spring**, Dr Howard Wearing recounts the struggles and ultimate success of building a programme that weaned the New Zealand apple industry from high chemical pesticide dependency to an icon of Clean Green and 100% Pure New Zealand, benefitting from access to high quality international markets and low environmental impacts at home. Dr Wearing makes many perceptive comments relevant to the science reforms, including; *"Commitment to a totally cooperative research model by participating scientists was essential and extremely beneficial from the outset of this research programme"*; *"science is most productive in an environment of strong collaboration and is grossly impeded when institutional or individual competition for funding and resources dominate decision making. It flourishes when science managers are empowered to collaborate and use the unique skills and training they have acquired over many years to make the decisions that they are best qualified to make"*; *"We must recreate a stable working environment that attracts the resolute commitment of our brightest young people to cooperate and solve the major long-term research challenges facing the country"*.

The reforms and business models of the CRIs have weakened the science culture and stifled collaborations. "Unreformed" institutes that I have worked with in Asia and South America still have a clarity of purpose and a strong sense of collaboration to meet common goals (Evidenced by willingness to collaborate, public outreach and community participation).

Within our system I have experienced excellent collaborations with scientists from different CRIs and consultants when a NZ inc. approach has been adopted for overseas development projects funded by MFAT. But this has been a bottom-up process through pre-existing science connections rather than through CRI institutional support.

In summary – with clear goals and opportunities, collaborations will flourish. It is part of our science culture. Collaboration has been inhibited by the compartmentalised and individualistic CRI structures. Openness is needed at the top, within CRIs or an alternative structure, to provide the best teams to solve a problem, not to use a problem to support the finances of a particular institute. From the bottom, scientists need the freedom to develop collaborations for the best partnerships.

*Wearing, C.H. (2019). Farewell Silent Spring, The New Zealand Apple Story. NZ Plant Protection Society, 278 pp.

Key Question 10: How can institutions be designed or incentivised to better support capability, skills and workforce development?

Institutions can support *capability, skills and workforce development* when they have clear goals, a development plan and security of funding for implementation. Our future institutions should be led by scientists who can understand the need for continuity and can identify gaps and the needs of workforce development. Administration staff should support the science leadership. This can maintain an outward and forward-looking community rather that the internally focussed institutes resulting from the CRI model.

Key Question 11: How should we make decisions on large property and capital investments under a more coordinated approach?

Decisions on large property and capital investments should be made based on national need. This will become evident following decisions on organisational structure and research priorities. These decisions should be based on science need rather than a business case for an individual institution. A national structure with regional centres will provide the opportunity for rational, coordinated investment rather than a piecemeal approach from a number of individual institutes.

Key Question 12: How do we design Tiriti-enabled institutions?

Define problems with Maori and codesign institutions to resolve them.

Key Question 13: How do we better support knowledge exchange and impact generation? What should be the role of research institutions in transferring knowledge to operational environments and technologies?

We will better support exchange of knowledge and impact generation when we value these aspects. Locking scientists into fixed, detailed contracts with "tick the box" milestones does not help discussion, debate or improvement of project outputs. It is notable that the number of scientist seminars has declined markedly during the governance of the CRIs. This contrasts with institutes overseas where I have worked where strong, outward looking activities are maintained.

All projects should have a focus on outcomes. This becomes self-evident if the projects are bundled into a programme targeting a defined Research Priority. Regular scientist reviews (internal and external) will ensure that projects move towards outcomes and produce impact. Science involves a cycle of hypothesis–experimentation-evaluation to create the solid building blocks which will be needed for system change. Not all ideas will flourish, but a science system should have memory, through publications and reports, to avoid repetition of "bad' ideas. If there is still potential in an idea to meet the goal, the hypothesis should be modified for another round of testing.

It has been suggested, and was part of the rational for the CRI model, that competitive contracts are a more efficient (and economical) way of delivering research outputs than research grants. This is not my experience. Contracts often lock scientists into a process where the milestone is more important than the outcome. For scientists, grants are hard to come by and money will only be spent sparingly. The project pathway will be monitored carefully as savings can be applied to amplify outcomes.

Science involves a competition of ideas. In his *21 Lessons for the 21st Century* (2018), Yuval Noah Harari makes an inciteful comment relevant to the scientific reforms; *"if you want to go deeply into any subject, you need a lot of time, and in particular the privilege of wasting time. You need to experiment with unproductive paths, to explore dead ends, to make space for doubts and boredom, and to allow*

little seeds of insight to slowly grow and blossom. If you cannot afford to waste time you will never find the truth". The challenge of our reformed science system will be to allow scientists time to be creative and produce the best results to lead to impact.

Under the competitive science system contracts are time bound. Once a project is completed this will often leave a technology/initiative abandoned. In the case of technologies with commercial potential this can be the "valley of death" too early to go to the market, too late for further research money. The results often remain unpublished, due to issues of confidentiality, intellectual property or simply lack of time as scientists have had to move on to other areas. More flexibility of staff/funding within the Research Priorities will enable worthwhile projects to be rescued, if warranted.

5. RESEARCH WORKFORCE

Key Question 14: How should we include workforce considerations in the design of research Priorities?

The workforce should be capable of maintaining core activities and meeting Research Priorities. Research priorities should be forward looking and have a long timeframe (10 years+) which will allow the workforce to adapt to changing needs.

Key Question 15: What impact would a base grant have on the research workforce?

The competitive funding system adopted with the reform to CRIs has had many negative consequences. It is noteworthy that, as far as I am aware, there has not been even a single Government or Province that has followed the New Zealand model. In a masterful case of Irish understatement, in interview with Dr Liz Wedderburn (23/02/22), Prof Frank O'Mara (Director of TEAGASC) stated that the New Zealand science funding system was "not optimal" and explained how the Irish system is preferable and is underpinned by base funding.

Base funding and appropriate allocations would enable research institutions to maintain and improve core functions. We cannot protect biodiversity or control biosecurity without a strong understanding of taxonomy and ecology. Water quality needs a deep understanding of soils, climate and land use. Base funding of scientists and their overheads for core functions will enable building of expertise which can underpin several different Research Priorities. It would value expertise rather than just the ability to capture new funding.

Competitive grants have an important role, especially in developing concepts for new research priorities. They provide a way of incorporating new staff (Post Docs and students) into projects to develop and prove themselves. If key staff leading project bidding are supported through base funding, we would be able to bid into many more sources of funding, both national and international. At present high costs (staff, overheads and profit) exclude us from bidding into many international funds (e.g. World Bank, FAO, Gates Foundation). Scientists from most overseas research institutions (e.g. USDA, JKI Germany, Universities) have staff time covered and can give more for limited project funding. Missing out on these opportunities is more than a loss of funding, it means that scientists miss the opportunity of working in international teams on complex problems and the benefits that this experience can bring to New Zealand.

In summary – The intense competitive funding model adopted with the CRI reforms has not served New Zealand well. A significant proportion of base funding for core purpose and continuity would provide the space for scientists to develop expertise and careers of benefit to New Zealand. A level of competitive funding should be maintained to encourage innovation. Base funding should be provided for key scientists to allow full collaboration into international programmes.

Key question 16: How do we design new funding mechanisms that strongly focus on workforce outcomes?

We need to design funding mechanisms which enable the scientist community to meet our goals. Within this process we need motivated scientists and support staff who feel they are contributing to scientific advances for the benefit of New Zealand. With significant base grants, scientists will have less burden from preparing proposals but should have more time involved in prioritisation, planning and evaluation of projects resulting in better integration within the institute and strengthening of the science culture. Levels of base funding and research prioritisation should be determined at a high level (with strong scientist input) through negotiation with Government. A Foundation with an independent board could manage the competitive funding component.

These changes would streamline the funding system, require less administration and free-up resources for science delivery.