



AGRICULTURE RESEARCH GROUP ON SUSTAINABILITY



Research Report: Number 13/01

ISSN 2324-5751 (Print)
ISSN 2324-5700 (Online)

The New Zealand Sustainability Dashboard

Unified monitoring and learning for sustainable agriculture in New Zealand

April 2012



New Zealand's specialist land-based university

Ecosystems
Consultants



Te Rūnanga o NGĀI TAHU



Landcare Research
Manaaki Whenua

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Suggested citation for this report:

Manhire J.; Moller H.; Barber A.; Saunders C.; MacLeod C.; Rosin C.; Lucock D.; Post E.; Ombler F.; Campbell H.; Bengé J.; Reid J.; Hunt L.; Hansen P.; Carey P.; Rotarangi S.; Ford, S.; Barr T. (2012). *The New Zealand Sustainability Dashboard: Unified monitoring and learning for sustainable agriculture in New Zealand*. ARGOS SD 13/01 18 pages. [available for download from www.argos.org.nz]

Acknowledgements

This work was funded by the Ministry of Business, Innovation and Employment (Contract Number AGRB1201).

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Executive Summary

The *New Zealand Sustainability Dashboard* project will develop a sustainability assessment and reporting tool in partnership with five primary industry sectors in New Zealand. Internationally recognised frameworks and their key generic sustainability performance indicators (KPIs) will be co-opted to ensure that overseas consumers can benchmark and verify the sustainability credentials of New Zealand exported products. We will also design New Zealand and sector-specific KPIs to guide farmers and local consumers to best practices of special relevance to New Zealand society, ecology and land care. Monitoring protocols will be described, where possible for the farmers themselves to rapidly score their own performance across economic, social and environmental dimensions of food and fibre production. A multifunctional web application will be created that facilitates uploading of regular monitoring results and instantly summarises and reports back trends to the growers, to industry representatives, and to agriculture regulators and policy makers at regional and national government levels. Tests of the accuracy and statistical reliability of the KPIs will be coupled with ongoing research on how much the farmers use the tool, whether it changes their actions and beliefs for more sustainable agriculture, and whether stakeholders at all levels of global food systems trust and regularly use the tool.

The Dashboard will be more than just a compliance and eco-verification tool – it will also provide a hub for learning to become more sustainable. It will create an information ‘clearing house’ for linking past data sources and at least five existing decision-support software applications so that growers can discover optimal choices for improved farming practice, should the Dashboard alert them that their KPIs are approaching amber or red alert thresholds. We will also design and test two new decision-support packages; one enabling farmers to calculate their energy and carbon footprint and how it can best be reduced; and a whole-farm ‘*What if*’ decision-support package that explores how investment in improving one sustainability KPI (eg. application of nitrogen fertiliser) affects another (eg. farm profit). The *Sustainability Dashboard* will also include customisation capabilities for use in product traceability; for undertaking surveys of users; for estimating the value placed on different aspects of sustainability by growers, industry representatives, regulators and consumers; for comparing Māori and other communities’ values in sustainability assessments; and for identifying market opportunities and constraints. The Dashboard web application will be designed so it can be quickly integrated into an industry’s/sector’s existing IT platform and infrastructure and this will facilitate rapid uptake. Some host industries may force growers to use the *Sustainability Dashboard* as part of their existing Market Assurance scheme.

Our project partners include New Zealand Wine, Zespri International, Forestry organisations, Te Rūnanga o Ngāi Tahu and BioGro New Zealand, with linkages also with Dairy New Zealand, Beef + Lamb and Aquaculture New Zealand on the Governance Group. The estimated annual benefit to project partners is \$174m.

The research programme is built on a core of existing capability and knowledge of the Agriculture Research Group On Sustainability (ARGOS) researchers, supplemented by additional specialist researchers. The Sustainability Dashboard will first be tested on ARGOS orchards and farms where established relationships with the growers can best evaluate the utility of the web application and how best to improve its user-friendly features. Collaboration is invited with other research teams, including the Food and Agriculture Organization’s (FAO) Sustainability Assessment of Food and Agricultural systems (SAFA) project, Switzerland’s RISE project, Norway’s Norwegian Research Group On Sustainability (NORGOS), and Denmark’s *MultiTrust* project.

Our transdisciplinary mix of classic qualitative and quantitative research methods and Participatory Action Research approaches will focus primarily on the practical imperative of improving the Dashboard's usefulness. In addition, we will simultaneously evaluate the overarching theory of 'metrologies' (the science and consequences of scientific measurement), a rapidly emerging theoretical theme in international sustainability studies. The Dashboard will provide a case study to examine overarching questions like: Do metrics codify how to define sustainability and inadvertently reduce the variety of approaches that underpin farming resilience and adaptability? Might growers start to focus on manipulating the KPIs themselves rather than what they purport to represent? Can multiple dimensions of sustainability be meshed into a single aggregate index of performance for a whole farm, orchard or forest? Does the tool trigger a real difference on the land and within farming families?

The Sustainability Dashboard is primarily being developed to assist farmers/growers with the rational management of the large amounts of information available and to assist them with their subsequent management decisions. It will also help them comply with the ever increasing demands for market and regulatory reporting. It is anticipated that the use of the tool and enhanced information flows resulting from it will assist farmers/growers optimise their overall farm performance including productivity/profitability while protecting environmental and social values. It will reduce monitoring and regulatory costs, build consumer trust, secure market access and garner support from wider New Zealand society by verification and regular reporting of standardised sustainability criteria.

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Acknowledgements

The design of the *New Zealand Sustainability Dashboard* project was guided by experienced industry representatives from: New Zealand Wine; Zespri; Future Forest Research Te Rūnanga o Ngāi Tahu and BioGro NZ.

We are also grateful for input and discussions with other researchers that will either be subcontracted to perform some of the research described here, or who will liaise with the research team to ensure that their own research complements rather than duplicates the work proposed for the *New Zealand Sustainability Dashboard*: SCION (Peter Clinton, Tim Payne, Tim Barnard), Landcare Research (Andrew Gormley, Adrian Monks); Massive Media (Julian Moller), and; Chop Chop Design (Alex Gilks).

INTRODUCTION

The need for the New Zealand Sustainability Dashboard

This project will establish a flexible and broad sustainability assessment and reporting framework that is applicable to all New Zealand primary industry sectors for the development, operation, refinement and efficient regular reporting of sustainability Key performance Indicators (KPIs). Since the completion of the Sustainable Agricultural Management Systems (SAMSN¹) initiative completed in 2004 by researchers in this project, no co-ordination between sectors in the development or operation of sustainability assessments is occurring. The impacts of the absence of co-ordination are: 1) expensive duplication in sustainability assessment programmes 2) limited sharing of experiences and best practices between sectors, 3) a lack of consistency in KPIs and, 4) absence of systems for making outcomes transparent to consumers and industry. These issues pose a significant threat to the elaboration of high-value market opportunities and New Zealand's wider market image. The challenge is also recognised internationally with the FAO creating the Sustainability Assessment of Food and Agricultural systems (SAFA)², to establish a uniform basis of integrity for the plethora of green production standards (e.g. consumers in Europe face a bewildering array of over 365 green labeling schemes)³. New Zealand needs to be a leading contributor to the international process of integrating and creating greater scientific substantiation of green product claims.

The *New Zealand Sustainability Dashboard* incorporates and extends existing scientific knowledge generated by the Agriculture Research Group On Sustainability (ARGOS)⁴ and partner projects in New Zealand as well as linking to the SAFA framework. The Dashboard is more than a new set of indicators. It is a tool for both integrating existing knowledge as well as facilitating the rapid generation and incorporation of new KPIs and guidance on changes to farm management (see Project Plan on next page). It will allow us to shift emphasis amongst sustainability KPIs in ways that make most sense for New Zealand growers and citizens, while still providing eco-verification for consumers in foreign markets.

The urgent need for the establishment of a comprehensive sustainability reporting framework for the primary sector has been identified by a wide range of organisations, including government agencies: the MED Green Growth Advisory report Dec 2011⁵ – *Greening New Zealand Growth*; the Statistics New Zealand/ MAF – 2009 Domain Plan⁶, and the PCE 2010 report⁷. The value of a sustainability reporting framework has also been identified at the industry level where it is highlighted in recent plans or reviews⁸ by sectors included in this project. Consultation with industry in the development of this proposal highlighted that the Dashboard would provide a vital resource for decision support at various levels:

- Farm/orchard level – Monitoring of sustainability performance over time and comparing against regulatory and industry baselines as well as recommended best management practices to simultaneously promote learning for optimising productivity and sustainability as well as meet compliance and reporting requirements.
- Industry level – Satisfying market demands for transparent and internationally recognised sustainability assessment.
- Regulators – Facilitating audited self-management reporting and possible decreases in associated costs such as for monitoring and compliance.

In summary, the *New Zealand Sustainability Dashboard* and framework have the potential to unlock a key barrier to better environmental and economic performance in New Zealand primary industry by addressing a gap that has been identified by international agencies, domestic government agencies and key exporter industries in New Zealand.

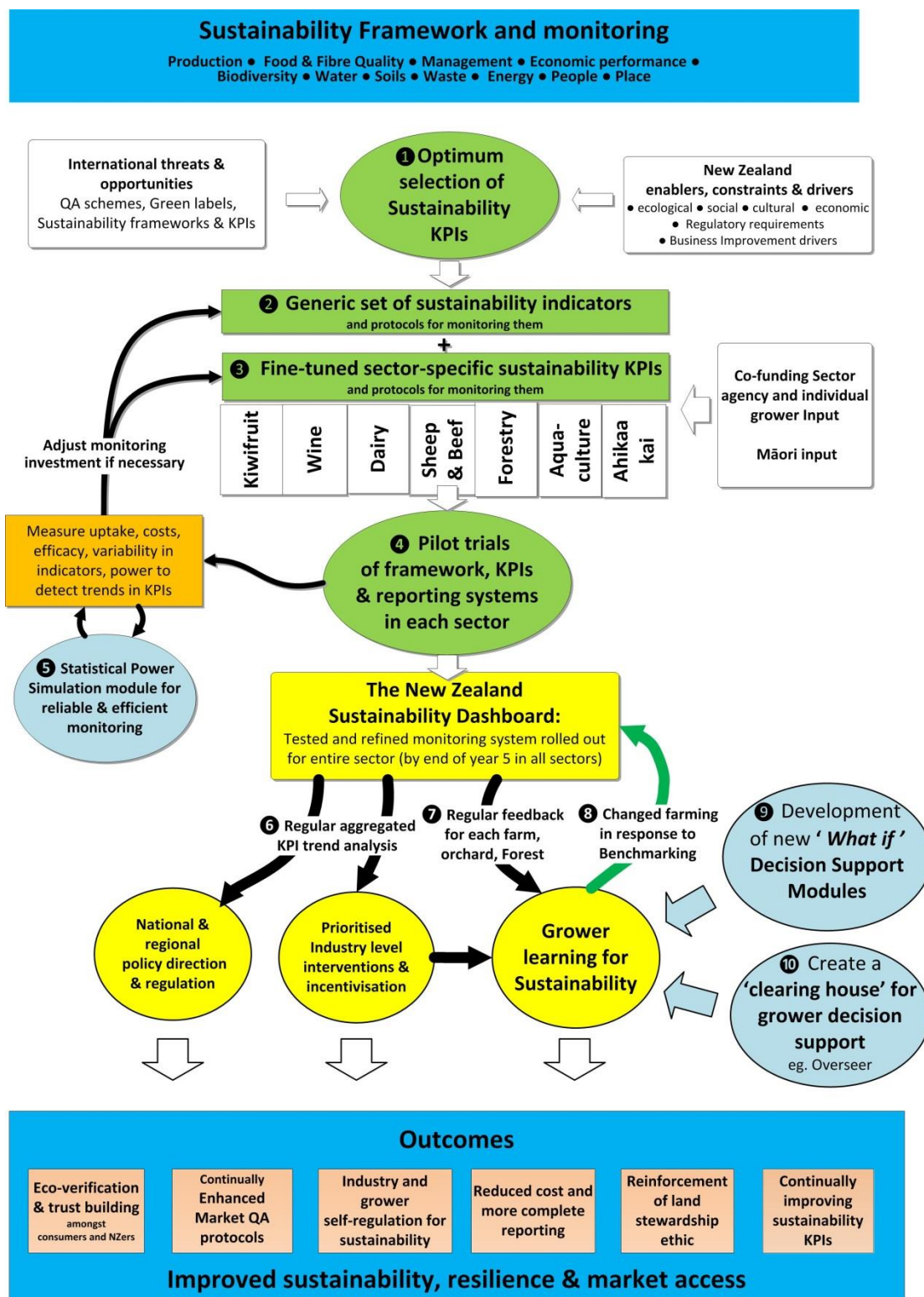


Figure 1: The New Zealand Sustainability Dashboard Project Map

Project Vision Statement

Our vision at the completion of the six year research project by September 2018 is that:

The New Zealand Sustainability Dashboard is unifying sustainability monitoring and reporting of internationally recognised metrics across five primary production sectors. Fine-tuned monitoring has been designed, tested and integrated into the framework. A web-application tool enables (i) users to directly upload their sustainability KPIs to industry databases, (ii) smart visualisation of trends and benchmark comparisons between farms and sectors, (iii) semi-automated reporting at regional, industry and farm levels, and (iv) a 'clearing house' for access to decision-support tools for improving KPIs. The Dashboard is used throughout product supply chains by market assurance programmes and is providing regular feedback to growers for learning, and to government for policy formation. The system has reduced monitoring and regulatory costs, built consumer trust, secured market access and garnered support from wider New Zealand society by verification and regular reporting of standardised sustainability criteria.

Target Funding

The *New Zealand Sustainability Dashboard* project's research questions and design features are matched to Question 9 of the Ministry for Science & Innovation's 2012 Requests for Proposals in their Biological Industries portfolio⁹.

Their Question 9¹⁰ asks:

How can whole-of-system management and performance be maximised within biological, economic, environmental, and social limits by integrating tools, information and/or specific technologies into a whole-of-system decision-making process?

The Request For Proposals notes that this question refers to all-of-farm functions (devices or farm sub-systems are covered by the Precision Agriculture question in the High Value Manufacturing and Services Fund) and instructs that proposals should demonstrate how integrated tools will improve decision making and make tools easier to use, including reducing the complexity of and range of tools required.

PROJECT PARTNERSHIPS AND IMPLEMENTATION

Partner profile and benefit analysis

Securing scientifically credible pathways for developing high value export products based around environmental, sustainability or other credence value claims has important economic implications for New Zealand. One study¹¹ estimated the cost to the New Zealand economy associated with a 5% reputational loss in primary products and international tourism at more than 22,000 jobs and \$455 million direct loss p.a. In contrast, the development and implementation of an integrated framework for capturing the benefit of higher value market access and securing product claims was estimated during project consultation to be worth an extra \$300m p.a. to the full project partners. Table 1 provides an analysis of the potential benefits from this project:

The research moves well beyond business as usual by creating an integrating tool to simultaneously: (a) meet market drivers for adoption of best practice, compliance and eco-verification, (b) harness and extend farmer knowledge to improve farm performance, and (c) inform New Zealand regulators, policy makers and members of the public about growers' own efforts and track record for improving sustainability. The tool aims to reduce monitoring and reporting by farmers, not increase it! It will do this by monitoring and reporting in smarter ways that prevent having double entry for reporting to multiple stakeholders and by selecting fast and efficient methods for scoring KPIs. Better quality information and decision-support tools will be made easily available for farmers to make management choices. Rapid feedback of changing KPIs on the Dashboard in response to the farmers' management experiments will help the farmer steer their operation to target outcomes.

Table 1: Approximate value of the New Zealand Sustainability Dashboard project for New Zealand export earnings

	2011 value of exports ¹²	Estimated project impact on product value		Estimated project impact on production	
		%	Value	%	Value
Full Project Partners					
New Zealand Wine ¹³	\$1,104 m	5	\$110 m	5	\$110m
Zespri	\$944 m	2	\$18	5	\$47m
Te Rūnanga o Ngāi Tahu	NA	NA	NA	NA	NA
Forest Owners Assn	\$4,327 m	1	\$43m	.05	\$21
BioGro New Zealand	\$85 m ¹⁴	3	\$3m	3	\$3m
Project Consultative Partners					
Dairy New Zealand ¹⁵	\$13,000 m				
Beef + Lamb ¹⁶	\$4,662 m				
Aquaculture New Zealand ¹⁷	\$380 m				

Vision Mātauranga

Our project develops two main ways for Māori to unlock benefits of cultural dimensions of sustainable primary production for all of New Zealand: (i) co-development of a Māori *Sustainability Dashboard* for exotic forestry based on land owner experiences in the central plateau and East Coast of Te Ika a Maui (North Island); and (ii) a Ngāi Tahu-led initiative for most of Te Waipounamu (South Island) identifying optimal policy, institutions and tools to create a competitive advantage for sustainable fishing, aquaculture and farming enterprise development at the whānau and hapū scales. Māori primary industries account for 50% of Māori commercial assets, as compared with 11% of assets for New Zealand business sector overall. Māori involvement in the New Zealand planted forest sector is significant both as owners of forested land and as forest investors. Approximately 22% of the nation's planted forest estate is currently on Māori land (predicted to rise to 40% by 2017). Our research will include an investigation of sustainability in a variety of exotic forest governance and tenure arrangements. Preliminary discussions with research partners include: the Central North Island Iwi Collective – 147,000 hectares (Ngāi Tūhoe, Ngāti Tūwharetoa, Raukawa, Ngāti Manawa, Ngāti Whare, Ngāti Whakaue, Ngāti Rangitihi and Te Pūmāutanga o Te Arawa), Lake Taupō Forest Trust – 33,000 hectares (Ngāti Tūwharetoa) and Ngāti Porou Forests – 10,000 hectares with potential settlement expansion to 50,000 hectares. Iwi have already begun to invest in branding and labeling initiatives to create unique market profiles for products and to capture a distinct set of cultural values and responsibilities, collective economic goals and a specific land management requirements (e.g. Te Rūnanga o Ngāi Tahu's *Ahikaa Kai* project¹⁸). Our Māori forest Dashboard and Te Rūnanga o Ngāi Tahu's 'Symbiotic Development Model' framework promotes all four goals of the government's **Vision Mātauranga**¹⁹: **Taiao** for improved environmental wellbeing, **Hauora** through special emphasis on community and cultural wellbeing outcomes for forest management, **mātauranga and science** synergies, and particularly **Indigenous Innovation** (Objective 1) by *contributing to Economic Growth through Distinctive R&D*. Early work with Central NI iwi by one member of the project team has already demonstrated that Maori-led contributions to the Dashboard would complement but also promote different value sets to the wider FSC certification that dominates that sector, and thereby our Māori case studies offer lessons for all of New Zealand.

Implementation pathway

This proposal reflects a process of extensive consultation with stakeholders in primary production to identify the most appropriate pathway and direction to develop the key research insights from ARGOS into applied tools for industry. The proposed research is targeted towards a particular suite of tools and practices that have proven acceptance and utility at the farm-level but connects them together to learning tools, reporting functions and uptake pathways through QA programmes, State of Environment reporting (see project plan). The plan has strong co-funding and addresses the main risks to implementation and provides a staged development process that reflects best practice for tool development. The resulting project implementation plan has been designed to ensure that the value of the *New Zealand Sustainability Dashboard* is optimised to meet the needs of a wide range of potential users, both on and off-farm, as well as the expectations of external stakeholders that will use the outputs from the tool.

The Project will operate within a strong network of primary production stakeholders – building on the key partners in the ARGOS Project and bringing in strong new partners like Wine, Forestry and Aquaculture (Table 2). Using the ARGOS technique of 'embedding' researchers inside industry partner organisations will help build the capability of both industry and research providers. Building this network around the Dashboard will be one of the key capability-building contributions from the project. ARGOS has a strong longstanding partnership with Te Rūnanga o Ngāi Tahu. The project also extends this successful model of iwi partnership by building on recent research activities with NI iwi investigating the resilience

of forest management so that Vision Mātauranga benefits will be disseminated more widely.

Table 2: New Zealand Sustainability Dashboard Industry partners and timeline

Driver Targeted	Profile	Project partner	Relationship with project
Project Stage 1 Tool Development			
Market	Large	New Zealand Wine	Full project partner - Pilot, stage 2 roll out
Regulatory	Large	Forestry	Full project partner Development of cultural/social component of the New Zealand Forest Standards
Development	Medium	Te Rūnanga o Ngāi Tahu (TRONT)	Full project partner - linkage to their innovation and entrepreneurial software platform.
Market	Large	Zespri	Full project partner - Pilot and possible roll out
Project Stage 2 Tool Extension			
Market	Small	BioGro	Full project partner - Stage 2 pilot and possible roll out
Consultative Partner Linkage			
Mixed	Large	Beef + lamb	Governance Group – to gain and share insights with the project and harmonisation opportunities.
Mixed	Medium	Aquaculture New Zealand	Governance Group – to gain and share insights with the project and harmonisation opportunities.
Regulatory/ market	Large	Dairy New Zealand	Governance Group – to gain and share insights with the project and harmonisation opportunities.

The project incorporates the following strategies to ensure strong linkages with project partners to ensure their expectations and capabilities inform the design of the *New Zealand Sustainability Dashboard* and resulting tools:

- *Industry Partner Direct Co-funding and Support* – The significant direct co-funding proposed for this project reflects the alignment of this project with our partner industries' strategies and needs. The inclusion of all the main primary industry sectors within the project as either a Full or Consultative Partner provides a strong signal of the broad potential applicability of this project.
- *Participatory Action Research* – This method reflects a commitment to engagement with partner industries through the whole research process (eg. in the use of 'embedded-researchers' who are hosted by the industry partner).

- *Project Governance Group* – This group will meet every 6 months and provide oversight and strategic leadership for the project. The Group will be made up of relevant stakeholders, including from each of the project's Full Partners (Zespri, New Zealand Wine, Te Rūnanga o Ngāi Tahu) and Consultative Partners (Beef+Lamb, DairyNew Zealand, Aquaculture New Zealand).
- *Sector Oversight Committees* – committees (including researchers, sector representatives (including producers) as well as other relevant stakeholders) will be established with a specific focus on outputs in each pilot sector to ensure that the research outputs are tailored to the needs and expectations of the industry.

These significant linkages with the users of the Dashboard in the development, piloting and refinement of the tool and its functional integration with assurance and marketing systems will guarantee its fit to purpose. The long-term established relationships that already exist between the team and stakeholders will be utilised in the pilot phase in order to establish industry champions for the use of the Dashboard and enhance buy-in from other sectors.

The project will be managed by The Agribusiness Group (TAG) on behalf of the Agriculture Research Group on Sustainability (ARGOS). TAG has successfully managed the ARGOS group linking multiple universities, CRIs, industry/sector groups and iwi for nine years. This new project extends the capacity of TAG to develop new tools and solutions while still building on the strong management process deployed in ARGOS since 2003.

METHODOLOGY & SCIENCE PLAN

Overall research rationale:

Our project is designed around a core proposition that: ***Adoption of sustainability assessment and reporting systems increases the economic, social and environmental sustainability and resilience of those individual growers and sectors that adopt them.*** ARGOS's work has emphasised the importance of local farming families and managers as key 'sites of action' for sustainable food and fibre production²⁰. However, turbulence in global food systems and concerns regarding social and environmental impacts among consumers in international markets are increasingly driving changes on local farms and demanding eco-verification of New Zealand Inc.'s "clean-green" assertions. We have chosen development of an open, scientifically defensible, and internationally recognised *New Zealand Sustainability Dashboard* tool which will be embedded within global market accreditation systems as the main cross-scale linkage tool for future-proofing resilience of New Zealand agriculture.

New Zealand's growers are also facing similarly escalating demands from domestic sources to utilise production landscapes in ways that, in addition to economic prosperity, sustain biodiversity, land and water quality and provide lifestyle and social benefits²¹ and deliver animal welfare²². These pressures are exacerbated by the disparity between the over 60% of New Zealand exports that come from biological industries and the 87% of voters living in towns. In order to help bridge the rural-urban divide, our project is also designed around a second proposition: ***Grower participation in a transparent sustainability assessment and reporting system will protect their "license to farm" and promote a more supportive policy environment for both efficient production and sharing the cost of enhanced river, sea and land care.*** Therefore, the *New Zealand Sustainability Dashboard* will incorporate New Zealand KPIs (③ and ④ in the Project Map) and develop capacity for more regular sustainability reporting to New Zealand's regional and national agencies and citizens ⑦. To this end, we will test and develop cost-effective methods to increase the potential for growers to self-monitor. A mixture of interviews and questionnaires

will poll local and global food system stakeholders and regulators to ensure the resulting tool is trusted as being scientifically robust.

Several more specific hypotheses, research questions and assumptions flow from the two core propositions and have informed the details of our research design:

- (a) Growers are more likely to change their sustainability orientation and actions ⑨ if they are given a responsibility and role in monitoring²³, so the Dashboard is geared to capture metrics scored by the farmers themselves.
- (b) Participation and trust in the tool will increase if feedback is personalised, rapid and benchmarked against the performance of their colleagues, so the Dashboard software will provide instant benchmarking as soon as the farmer uploads her/his own data ⑩.
- (c) The 'survey module' embedded within the Dashboard will accelerate and deepen the reflexive qualities of our Participatory Action Research dimension to tool development and proof-of-product, capture farmer's own local and expert knowledge, ensure the tool's practicability and continually grow ownership and participation amongst stakeholders.
- (d) Mistrust amongst outsider stakeholders of self-monitoring by growers is intense so considerable investment in cross-checks by our independent science team will enhance eco-verification. We will cross-check a randomly selected subset of the inputs recorded into the Dashboard databases against our own measures on focal ARGOS farms to report data accuracy ⑪. The project will use a generalised statistical power simulation module ⑫ that optimises investment rates in these high-end monitoring components. The Project will include simulations for all the chosen Dashboard metrics to assure scientifically substantiated data interpretations and show margins of error on the Dashboard itself. Formal tests of replication through power analysis are remarkably uncommon in environmental monitoring and experimentation²⁴, so the generalised simulation tool will have many future applications beyond its use as a module embedded within the Dashboard.
- (e) Feedback showing weak sustainability performance ⑬ is probably not enough on its own to trigger change amongst growers or industry stakeholders. Thus, the Dashboard provides support to assess consequences of change and to pick optimum choices and targets for degree and rates of change as an essential complement to performance measures ⑭ and ⑮. Decision-support tools in the same package allow the growers to explore context appropriate means to improve their KPIs.
- (f) Grower learning for sustainability is an iterative and adaptive management process²⁵ that will be greatly accelerated by the structured feedback from the Dashboard. Creation of new decision-support (DS) modules is expensive, so we have concentrated on linking existing tools into the Dashboards ⑯. For example, results exported from Overseer can be automatically integrated and uploaded into the growers' Dashboard and database. Farmers will be made aware of facilitated access to alternative soil management models like SINDI and other LCR modules²⁶. Two new DS modules will also be developed ⑰ to fill gaps in support for managing overarching challenges faced by all farms, across all sectors: (i) an energy and carbon footprint assessment tool that tracks the primary determinants of a grower's energy KPI as well as the fastest and most cost-effective method of improvement, and (ii) a generalised '*What if*' module that allows the grower to predict the effect of modified farming and land use practices on other aspects of their KPIs (e.g., the effect of reduced fertilizer inputs on farm profit). This '*What if*' DS will make the feedbacks between dials on the Dashboard explicit and help farmers steer their enterprise towards a more sustainable overall outcome. Farmers face pressure to change, yet few tools are available to identify the maximum set of options, establish the consequences of each, and thereby enable the farmer chose the optimum strategy for their land and circumstances. The Dashboard seeks to simultaneously signal whether change is needed, while providing better decision support for achieving positive solutions.
- (g) Multiple approaches will test confidence in the credentials of the Dashboard and its ability to build trust, legitimise eco-verification and accelerate farm management transitions to

more sustainable practice ⑩. These approaches will be informed by engagement with stakeholders from all parts of food systems.

Overall Methodology and approach:

Definitions of sustainability are complex and vary among different stakeholders. Therefore developing metrics that are statistically robust, standardised and repeatable, inexpensive to measure and, most crucial of all, focused on keystone processes of agri-systems is a formidable methodological challenge. The research methodology underlying the *New Zealand Sustainability Dashboard* will incorporate expert knowledge from New Zealand and international teams. It involves Participatory Action Research²⁷ (PAR) with a concerted focus on the inclusion of end-users and scientists from a range of disciplines working together to develop tool prototypes. This uses non-traditional approaches to 'extension/adoption' of change in farm/orchard practice and builds reflexive knowledge production between farmers, researchers and industry into a continuous research process.

We have chosen to test the prototype Dashboard with New Zealand Wine and kiwifruit growers because these are well-managed industries with virtually complete participation of all their growers in communication networks. Similarly, we propose to consolidate and test the chosen KPIs and the Dashboard tool on farms/orchards already included in the ARGOS Project where the researchers have long-established relationships with the growers and industry agents. Research over the past 9 years has confirmed that the farm characteristics and indicators in ARGOS panels are an excellent representative sample of those in the sectors as a whole²⁸.

Multidimensional sustainability tool development demands that the researchers stretch and join methodologies in innovative and transdisciplinary ways. We will deploy the best possible Qualitative Research techniques using semi-structured interviews, transcription, and coding within NVivo by multiple researchers (to formally compare their conclusions)²⁹. We will then bridge to quantitative inferences in two ways: first by using the testimony of interviewees to design a questionnaire with closed questions about the utility of the Dashboard and its depiction of sustainability; and second by combining discourse analysis and multivariate techniques to measure relative emphases on different dimensions of sustainability (e.g. social, cultural, environmental and economic domains) in interviews. We will compare perceptions of the appropriateness of the sustainability framework chosen and the utility of the Dashboard held by different agricultural sectors, ethnic groups and stakeholder roles (e.g. growers, industry representatives and managers, scientists, regional council regulators and national policy analysts, overseas consumers). Also, the state-of-art *1000Minds* software (see www.1000minds.com) will be integrated into the Dashboard web application to facilitate choice modeling by project economists. Their primary goal is to price the intangible values of sustainable growing that are reported in the Dashboard; but the tool also ranks the values assigned to different parts of the Dashboard by different stakeholders. This allows for triangulation of inferences from distinct methodologies: qualitative analysis of interviews and associated discourse analysis, questionnaire responses and formal choice modeling of values. Finally the response of individual growers recorded by these methods can be compared to their level of consultation and interaction with the Dashboard to assess the extent of change in farming actions and KPIs. This provides a powerful test of the overall utility of the tool and its impacts on targeted outcomes: improved economic, social and environmental wellbeing.

Combination of qualitative and quantitative methods will discern the full range of underlying sustainability values from which we can judge the generalisability of the tool. We will use the mix of qualitative and quantitative methods to critically evaluate the extent to which the multiple dimensions of the Dashboard can be meshed into a single aggregate

index of sustainability for a whole farm, orchard or forest. While such a single index may well be anticipated eagerly by many stakeholders and farmers themselves, there is a need to evaluate whether such a single metric has any real meaning for sustainability and resilience, and if it could divert effort or distract attention from where it is needed most³⁰. These inquiries will allow our social researchers to treat the Dashboard as a case study to examine the impact of new 'metrologies' (the science and consequences of scientific measurement) on food value chains. This rapidly emerging theoretical approach in international sustainability studies³¹ suggests that measurement may entrench and favour a particular set of feedbacks or indicators which may contribute little to sustainability in the longer term.

Growing concern globally about the adverse effects of agricultural intensification on biodiversity and ecosystems services³² are increasingly leading consumers to seek agricultural products grown using sustainable land management practices³³. Identifying suitable indicators of sustainable land management requires a better understanding of the impact of specific management practices at different spatial scales on farmland biodiversity³⁴. We will measure biodiversity trends on our existing ARGOS kiwifruit and sheep/beef farms and extend these surveys to vineyards to identify key associations between management practices and biodiversity. These results will inform development of environmental KPI.

The basic software will be made available free of charge to all industries who are interested in incorporating it into their own systems. We anticipate that this will result in surprising and innovative research applications triggered by our efforts to create the basic platform for the general Dashboard tool.

Reliability of the detailed methodology & design

Several practical considerations have influenced our proposed methodology. We have co-opted professional IT staff to design the actual Dashboard and make it as user-friendly as possible. We will subcontract a graphic artist to incorporate rapid and simple visualisation techniques to achieve a clean and efficient interface to the software underlying the application. It will include interfaces for uploading KPI measures, descriptions of monitoring protocols, multimedia components to explain their rationale and usefulness for users, links to its own database to store the long term sustainability records so it can present trends in the standardised metrics.

We will thoroughly test prototype Dashboards on our ARGOS farms before they are made available to growers in that sector at large. This facilitates the provision of a working model from the outset of public release, which is essential in order to avoid undermining future participation and trust if farmers have a poor first experience of the tool. The established and strong relationships between our ARGOS field officers and participating growers will increase the reliability of interviews and polls of the utility and relevance of the Dashboard. Data collected by ARGOS from 2003-2012 will be used to retrospectively populate the Dashboard with chosen KPIs and test the longitudinal reporting functions of the Dashboard. Back-loaded data for case study farms will allow stronger first tests of the tool prototype with our own panel members. While entry-level growers will initially receive fewer rewards from adding relatively recent KPIs, they will be given comparisons with existing industry level and ARGOS median statistics allowing them to benchmark their performance to sector standards.

The web application that supports the Dashboard will have a 'survey module' added so that industry managers and planners, scientists and marketers can quickly and regularly poll all their growers about new threats and opportunities for their industry at minimal expense. Previous ASRGOS surveys are immensely valuable, but paper and post methods are

enormously time-consuming, feedback is slow and generalised, and response rates of farmers is declining³⁵. Online responses of growers will be instantly aggregated and reflected back to the participants by the Dashboard. Eventually that questionnaire module will be used for formal choice modeling work, using the '1000Minds' algorithms³⁶, so that industry representatives can place a dollar value on new market and farm management options. Towards the end of the project we will conduct one such choice-modeling module within each sector to test this eventual market research facility. However, in the first instance our researchers will use the polling module to invite a stratified random sample of users to report their assessment of the prototype's utility, and especially how it might be improved.

Because participation rates are crucial to the success of the Dashboard, we will focus substantial research on measuring the type of uses made of the tool and by whom, as well as ways of increasing participation overall. Growers, when first registering on the Dashboard, will populate a personal and family-styled profile that will be stored against their PIN access number and used to link all their subsequent responses to a set of farm and personal details (gender, age, life stage etc.). We anticipate that the host industries will designate a public and private section for the Dashboard web application and PINs are used to regulate access and confidentiality in much the same way that Fencepost secures personal details for dairy farmers. Part of initial co-planning critical steps is to tailor the Dashboard to the industry's needs – full traceability might be chosen for the public pages (e.g., a full traceability facility might eventually incorporate a two dimensional bar code on a bottle of wine being consumed by a wine club in Scandinavia that could be scanned by a Smartphone and invite the customers to connect with the Dashboard, and thereby to a map of where the wine was grown, a picture of the vineyard or vintners and even their sustainability scores).

The online and structured nature of the Dashboard will allow us to automatically and continually measure participations by growers, industry representatives, marketers and the general public (from hits, time logged in, downloads of salient documents, use of linked decision-support modules and, of course, the proportion of growers that start to populate the databases and generate sustainability reports for their farm, orchard or forest). We can thereby report accurate and complete participation metrics. If structured interventions with growers are required to build participation in the Dashboard, we can compare metrics in a 'Before-After-Control-Impact' (BACI) sample design to learn how to improve engagement by end-users. Such analyses increase the likelihood of return on investment benefits from the Dashboard through widespread use of the tool – the only question is how quickly it will be taken up and how that can be accelerated if necessary.

Māori research methods

Application of several methods to bridge quantitative and qualitative ways of knowing will be particularly important in our work for interfacing mātauranga and science (Objective 4 of *Vision Mātauranga*). Participatory and Kaupapa Māori research methods will be applied³⁷. Both mātauranga and science will respectfully and rigorously peer review each other from different standpoints to avoid preconceived notions that each is like the other, or one is better than the other³⁸. We will formally test for differences in the relative importance of tangible and intangible values for the two Māori Dashboards compared to the others. Differences in emphasis in values underpinning sustainability between ethnic groups are commonly asserted, but there are remarkable few quantitative studies to test this idea in New Zealand and overseas³⁹.

Impact Statement, Research Aims, Critical Steps and timetable:

The Ministry of Science & Innovation structure their research contracts around a series of 'Impact Statements', 'Research Aims' and 'Critical Steps' required to achieve those research aims.

The overarching Impact Statement for the *New Zealand Sustainability Dashboard* project is:

Final versions of the New Zealand Sustainability Dashboard are being used by 4 case study partners – fully integrated versions for (1) NZ Wine and (2) Zespri (3) Te Rūnanga o Ngāi Tahu use theirs within their Ahikaa Kai assurance programme and as a component of their innovation software platform; (4) New Zealand Forest industry where sustainability assessment indicators and draft monitoring protocols have been developed for social and cultural sustainability KPIs. KPIs and monitoring processes have been refined. A trial prototype has also been developed for BioGro NZ. Existing decision-support tools have been linked to the Dashboard and 2 new decision-support modules have been developed and are in use by 2 sectors. A full evaluation of the functionality, use, value and recognition of the Dashboard across multiple stakeholders has been completed with the results incorporated into dashboard enhancements. Operation of the Dashboard has been transferred from the researchers to the host industries.

Start date: 1 October 2012. **End date:** 1 October 2018.

There are eight inter-dependent research Aims:

- 1. Project establishment and background analysis:** Project and the four case studies are established with analysis of the character of their sustainability assessment and reporting needs completed with a subsequent analysis of possible options. Plans for the pilot development of sustainability assessment and reporting are completed and accepted for the 4 sectors. *Start date: 1 October 2012. End date: 1 October 2013.*
- 2. Design, development and evaluation of Dashboard prototypes for wine, Zespri, forestry and iwi initiatives:** Prototypes of the New Zealand Sustainability Dashboard are designed and developed with 30 vineyards and their associated wineries and the existing 36 ARGOS kiwifruit orchards for Zespri. The prototypes are rolled out and evaluated by at least 100 vineyards and 100 kiwifruit growers, three North Island Māori forest owner collectives and 10 participating whānau or hapū from Ngāi Tahu's rohe. *Start date: 1 July 2013. End date: 1 October 2015.*
- 3. Optimising and verifying sustainability assessment indicator monitoring and setting performance targets:** To identify simplified KPIs in the wine and kiwifruit sectors, and in exotic forestry, to determine the minimum set of most cost-effective methods required for reliable sustainability assessment. To test the importance of management practices and landscape context in predicting and optimizing biodiversity KPIs in vineyards. To measure the relative importance ascribed to different KPIs in the Dashboard prototype by growers, industry, regional and national government agents, food chain regulators and the domestic and international customers of wine and kiwifruit so that targets and monitoring investments can be better prioritized. To prescribe the optimal scale, design and intensity of sampling required to cost-effectively detect deleterious trends or critical thresholds in performance indicators scored by the growers themselves, wineries, and expert monitoring teams. *Start date: 1 Oct 2012. End date: 1 October 2018.*
- 4. Energy use and carbon footprint minimisation learning tool:** To develop a decision-support programme for energy and carbon to benchmark, track performance and identify efficiency gains for the NZ Wine and Zespri case studies to inform the development of

similar resources for other sectors. Start date: 1 October 2012. End date: 30 September 2018.

5. **To Develop a ‘What if’ decision-support tool embedded in the Dashboard:** To develop a decision-support system for trading off different components of vineyard, orchard, farm and forest sustainability performance. To embed this into the NZ Sustainability Dashboard so that individual growers can identify the investment required to improve particular KPIs on their farm which are approaching Amber and Red alert levels, and the knock on effects of that investment on other KPI measures. *Start date: Oct 2012; End date: Sep 2018.*
6. **Existing decision-support tools have been interfaced with the NZ Sustainability Dashboard:** To link at least five existing grower decision-support tools, including 1000 Minds and Overseer, to the New Zealand Sustainability Dashboard so that growers and industry facilitators can (i) quickly match tool capabilities to their management challenges for improving sustainability KPIs, (ii) easily access and trial the tools, and where possible (iii) use tools that have been interfaced within the Dashboard to explore consequences of changing land use on the reported KPIs depicted in the Dashboard itself.
7. **Dashboard prototype developed for a new sector: The knowledge gained** from the original 4 case studies is applied to the development of a dashboard for a new sector – organic farming – which covers all primary production systems. Start date: 1 October 2013. End date: 1 March 2018.
8. **Testing, demonstration and evaluation of the Dashboard tool and project synthesis:** To test, evaluate and demonstrate the various Dashboard capabilities such as the ability of the Dashboards to facilitate; State of Environment reporting; the surveying of users; the evaluation of strategic marketing opportunities and risks; and decision-support tools. To evaluate stakeholders perceptions of the various Dashboards to clarify the economic impact of the tool, whether the tool meets expectations and adds value to users and other stakeholders. To promote findings to support the adoption of the Dashboard and its capabilities to other sectors and uses. Start date: 1 July 2016. End date: 1 October 2018.

THE RESEARCH TEAM AND COLLABORATORS

ARGOS's Sustainability Dashboard team

The *New Zealand Sustainability Dashboard* project is led by Jon Manhire (The Agribusiness Group), who has longstanding relationships with industry and a track record of cost-effective delivery to a wide spectrum of primary industry players, regional and national policy makers and farming families. He participated in the SAMSN project, developed the ZQue and second generation of CMP's QA system as part of the ARGOS work as well as other sustainability programmes in New Zealand and overseas. He brings practical and focused leadership that forces creative transdisciplinarity between academics and practitioners, and locks in research implementation and uptake through design of market accreditation systems. The project's Science Team includes:

- Prof. Henrik Moller (UoO) provides scientific oversight of programme design, and detailed support of environmental research. He was the Environmental Objective Leader in ARGOS from 2003-2009 and combines 35 years of experience in field ecology, mathematical modeling and both qualitative and quantitative research methods for promoting bottom-up environmental management.
- Prof. Caroline Saunders (LU) leads ARGOS's economic studies on global drivers and opportunities for agricultural exports⁴⁰. She used the ARGOS results to defend New Zealand market access in the 'Food Miles' debate in 2007. She is ideally placed to hone

the Dashboard design to meet international market requirements and guide the choice modeling and Multicriteria Assessment methodologies.

- Prof. Hugh Campbell (UoO), Dr Chris Rosin (UoO), Dr Lesley Hunt (LU), and Andrew Barber (TAG) are established researchers from the ARGOS group. Campbell has contributed 20 years of research on the role of market accreditation schemes as pathways to sustainability. He co-designed the ARGOS programme with Manhire. Hunt and Rosin are social researchers who will evaluate responses of stakeholders to the Dashboard's sustainability framework and farm practice.
- Dr Catriona MacLeod (LCR) has been Environment Objective Leader for ARGOS since 2009. She has expertise in farmland ecology and brings a strong background in environmental survey design and methods, having contributed to the development national biodiversity monitoring schemes for DOC and Regional Councils. Dr MacLeod will lead a strong established LCR team of experts with analytical skills in power analysis (especially Dr Adrian Monks).
- Elizabeth Post (*Lincoln Ventures*), leads the design and delivery of the technological aspects of the Dashboard web application. She has 15 years of experience in developing software for agricultural and environmental research applications, primarily modeling, simulation and interactive web applications.
- Franz Ombley (*1000Minds*), Paul Hansen (*1000Minds*, UoO) and their team of software developers will provide additional support including the application of the 1000Minds software (www.1000minds.com). Paul is Associate Professor of Economics at the University of Otago and specialises in Multiple Criteria Decision Analysis (MCDA). Franz is a full-time director of 1000Minds Ltd and ex-CIO of the Treasury; he specialises in software development and MCDA. Expert web developers, working in association with experienced web graphic artists, will underscore the professional nature of the tool and minimise barriers to participation in the web application.
- Dr John Reid and PhD students Stephanie Rotarangi and Tremane Barr provide very strong credentials in the Vision Matauranga dimensions of this project. Reid and Barr are situated within Te Rūnanga o Ngāi Tahu's *Toitū Te Kāinga* research unit where they can spearhead uptake and resourcing within the Ngāi Tahu whānui. Dr Reid has researched ways to sustain livelihoods of Ngāi Tahu tribal members and led the *He Whenua Whakatipu* component of ARGOS⁴¹. Stephanie Rotarangi (UoO) has worked closely over the past 4 years with the central NI and East Coast Māori communities that will host the development of the prototype Māori Dashboard, as well as working with the wider forestry industry on QA programs and sustainability advocacy.

Project Management and Support

The Project will be administered on behalf of all the participating research providers by the AgriBusiness Group (TAG). TAG has nine years of experience in ARGOS - participating and managing a complex transdisciplinary research project⁴². Three leading researchers named on this project (Profs. Henrik Moller, Hugh Campbell, and Caroline Saunders) are prior FRST Programme Leaders and the Maori research leader (John Reid) was leader of the He Whenua Whakatipu objective of ARGOS and is the R&D Manager for Te Rūnanga o Ngāi Tahu. The majority of the research plan relies on technical capabilities and relationships that have already been established in the ARGOS project. The main exception is the IT platform, however new experienced team members who have developed similar software applications will manage any risks.

Extending national and International Partnerships

This project will accelerate progress and improve its ability to deliver by extending three key relevant, currently funded MSI projects in this area: ARGOS – Pathways to Sustainability in Primary Production⁴³; WOW – The Wheel of Water project⁴⁴; the Future Forest Research Group.

- 1) ARGOS has identified indicators and monitoring protocols and tested the utility of some

but not all of the anticipated KPIs to be incorporated in the dashboard.

- 2) WOW seeks to feedback biophysical indicators relating to water use in a similar manner to a community of stakeholders and integrates environmental, social, cultural and economic indicators in a single reporting framework. Collaboration will be maximised by hiring IT staff from WOW to help generate the Dashboard, and one senior researcher (Prof Caroline Saunders) serves in both teams. WOW programme leader, Dr John Bright, has been invited to join the Governance Group to reduce redundancy and share lessons.
- 3) The Future Forest Research group⁴⁵ is developing means of verification of QA practices in the forestry sector. To avoid duplication of effort, the teams have met to coordinate proposed research and will continue to meet regularly to share insights. Both social and cultural KPIs as well as a comprehensive Māori forestry sustainability framework will be developed to complement the predominantly biophysical indicators being developed by SCION and FFR.
- 4) The project will further develop collaborative links with three key research initiatives involving Landcare Research: the existing Envirolink-funded Regional Councils' Biodiversity Monitoring Framework project (Dr Peter Bellingham), the MSI Smart Idea proposal "Next generation biodiversity assessment" (under the Environment portfolio; Dr Robbie Holdaway) and the proposal for an Australian Cooperative Research Centre for "Safeguarding Biodiversity" (in which The AgriBusiness Group is a contributing organisation).

This project will benefit from deepening established international partnerships and creating new ones around sustainability indicators and assessment:

- OECD – Agri-environmental indicators development and reporting⁴⁶ as reflected in recent work by Prof. Saunders⁴⁷.
- Denmark's 'MultiTrust' project⁴⁸ – using multi-criteria assessment, an innovative transdisciplinary approach, to examine ways of communicating multiple values of organic agriculture to consumers and society in Denmark and worldwide. Project staff are named contributors to the Multi-trust project and ongoing exchange visits have been initiated.
- The Norwegian Research Group On Sustainability (NORGOS), a coalition of rural sociologists, economists and ecologists that have recently formed from four national research institutes to create a project modeled on the ARGOS program. Exchange visits are already underway.
- Our research will be fast tracked and harmonised with international standards and processes by participation in the Food and Agriculture Organisation's SAFA program⁴⁹, and the possible co-option of some components of the tools from RISE⁵⁰ and other international projects. Innovative visualisation techniques will be trialed, probably drawing on those used by RISE. Preliminary contact has been made with the SAFA and RISE co-ordinators and we have agreed to explore options for co-operation in each other's projects.

The ARGOS team is seeks transdisciplinary and inter-institutional collaboration. Potential new partners are invited to make contact with the team leader:

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