

# Sustainable Vegetable Systems



## Quarterly Report - Programme Governance Group

### Quarter 3, January – March 2022

Contract Agreement Number: 21859



Ministry for Primary Industries  
Manatū Ahu Matua



### In partnership with:



### 1.1 Summary of progress during this quarter

#### Workstream 1 – Controlled experimentation to quantify nitrate leaching

- We have progressed the four rotations and are approaching the last crop, ryegrass, to be sown in Rotation 1 and 2 in Canterbury and Rotation 3 in Hawke's Bay. Rotation 4 is entering cauliflower followed by a final crop of ryegrass.
- Data collection and analysis is ongoing in this Workstream. Here we summarise preliminary data of crop N and changes in soil N within Rotations 1, 2 and 4. In terms of crop N, we are interested in key components that contribute to the N balance, such as crop N uptake and N content (N%).
- In Rotation 1 (potato – wheat – broccoli), N uptake by harvested product increased for all crops except broccoli, which had no yield change with N rate. N residue also increased with N rate across all crops. The N% of the crops increased with N rate.
- In Rotation 1, soil N increased rapidly in the top 15 cm after the broccoli crop and during the onion crop. This increase in soil N is partly due to mineralisation, but also a likely important contributor is the breakdown of broccoli residues.
- A leaching event early during the wheat crop in Rotation 1 occurred before fertiliser was applied to this crop. Leaching was calculated as part of Workstream 3; averages were 15, 17, 21 and 42 kg N/ha leached for treatments N1, N2, N3 and N4 respectively. The differences between N treatments prior to fertiliser application suggest a legacy effect of N management in the previous crop. Importantly, there was leaching even in the N1 treatment, where no fertiliser was applied in the previous crop.
- In Rotation 2 (pak choy – oats), N uptake in harvest product, residue N content and N% of the crop increased with N rate.
- In contrast, in Rotation 3 (pak choy – lettuce) grown in Hawke's Bay, N rate had no effect on N uptake in harvested product or residue, or on N% in either pak choy or lettuce. Soil N in the Rotation 3 had values close to 200 kg N/ha in the top 15 cm, compared to 100 kg N/ha in Rotation 2. This difference in soil N led to difference between the two pak choy crops.

Trial crop rotations

Crop experiment and rotation outline - Hawke's Bay																								
	2020						2021												2022					
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	
<b>Rotation 1</b>														Onion								Grass crop		
<b>Rotation 2</b>									Pak choi		Fallow	Lettuce		Peas					Fallow				Caul.	
Crop experiment and rotation outline - LINCOLN																								
	2020						2021												2022					
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	
<b>Rotation 1</b>	Wheat							Broccoli mid Feb					Fallow	Onions							Fallow		Cover crop (ryegrass)	
<b>Rotation 2</b>			Pak choi - Shanghai (smaller)				Fallow	Cover crop (ryegrass / Oats)					Fallow			Potatoes - Fresh						Fallow		ryegrass

Workstream 2 – Crop rotations

Site No.	2020				2021												2022				
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1	Cover Crop (ryegrass cut and carry)				Fallow							Onions						Fallow			
2	Barley (crop/cover crop)				Fallow							Onions resown					Fallow		Broccoli		
3	Mustard				Fallow		carrots									Fallow					
4		Potato			Fallow		Cauliflower					Fallow	Maize							Fallow	
5			Potato				Fallow			Onions								Fallow	Grass	Grass	
6		Maize silage						Fallow	Grass							Fallow	Cabbage			Fallow	
7			Pumpkin			Fallow				Grass			Fallow			Butternut Squash			Fallow		
8	Potato							Fallow	Wheat									Fallow			
9			Pumpkin				Fallow	Fallow	Turf grass									Fallow			

## Workstream 2 – Regional on-farm monitoring

- Monitoring continues at the 9 regional sites. Most sites finished the quarter in fallow or about to enter a fallow period. The regional monitoring sites crop rotations are shown above.
- The splitting of soil samples between the commercial and Plant & Food Research laboratories for side-by-side comparison continued.
- The regional monitors meet on the last Monday of the month, along with PFR, and covers H&S, progress update, and discusses any issues and ideas amongst the nationally dispersed monitoring group.
- The individualised soil mineral nitrogen reports were updated and circulated to the monitor site growers. The nitrogen budget reports are waiting on further plant data.
- The additional crop monitoring continued. This is to provide a more robust database on crop nitrogen concentrations and harvest weights. 27 potato samples were taken with the intention of developing a variety specific dataset. 6 green vegetable crop samples were collected. The vegetable crop sampling will continue to provide a regional and seasonal dataset.
- It was identified that the monitoring sites do not include a winter grown potato crop in Auckland. An additional paddock has been added that is alongside an existing monitoring site. The same monthly sampling protocol is being followed from pre-planting through to the postharvest fallow period.

## Workstream 3 – Farmer facing tool(s)

- Anne-Maree Jolly has been appointed as the WS3 leader alongside Hamish Brown. Anne-Maree brings her extensive knowledge from a soil science perspective along with a lot of nitrogen modelling experience while at Ballance and now WSP.
- A significant step forward was the development of the tool prototype, tentatively named N-Sight.
- Discussions are continuing with Overseer about collaboratively working together.

## Workstream 4 – Developing a change landscape

- An SVS logo was created for use initially in the videos and podcasts but is now being used more widely in presentations and articles.
- Preparation for a series of 3 videos is underway. These include:
  - Project introduction and overview
  - Case studies/monitor sites. Greater understanding of the nitrogen cycle.
  - Science story - trial sites to labs to modellers
- Preparation for 6 podcasts. These are being recorded on the same day and will be distributed monthly. The topics are:
  - Why SVS
  - Understanding the leaching problem (catchment perspective)



- A nitrogen balance
  - A Nitrogen budget and tool prototype. N-Sight.
  - Regulatory landscape (possibly delayed)
  - What does good look like?
- Turned articles into SVS Updates that are sent to the growing email distribution list, are hosted on the Potatoes NZ website and linked to in product group newsletters.
  - The Workstream 4 team begun developing a Logic Model (below) for SVS as a halfway review step and giving direction to future dissemination.

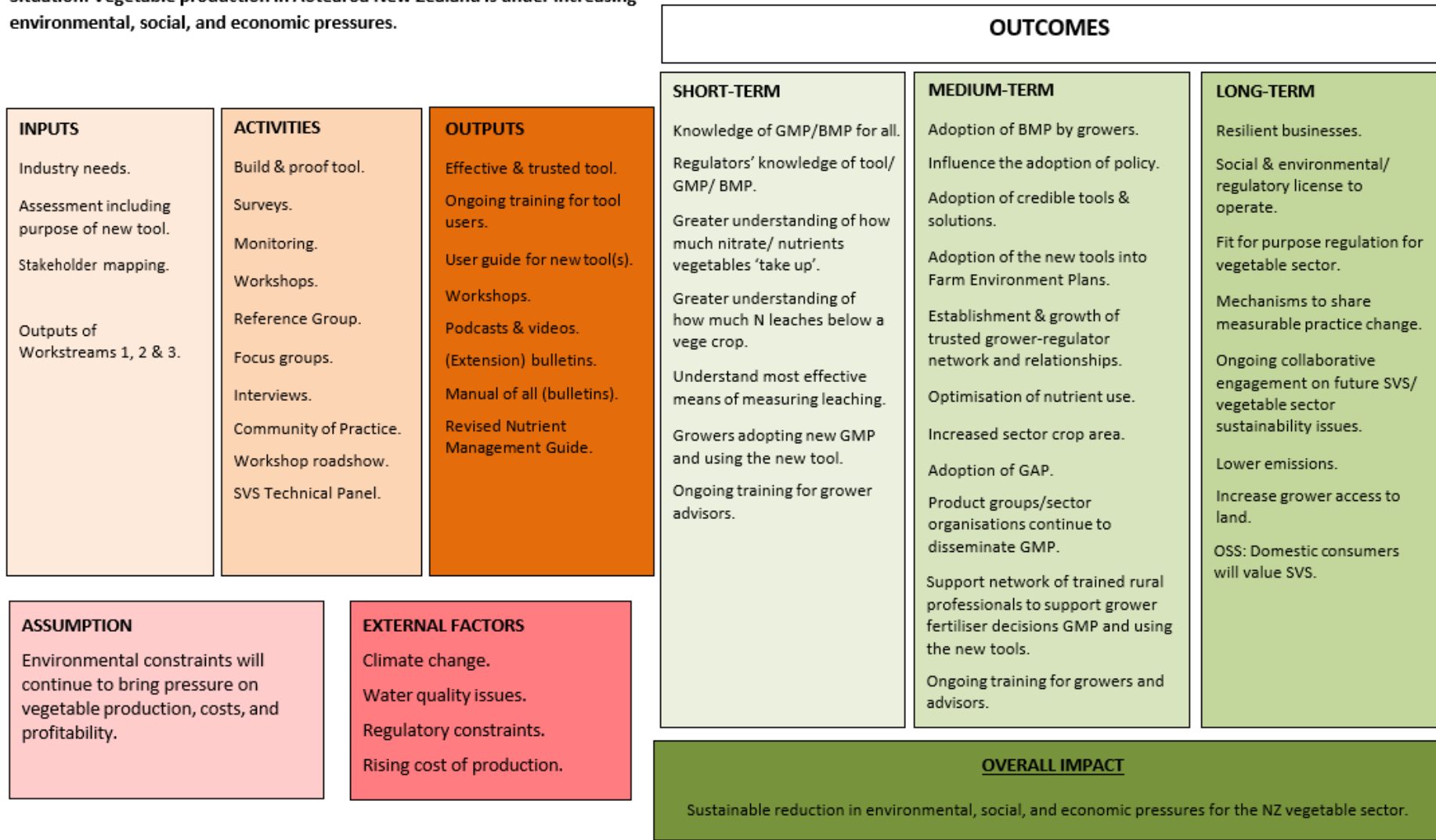
## 1.2 Key highlights and achievements

- The tool prototype (N-Sight) was developed. This is now ready for demonstrating to a wide range of audiences.
- Mineral N tracking reports at a point where they are valuable tools that act as the basis for discussing mineral nitrogen flows. Used in the February NZ Grower article and in upcoming Tech. Panel meetings.
- Development of the video and podcast series.
- Collection of over 33 additional plant samples with the process continuing to build a more robust crop database. This also engaged more growers directly in the programme with the opportunity to describe SVS's goals and giving them a stake in the outcome.
- The collaborative development of the Logic Model by the Workstream 4 team and subsequent clarity around the dissemination plan.
- Advancing the thinking on the tool implementation pathway options, issues, and opportunities. Culminating in the Special Project Governance Group meeting.
- Preparation for grower, and supply and service industry interviews on the tool to be conducted in Q4.
- Formalised contracted links into concurrent PFR projects on soil mineralisable N.
- A new Workstream 3 leader – Anne-Maree Jolly (WSP) is now part of the programme.
- Recruitment of people to join the Reference Group across growers, councils, suppliers, Overseer, and product group representatives.

# Outcome Logic Model

## Realising Sustainable Vegetable Systems

Situation: Vegetable production in Aotearoa New Zealand is under increasing environmental, social, and economic pressures.



### 1.3 Collaboration with other programmes (optional)

Red font is new text this quarter.

Project name	Industry lead / Researcher	Description	Link to SVS
Future Ready Farms	SFFF Ballance	<p>This programme aims to trial and develop 12 farm nutrient technologies that will help meet national environmental targets for reducing greenhouse gas emissions, agricultural chemical use, and nutrient loss to waterways.</p> <p>Products and tools for reduction of nitrogen emissions from the horticulture [kiwifruit] and arable sectors are identified. [FRF will collaborate with SVS, but not looking to develop vegetable focused tools]</p>	Scott Champion (Ind. Chair)

Project name	Industry lead / Researcher	Description	Link to SVS
MPI SFF - Mineralisable N to improve on-farm N management	PFR led, funded by MPI, FAR, VR&I, Environment Canterbury, HBDC, Waikato Regional Council, Ravensdown, Hill Laboratories, Eurofins Food Analytics Ltd.	<p>The productivity of broad acre cropping depends on supplying sufficient nitrogen to meet crop demand; however, farmers often do not know how much N will be mineralised during the growing season.</p> <p>Plant &amp; Food Research have developed a new laboratory test (published 2017) that can be used to predict in-field N mineralisation. The new test is faster and more accurate than existing commercial tests. This project will conduct on-farm demonstration trials with different crops, soils, and climates to demonstrate the benefits of the new test to improve N management on farm.</p>	<p>SVS sampling protocol includes the hot water (HW) test in both the trials and regional monitoring sites.</p> <p>Mike Beare (PFR) is involved in SVS through the Tech. Panel.</p> <p>Soil samples are being split and sent to both Eurofins and PFR to test HW result consistency and Mineral N vs hot water extractable inorganic M.</p>
Crop residue N project	VR&I, PNZ, FAR / PFR	PFR-funded project looking to quantify the rate of decomposition of different vegetable residues and the rate of N release from the residues into the soil. Taking the small-scale laboratory trials conducted last year by Trish Fraser (PFR) into a larger scale field trial and literature review.	Essential for the nutrient budget. Direct industry and researcher connections. Some residues will be obtained from crops in Workstream 1.
Measuring real time nitrate leaching from a Hawke's Bay onion field	Ravensdown / PFR	The purpose of this research was to compare data from two nitrate sensors installed in a sump measuring nitrate-nitrogen concentrations in situ, with data from grab samples that were taken immediately to a laboratory for analysis.	Problem recognition. Direct industry and researcher connections.



Project name	Industry lead / Researcher	Description	Link to SVS
Future Proofing Vegetable Production	VNZ & PNZ / LandWISE	Completed MPI SFF project. On farm trials in Levin and Gisborne. Developed a simple nitrogen budgeting tool designed specifically for vegetable production systems.	Picking up on the nitrogen budget and further developing the components and deliverable tool. Direct industry and researcher connections.
Process Vegetable Coefficients	PVNZ / PFR	Quantify some of the coefficients needed for N uptake and use by processing crops within Overseer.	Direct industry and researcher connections.
Protecting our groundwater: Fluxmeter	FAR, VR&I / PFR	A network of tension fluxmeters were installed on commercial arable and vegetable farms around New Zealand to directly measure losses of nitrogen and phosphorus in drainage water. Completed. Now being extended by FAR & VR&I.	Problem recognition. Direct industry and researcher connections.
Measuring nitrate in drains	Auckland Univ.	A Massey Univ. trial measuring nitrate levels in tile drains is being conducted in one of the Regional Monitoring sites. Now have the contact details and will follow up. The student trial has been running since 2019.	Trial is on a regional grower's site.
Modelling to reduce nitrogen in Pukekohe (Whangamaire stream)	MPI	Indicative environmental-economic modelling to investigate the potential scale of impacts on commercial vegetable growing from the annual median nitrate in Pukekohe. Considerable change in productive land use may be required to achieve the NPS-FM 2020 national bottom line. <a href="https://www.hortnz.co.nz/assets/Environment/National-Env-Policy/JR-Reference-Documents-/MPI_2020-42078-Pukekohe-Modelling-Report-Final-Sanitized.pdf">https://www.hortnz.co.nz/assets/Environment/National-Env-Policy/JR-Reference-Documents-/MPI_2020-42078-Pukekohe-Modelling-Report-Final-Sanitized.pdf</a>	Aware of

Project name	Industry lead / Researcher	Description	Link to SVS
Asparagus N budgeting	LandWISE, Asparagus product group / PFR	Previous survey work identified a very wide range of fertiliser practices. Preparation of FEP's highlighted the need for better information that can be fed into asparagus nutrient budgets.	Using sampling protocols developed by SVS. Direct industry and researcher connections.
Freshwater Management Tool	Auckland Council	AC is currently in the process of developing a Freshwater Management Tool. This tool will provide a more sophisticated assessment of water quality in the Auckland region. 2% of waterways in the Auckland region are predicted to exceed the 95 <sup>th</sup> percentile concentration of 9.8 mg/L. All are in the vege rich sub-catchments of the Franklin aquifer.	HortNZ is working with AC.
Global Literature Review on nitrogen mitigation options in vege. prod.	MPI / PFR	Literature review of mitigation technologies and their potential impact. Not yet available beyond MPI and PFR.	Important background for beyond SVS when mitigations are investigated.
Remote soil water measurement	NIWA	Remote auto sampling of soil leachate. Lysimeter was originally prototyped by Landcare Research, developed into a product by NIWA. <a href="https://niwa.co.nz/publications/isu/instrument-systems-update-21-november-2015/remote-soil-water-measurement">https://niwa.co.nz/publications/isu/instrument-systems-update-21-november-2015/remote-soil-water-measurement</a> . Researcher says progress has been slow and expensive (Andrew correspondence 2020).	Watch progress, along with other emerging technology.
Ag Matters	NZ Ag GHG Research Centre	Dissemination of practical information, backed by science, to help farmers and growers get to grips with climate change. <a href="https://www.agmatters.nz/">https://www.agmatters.nz/</a>	Collaborate on dissemination and case studies.

## 1.4 Upcoming

- Technical Panel workshop (2 days in 4 Zoom sessions)
- Workstream 3 modelling meeting in Lincoln (24<sup>th</sup> May)
- PGG meeting to discuss tool pathway options (1<sup>st</sup> April)
- Rezare interviews, analysis, and draft report on SVS Tool implementation pathways
- FOLKL grower, FAR, supplier and service industry interviews on the tool prototype
- Ongoing monitoring, trials, and additional crop sampling
- Reference Group first meeting (28<sup>th</sup> July tbc)
- Formation of the Community of Practice
- Incorporating plant analysis into a new individualised monitoring site report based around a nitrogen budget.
- Grower initiated XLabs project using the SVS tool prototype N-Sight. XLabs is a proven capability - building program — here to accelerate the design, validation and progress of your circular solutions and innovations. Design sprint will take place from 23<sup>rd</sup> to 27<sup>th</sup> May.

## 1.5 Investment (Cash & In-kind)

<b>Investment period</b>	<b>Co-investor contribution</b>	<b>MPI contribution</b>	<b>Total investment</b>
During this quarter	\$0.142m	\$0.333m	\$0.475m
Programme to date	\$1.096m	\$2.565m	\$3.661m