

Background

Premier’s Office is coordinating the development and implementation of a Food Security Task Force (FSTF), which was initially introduced by the 2019 Throne Speech. The focus of the FSTF is to provide recommendations on how innovation and technology can be used to increase the productivity and competitiveness of BC’s agriculture sector and promote food security. The Task Force will report to the Minister of Agriculture and Minister of Jobs, Trade and Technology.

Three members of the FSTF will be appointed (note: appointments have not been finalized):

1. Peter Dhillon, Chairman, Richberry Group (**Chair**)
2. Arvind Gupta – Professor, University of Toronto
3. Lenore Newman - Canada Research Chair, Food Security and Environment, University of Fraser Valley

Raghwa Gopal, President & CEO of Innovate BC – EX-OFFICIO MEMBER

The FSTF will be responsible for engaging with the public and stakeholder groups to inform recommendations, for which a final report will be presented to ministers by Dec 31, 2019.

PO has expressed interest in announcing the FSTF by way of a targeted event. Staff have suggested leveraging the Agritech Challenge, that is currently being led by AGRI in collaboration with Innovate BC, in order to simultaneously announce the “winners” of the Agritech Challenge and launch the FSTF mid-July. The event is a place to start early communication of the Innovation policy Framework goals given the full public release may have to wait for the release of Government’s Economic Development plan.

- For context: The Agritech Challenge will provide up to three small/medium scale BC innovators, that are proposing a solution related to processing, precision agriculture and/or food traceability, with up to \$50k (each).
- **Location:** The event could be hosted at one of the companies’ headquarters—i.e. likely Lower Mainland (most finalists located there); however there a few finalists in rural communities (potential regional event).

The proposed role for MBR at this event would be to:

- Support overview of the Agritech Challenge and announce/congratulate the winners.
- Co-introduce the Food Security Task Force members (AGRI Minister and/or Raghwa Gopal).
- Talk about our innovation goals (clusters, scale-up, regional participation and talent) and illustrate how this work embodies the goals
- Discuss how agritech is a key opportunity for enhancing food security; anchor key innovation sectors throughout BC; and support the objectives of CleanBC by reducing GHG emissions.

Status

- Terms of Reference drafted by PO and shared with ministries for reference.
- Working group/staff within AGRI and JTT assigned to support the FSTF work.
- Staff working with GCPE to explore logistics and propose key messaging for a news release/ event

Next Steps

- Staff to collaborate on developing key messaging and provide to PO for consideration (Jun 17).
- PO to confirm whether to proceed with event (Jun 18).
- Staff to continue exploring logistics for potential event, working with Innovate BC (ongoing).

FW: Food Security Task Force

From: Collier, David JTT:EX <David.Collier@gov.bc.ca>, Collier, David JERI:EX <David.Collier@gov.bc.ca>
To: Smith, Siobian JTT:EX <Siobian.Smith@gov.bc.ca>, Smith, Siobian JERI:EX
Attachments: FSTF Theme Research Annotated Summary Template.docx, FSTF - Food Security Definition - August 7 - GCPE reviewed.docx, FSTF Themes Research Work plan.docx, Food Security Task Force Proposed Key Themes - July 26.docx

Hi Siobian,

I joined a call earlier this week with Nathan and Mica and some of the Min of Ag folks.

To support the start of a cross-government Food Security Task Force (FSTF), they're asking for ITD's help to search for and briefly summarize any internal (existing) research pieces that relate to Agri-tech. These would likely be from former IBD/ISC days. For anything that we find, let's run by Mica first before summarizing. If she thinks it would be valuable to the Task Force then we'll need to complete the attached "summary template". For example, Nathan believes that Maija Duffy (while with ISC) led some Agri-tech research piece(s) 1-2 years ago that may be useful.

In addition to any existing research pieces, Mica will also need our help with some info gathering (desk research) on topics that they suspect haven't been researched before – outlined in the "Work plan" attachment and noted as JTT. Nathan's team is also working on these so we'll need to divide. Mica doesn't see this as being an onerous exercise – mainly desk research and summarizing.

This could be a good little August/September project for someone on your team. ☺

Mica is seeking a point-person from ITD and plans to set up a brief kick-off meeting next week to clarify things and answer any questions. May I put your name forward? The FSTF is a government priority and Tracy has asked COBI to support Nathan's efforts.

Thanks!

David

From: Munro, Mica JTT:EX
Sent: Tuesday, August 6, 2019 4:39 PM
To: Collier, David JTT:EX; Nankivell, Nathan JTT:EX; Lesiuk, Tim JTT:EX
Cc: Cowden, Samantha JTT:EX
Subject: RE: Food Security Task Force

Hi all,

Attached are three documents:

1. A break down of the different research areas / themes the FSTF is requesting packages on – this document is intended to help divide the work between the two supporting Ministries and align the topics with specific areas of expertise
2. A list of themes with a high-level description of some of the key considerations the FSTF would be interested in learning more about
3. A template for people to use when summarizing lengthy reports to identify key findings for the members to consider

I can run through these in tomorrow's meeting (for those in Victoria, I booked the board room at 800 J (Rm 512))

Just wanted to note this isn't going to be a huge capacity drain, we are essentially just asking for individuals to do some general google research on the themes, provide a template for any key readings to give the TF a sense of the topic. Ideally the template should be super simple for users.

Talk more tomorrow - And thank you again in advance for the support!

MM

From: Munro, Mica JTT:EX
Sent: August 6, 2019 3:30 PM
To: Collier, David JTT:EX <David.Collier@gov.bc.ca>; Nankivell, Nathan JTT:EX <Nathan.Nankivell@gov.bc.ca>; Lesiuk, Tim JTT:EX <Tim.Lesiuk@gov.bc.ca>
Cc: Campbell, Tracy JTT:EX <Tracy.Campbell@gov.bc.ca>; Cowden, Samantha JTT:EX <Samantha.Cowden@gov.bc.ca>
Subject: RE: Food Security Task Force

Great, I will set up a call in the next few days!

From: Collier, David JTT:EX
Sent: August 6, 2019 3:03 PM
To: Nankivell, Nathan JTT:EX <Nathan.Nankivell@gov.bc.ca>; Lesiuk, Tim JTT:EX <Tim.Lesiuk@gov.bc.ca>
Cc: Campbell, Tracy JTT:EX <Tracy.Campbell@gov.bc.ca>; Munro, Mica JTT:EX <Mica.Munro@gov.bc.ca>; Cowden, Samantha JTT:EX <Samantha.Cowden@gov.bc.ca>
Subject: RE: Food Security Task Force

Happy to. I'm around all week. My calendar is up to date.

From: Nankivell, Nathan JTT:EX
Sent: Tuesday, August 6, 2019 2:31 PM
To: Lesiuk, Tim JTT:EX; Collier, David JTT:EX
Cc: Campbell, Tracy JTT:EX; Munro, Mica JTT:EX; Cowden, Samantha JTT:EX
Subject: Food Security Task Force

Hi Tim and David,

JTT is co-leading support for the Province's Food Security Task Force. The focus of that group (my words) is to ensure B.C.'s agriculture sector is able to retain its competitiveness and productivity in the face of challenges (climate change, access to water, market competition etc) so that it can produce enough high quality food to supply local demand while also growing export capacity which is a key part of BC's GDP/ economic development. The thought is we can achieve this by applying technology and innovation to the agricultural sector in ways that improve efficiency and reduce wastes and other expensive/ deleterious to the environment inputs. JTT, along with Agriculture have been asked to help support the task force in a number of ways, one of which is with research and analysis that the task force will use when providing its findings back to govt in December. Given you have the BI team and some agrifood experts, we're hoping we can tap into some of your existing expertise, work and things in progress to support the task force. To that end, are you available for a call/ meeting later this week to go over the research pieces and identify which ones you'd be able to support? Thanks in advance and if you need more details, Mica (on this email) is JTT's lead on the project.

Thanks

N

Food Security Task Force Theme Research Findings - Annotated Outline template

Theme:

Insert - Please Identify which of the theme(s) (there can be overlap) that align to this subject / topic

Document / Article Title:

Insert

Author(s) / Organization:

insert

Link to full article:

insert

Summary:

- Please provide a brief summary of the subject / topic (3 bullets max.)

Linkages to the FSTF mandate:

- *Please identify linkages / relation to the FSTF mandate (i.e. why they should consider this topic) and why it relates to BC's Agritech Sector*

Key Considerations / Findings

- *A high-level overview of the key points to the subject / topic. Please include any:*
 - *preliminary analysis*
 - *policy questions*
 - *gap analysis*
 - *highlight any direct BC examples / related initiatives, programs, etc.*
 - *include metrics where possible (costs, data, estimates, etc.)*

Related Readings / Research:

If applicable, please provide any related articles / research if the FSTF might want a second opinion or perspective

Contact:

Name, Ministry, Contact

Food Security Task Force – Scoping

Food Security Definition:

Food security in the context of the Food Security Task Force (FSTF) means ensuring B.C.'s agriculture sector can retain its competitiveness and productivity in the face of challenges such as climate change, resource scarcity (e.g., water), growing market competition from other jurisdictions and a tight labour market. Food security also means that the agricultural sector can produce enough high-quality food to supply local demand while also growing the sector's export capacity to help diversify B.C.'s GDP and support economic development. The FSTF will look at the following food security strategies:

- Applying technology and innovation to the agricultural sector in ways that improve efficiency and reduce waste and consider other expensive or damaging environmental inputs.
- Developing the talent needed to advance, drive and implement innovations in the agriculture sector.
- Identifying other barriers (e.g., policy, legislative etc.) that may be negatively impacting sector growth as well as considering approaches and best practices in other jurisdictions that have advanced food security.

Issue:

To support the development of recommendations to the Minister of Agriculture (AGRI) and the Minister of Jobs, Trade and Technology (JTT) to grow the BC AgriTech sector into a stand-alone economic, globally competitive sector, ***a broad range of information-gathering and research is required.***

This work will be accomplished through: public engagement; targeted engagement with key sector and business stakeholders; field studies to leading-edge jurisdictions; and in-depth research and analysis on related topics.

The FSTF has identified several key themes they will consider throughout their process and have requested research “packages” with:

- related readings
- research papers
- annotated summaries of readings / research findings

This work will be divided between the PO, JTT and AGRI. A template will be used to ensure consistency in information format and content.

Theme	Ministry and key lead	Details	Examples
Labour Market	JTT Lead: Nathan to identify	- Focus on creation of quality, high-paid jobs within the tech sector	- BC’s Labour Market Outlook, https://www.workbc.ca/getmedia/1dce90f9-f2f9-4eca-b9e5-c19de9598f32/BC_Labour_Market_Outlook_2018_English.pdf.aspx - BCBC labour paper: https://bccbc.com/reports-and-research/strong-b-c-job-market-leads-to-significant-wage-gains-in-2018
Consumer Demands	PO Lead: Allison Witter	- Increasing standards of living, changing consumer habits, shifting into local / higher quality / niche foods (e.g. plant-based proteins)	- TBC
Academic programming	JTT Lead: Nathan to identify	- Key jurisdictions: Key jurisdictions: BC institutions, University of Guelph, UC Davis, Wageningen University and Research	- VIU Aquaculture programming - UBC Faculty of Food and Land Systems: https://www.landfood.ubc.ca/

Theme	Ministry and key lead	Details	Examples
		<ul style="list-style-type: none"> - Identify existing programs in BC, cross-reference with well established in other jurisdictions and offer preliminary gap analysis 	
R&D / Role of Industry	AGRI Lead: Julia	<ul style="list-style-type: none"> - looking for other routes other than direct capital investment from gov't—e.g. incentive programs for industry 	<ul style="list-style-type: none"> - TBD
Sustainability	AGRI Lead: Brooke to identify	<ul style="list-style-type: none"> - shift to more sustainable products / processes to address CleanBC targets (GHG emission reduction) - feeding growing populations with limited resources (land/water base) 	<ul style="list-style-type: none"> - CleanBC - Leading-edge climate adaptation programming
Competitiveness	JTT / AGRI Lead: Nathan / Brooke to identify	<ul style="list-style-type: none"> - increasing demand of BC goods and technology solutions, IP revenues, competitive wages to retain skilled labour 	<ul style="list-style-type: none"> - BCBC wages report: https://bcbc.com/reports-and-research/strong-b-c-job-market-leads-to-significant-wage-gains-in-2018 - BCBC Competitiveness report: https://bcbc.com/reports-and-research/budget-2019-delivers-some-promising-program-spending-but-little-to-address-b-c-s-deteriorating-competitiveness
Economic Growth	JTT Lead: Nathan to identify	<ul style="list-style-type: none"> - maintain/grow/diversify jobs in the sector, consumer demand, livelihood of farmers/industry, retain labour 	<ul style="list-style-type: none"> - Advisory Council on Economic Growth's Unleashing the Potential of Key Sectors report https://www.budget.gc.ca/aceg-ccce/pdf/key-sectors-secteurs-cles-eng.pdf
FPT Priorities re: agriculture / food processing, tech and innovation	AGRI Lead: Brooke to identify	<ul style="list-style-type: none"> - increasing government focus on supporting technology and innovation through targeted investments (e.g., federal Strategic Innovation Fund) 	<ul style="list-style-type: none"> - Strategic Innovation Fund \$30M to Canadian Food Innovators to support automation and digital tech for food processing https://www.ic.gc.ca/eic/site/125.nsf/eng/00031.html - Western Economic Development funding?

Page 08 of 43

Withheld pursuant to/removed as

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Food Security Task Force - Key Themes

From: Munro, Mica JTT:EX <Mica.Munro@gov.bc.ca>, Munro, Mica MAH:EX <Mica.Munro@gov.bc.ca>
To: Fast, Christine JTT:EX <Christine.Fast@gov.bc.ca>, Woods, Matthew JTT:EX <Matthew.Woods@gov.bc.ca>, Fast, Christine SDPR:EX, Woods, Matthew JERI:EX
Cc: Smith, Siobian JTT:EX <Siobian.Smith@gov.bc.ca>, Cowden, Samantha JTT:EX <Samantha.Cowden@gov.bc.ca>, Smith, Siobian JERI:EX, Cowden, Samantha JERI:EX
Attachments: Food Security Task Force Proposed Key Themes - July 26.docx, FSTF Themes Research Work plan.docx, FSTF Theme Research Annotated Summary Template.docx

Hi all,

Thanks again for your support on this research we are doing for the Food Security Task Force (FSTF) to support the development of their recommendation report to government due Dec 31. This is pretty interesting area of work and has direct linkages to some of the work that you are doing here at JTT.

In advance of our meeting tomorrow, I wanted to share a few documents *(some of you might have already seen these):

1. A list of identified themes the TF has proposed as focus areas for challenges / opportunities in growing the BC agritech sector – these will directly related to their recommendations in the report
2. A work plan for dividing the themes amongst the Secretariat ministries (JTT and AGRI), however there is opportunity to contribute to any theme if you have a good linkage.
3. A template for summarizing key content and/or findings from research papers, documents, strategies, etc.

The intention of this work is it build theme “research packages” for the TF to review and reflect when considering the key barriers to the BC agritech sector, and then proposing solutions. Another key element is using other jurisdictions (e.g. California, Guelph, Netherlands, etc.) as a case study to refer to when considering how to grow the sector.

I can give a brief overview of the attached and answer any questions you might have.

Talk more tomorrow, I have booked a boardroom over at 800 J for those who are located there
MM

Mica Munro | Project Director | Strategic Investment Office | Ministry of Jobs, Trade, and Technology |
Mica.Munro@gov.bc.ca | 250-216-0373 |

Acknowledging the Esquimalt and Songhees Nations, the traditional keepers of the land on which I work and live.

RE: Research FSTF

From: Lauzon, Nicole JTT:EX <Nicole.Lauzon@gov.bc.ca>, Lauzon, Nicole AFF:EX <Nicole.Lauzon@gov.bc.ca>
To: Diamond, Julia AGRI:EX <Julia.Diamond@gov.bc.ca>, Hayes, Brooke AGRI:EX <Brooke.Hayes@gov.bc.ca>, Munro, Mica JTT:EX <Mica.Munro@gov.bc.ca>, Nankivell, Nathan JTT:EX <Nathan.Nankivell@gov.bc.ca>, Hold - 200514 - Diamond, Julia AFF:EX, Hold - 201016 - Hayes, Brooke AFF:EX, Munro, Mica MAH:EX, Nankivell, Nathan JERI:EX
Cc: Smith, Siobian JTT:EX <Siobian.Smith@gov.bc.ca>, Cowden, Samantha JTT:EX <Samantha.Cowden@gov.bc.ca>, Lewthwaite, Jennifer JTT:EX <Jennifer.Lewthwaite@gov.bc.ca>, Smith, Siobian JERI:EX, Cowden, Samantha JERI:EX
Attachments: Food security and agrobiotechnology in British Columbia.docx

Hi all,

Julia, as per our conversation I've included a breakdown of my overview. For my own purposes this includes an overview of BC's agrifood sector in order to narrow my focus, and as per Nathan's request, I have included a description of CRISPR technology and genome editing applications applicable to BC. The literature surrounding gene edited crops and global acceptance of these technologies for products designed human consumption led me to include a description of the global regulatory framework and the implications for producing gene edited crops in BC.

This is not an exhaustive list and I'm open to feedback about topics and direction. I'll also include research surrounding the topics and projects mentioned from AGRI and look forward to seeing those descriptions.

I've just connected with Sam and will add my sources to the templates provided.

Looking forward to the next steps.

Thanks,
-Nicole

From: Diamond, Julia AGRI:EX
Sent: August 16, 2019 3:50 PM
To: Hayes, Brooke AGRI:EX <Brooke.Hayes@gov.bc.ca>; Munro, Mica JTT:EX <Mica.Munro@gov.bc.ca>; Nankivell, Nathan JTT:EX <Nathan.Nankivell@gov.bc.ca>; Lauzon, Nicole JTT:EX <Nicole.Lauzon@gov.bc.ca>
Cc: Smith, Siobian JTT:EX <Siobian.Smith@gov.bc.ca>; Cowden, Samantha JTT:EX <Samantha.Cowden@gov.bc.ca>; Lewthwaite, Jennifer JTT:EX <Jennifer.Lewthwaite@gov.bc.ca>
Subject: RE: Research FSTF

Hi all, the Task Force will be meeting with Genome BC on Aug 27th. Nicole, is there anything (based on your research) that might be able to be shared with the task force and/or Genome BC in advance of the meeting? Thank you.

Cheers,
Julia
250-208-9909

From: Hayes, Brooke AGRI:EX
Sent: August 15, 2019 11:33 AM
To: Munro, Mica JTT:EX <Mica.Munro@gov.bc.ca>; Nankivell, Nathan JTT:EX <Nathan.Nankivell@gov.bc.ca>; Diamond, Julia AGRI:EX <Julia.Diamond@gov.bc.ca>; Lauzon, Nicole JTT:EX <Nicole.Lauzon@gov.bc.ca>
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Subject: RE: Research FSTF

OK good to know. There are some genomics people inside AGRI as well... let me know if you would like us to make introductions.

E. Brooke Hayes
Ph: 778 698-2243 | Cell: 250-880-1225

From: Munro, Mica JTT:EX
Sent: August 15, 2019 10:52 AM
To: Nankivell, Nathan JTT:EX <Nathan.Nankivell@gov.bc.ca>; Diamond, Julia AGRI:EX <Julia.Diamond@gov.bc.ca>; Lauzon, Nicole JTT:EX <Nicole.Lauzon@gov.bc.ca>
Cc: Hayes, Brooke AGRI:EX <Brooke.Hayes@gov.bc.ca>; Smith, Siobian JTT:EX <Siobian.Smith@gov.bc.ca>; Cowden, Samantha JTT:EX <Samantha.Cowden@gov.bc.ca>; Lewthwaite, Jennifer JTT:EX <Jennifer.Lewthwaite@gov.bc.ca>
Subject: RE: Research FSTF

Sure - that makes sense.

s.13

From: Nankivell, Nathan JTT:EX
Sent: August 15, 2019 10:01 AM
To: Munro, Mica JTT:EX <Mica.Munro@gov.bc.ca>; Diamond, Julia AGRI:EX <Julia.Diamond@gov.bc.ca>; Lauzon, Nicole JTT:EX <Nicole.Lauzon@gov.bc.ca>
Cc: Hayes, Brooke AGRI:EX <Brooke.Hayes@gov.bc.ca>; Smith, Siobian JTT:EX <Siobian.Smith@gov.bc.ca>; Cowden, Samantha JTT:EX <Samantha.Cowden@gov.bc.ca>; Lewthwaite, Jennifer JTT:EX <Jennifer.Lewthwaite@gov.bc.ca>
Subject: Research FSTF

Hi Both,

FYI that I've asked Nicole from our team to do a bit of a dive into the questions surrounding genomics and agriculture. She has a super strong background in life sciences s.22 and is pulling together some interesting articles. I think it has a lot of relevance to potential export markets as well the

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this area.

Thanks

N

Anyways, just wanted to let you know in case the TF is looking for specific info/ analysis in

Food security and agribiotechnology in British Columbia

British Columbia's Agrifood sector – (Genome BC, 2018; McConnachie et. al, 2019; Ma, 2018)

4.6 M people in BC are food insecure

BC's Agrifood sector: consists of primary agricultural production and food and beverage manufacturing.

- 56,000 jobs in agrifood; 20,000 farms on 2.6 M hectares;
- 200+ agricultural products;
- \$3.0 B to the provincial GDP in 2015;
- 2,500+ food and beverage manufacturing establishments – generate \$9 B 2015;
- BC farms – largest producers by tonnage of fruit in Canada; 2nd largest greenhouse vegetables.
- F&B manufacturing - 2nd largest manufacturing sector in the province in sales in GDP.
- Agrifood and seafood revenues have grown to \$13 B in 2015;
- **B.C. Agrifood and Seafood Strategic Growth Plan** forecast the growth to \$15 B by 2020
- Non-seafood agriculture and food and beverage processing components are growing annually
 - Edible crops: fruit, berries, vegetables grain
 - Livestock products: dairy, beef, pork, poultry, eggs, honey
 - Value-added products: wines, pet foods
 - Non-edibles: flowers, nursery plants, cosmetics, textiles, and nutraceuticals
- BC is 2nd largest province by land mass; 4% of the total arable land base in Canada.
- 925,000 Km² land area – less than 5% is suitable for crops and horticulture production
 - 30% If range land for livestock production is included

BC Agrifood Exports:

- \$3.5 B in agriculture and agrifood products exported from BC to 149 markets
- US most important export market receiving **72% share**
- China, Japan, Hong Kon, South Korea = 20%
- Top exports:
 - Food preparations for food manufacturing (\$294 M)
 - Baked goods and cereal products (\$230 M)
 - Blueberries (\$218 M)
 - Mushrooms (\$131 M)
 - Water, Fruit and vegetable juice, wine, beer, cider

Need to increase access to new markets:

- EU: 28-member states; population of 510 M people; nominal GDP of \$16.77 T US.
 - Canada-European Union Comprehensive Economic and Trade Agreement (CETA)
 - 10 countries; 495 M people; combined economic output of \$13.5 T US (excluding the US).
- s.13
- Expand markets in Japan; emerging markets in Asia and Pacific Rim
- s.13

Contact: Nicole Lauzon, JTT – IITD, s.22

Agrifood sector challenges:

Several challenges exist in for BC's agrifood sector:

- Climate change
- Environmental threats from invasive pests and pathogens
 - annual rate of crop yield increase has dropped by half compared with that during the green revolution because of emerging pathogens and rapidly changing environments
- External pressures and global competition - draughts and fires in external regions (i.e. California) put further pressure on food availability and prices
- Rising input costs to the food industry
- Labour shortages and changing demographics
 - Avg age of BC farmers 55.7 yrs
 - Need more labour training
 - Need for seasonal agricultural workers and temporary foreign workers
- Growing world population: 2.4 B additional middle-class consumers by 2030; mostly in Asia-Pacific region.
- Rising incomes: increase caloric intake (milk and meat).
- Changing consumer demands
- Less land and water for food production
 - Agricultural Land Reserve – 50% of protected farmland is not in production
 - Rise in ALR farmland prices
- **Need to diversify and adopt innovative technologies to remain competitive**

Genomics and agrifoods:

Genomic tools can be useful in providing cost effective, innovative and solutions and reduce costs. These technologies:

- Ensure productive plant/livestock agriculture and food manufacturing;
- Allow for access to new markets through the development of new value-add manufactured food products;
- Novel plant varieties capable of resisting pathogens or adapting to climate change;
- Help protect ecosystems from agricultural impacts;
- Improve soil, water and air quality and biodiversity;
- Affect health of important microorganisms, plants, animals and human health;
- Improve decision-making tools for effective monitoring, assessment, and management;
- Develop more rapid tests for timely, sensitive and accurate diagnosis of foreign, new and emerging plant and animal diseases and pests;

Examples of genomic tools available for the agrifood industry and their uses in BC:**Genomic selection (GS):**

Examples of genome editing for animal production (McConnachi et al., 2019; Genome BC, 2018; Ishii, 2018; Es et al. 2019):

Genetic modification of farm animals has not been well accepted by the public; genome editing has been used successfully to reduce the environmental impact of agriculture, improve production, enhance meat quality and improve animal welfare. Some successes demonstrate the benefits of using these technologies:

Dairy production:

- Revolutionary and disruptive technology that has transformed dairy breeding around the world.
- Dairy breeding for milk production has been responsible for gains in milk production worldwide
 - Four-fold increase in the average production of milk produced in a cow's lifetime;
 - Commercial genomic test for bovine (Joint US/Canada research partnership)
- Since 2011 and the adoption of genomic testing, the use of genomic young bulls over proven sires for dairy breeding has grown to 70% of the total in 2016.
- Genetic gain for individual traits like milk, fat, protein yield has doubled in 5 yrs.

Cattle:

- Genetically dehorned cattle (*POLLED* cattle) - common in North America
- Disbudding or dehorning cattle is painful – dairy cattle are often subjected to the practice w/o anaesthetics.
- Angus beef have a natural variant in a gene called *POLLED* that causes hornlessness
- Able to spread the naturally occurring *POLLED* gene from beef cattle into the Holstein dairy cow genome using gene-editing technology (CRISPR: see below) and reproductive cloning to reproduce hornlessness
- s.13
- **UBC study** examining public attitudes toward genetically modified polled cattle eludes to the fact that public support of GM technologies increases with perceived benefits to animals.

Fish:

- **Canada** was the first country to develop a genetically engineered Atlantic salmon which grows almost twice as fast – a product from Aqua Bounty (US) – approved for sale in Canada.

Genome editing for other uses:**Pathogens in foodborne outbreaks:**

- Use whole genome sequencing (WSG) to identify outbreak organisms
- DNA fingerprint for bacterial isolates – compare to similar patterns in patient samples, contaminated food, environments (food production)
- Foodborne illness and outbreak investigations:

Contact: Nicole Lauzon, JTT – IITD,^{s.22}

- Centres for Disease Control and Prevention (CDC) – using WGS for *Salmonella*, *Campylobacter*, Shiga toxin-producing *E. coli*
- Canadian Food Inspection Agency (CFIA) and **BC Centre for Disease Control** – developing WSG approaches in Canada.

Precision agriculture (Genome BC, 2018):

The future of agriculture lies in developing more efficient systems and tailored crop varieties that are more efficiently grown for BC's adapting climate. Technologies can be used to address the following:

- Develop crop varieties suitable to specific environments.
- Develop innovative sensors that collect vast amounts of plant phenotypic (trait) data:
 - nitrate and other nutrient absorption and utilization
 - water transpiration from leaves
 - plant growth rates
 - measure soil nutrients, temperature, humidity and light
- Sensors in greenhouses or data collected from satellites and drones to support and accelerate breeding programs;
- 'Wearable devices' for plants and animals
- Sensors used to monitor food intake and measure feed efficiency in livestock breeding – manage production costs and reducing the environmental footprint of animal production systems.

Genomic selection for crops species:

When it comes to crop specific genome editing, there are options that will revolutionize crop selection and production systems, allowing for the ability to edit multiple traits with one system. Implementation of GS requires considerable genomic resource development and important investment in infrastructure and bioinformatic capabilities currently only available for more economically-important crops – e.g. Canola or wheat.

Previous technologies ('90s) generated crops by adding a gene from a different species (transgene) = GMO (e.g.):

- Herbicide tolerance (glyphosate – Roundup Ready) in soybean, canola
- Insect resistance (*Bacillus thuringiensis*) insecticidal gene in corn and cotton

Genome Editing-Aided Crop Optimization (GET-A-CROP) Strategies:

- These strategies are based on using sequence specific nucleases (SSNs); three options when applying the technology
 - Zinc finger nucleases
 - Transcription Activator-Like Effector Nucleases (TALEN)
 - Clustered Regularly Interspaced Palindromic Repeats (**CRISPR**)-associated system (Cas)
- Mimic mechanism discovered in nature to introduce targeted mutations into crops.
- In vivo, SSNs create double-strand breaks to trigger the endogenous non-homologous end joining (NHEJ) or homology-directed repair (HDR) pathways

CRISPR-Cas systems:

Genome editing as a novel, elegant and transgene-free way to improve and accelerate crop breeding. The CRISPR-Cas genome editing technology can be used for a variety of techniques and applications (Ishii, 2018; Es et al. 2019; Ma, 2018):

- Reduced costs
- More efficient - genetic modifications in many species by directly introducing bacterial DNA-cutting enzymes (nucleases) into cells
- Broad spectrum of targets for SSNs
 - Gene coding sequences
 - Regulatory elements
 - Epigenetic modifications
- NHEJ pathway: Can induce insertion-deletions (indels) leading to frameshift mutations in coding areas or fragment deletion
- HDR pathway: Can introduce new DNA sequences based on foreign DNA templates
- When combined w/ another activation, repression or modification domain, SSNs can be applied to regulate gene expression or to modify epigenetic loci
- SSNs can be excluded from the target genome by transient expression or segregation during meiosis
- Precluding unexpected consequences caused by the random insertion of SSNs into the genome in subsequent generations

Direct genome editing in crop plants –

- Improve crop yield, tolerance to biotic and abiotic stress and increasing nutrient contents.
- Engineering plant disease resistance
- Improve food quality
- Tissue-culture-free genome editing w/ CRISPR/Cas9 in germline cells
- Tissue-culture-dependent genome engineering
- High-efficiency targeted mutagenesis
- Functional genomics experiments
- Possibility to use a prokaryotic vector to deliver CRISPR/Cas machinery to plant cells

Current examples:

- BC has produced a non-browning Arctic apple sp. from Okanagan Specialty Fruits using gene silencing; Granny Smith and Golden Delicious varieties have been approved (2015)

BC Research: *The UBC Center for Sustainable Food Systems' Farm Joint Value Chain and Social Innovation Working Group* – s.13

Challenges/Bottleneck:

With the rapid advances in phenotyping and the identification of many trait-specific genes, there remains a few challenges to be addressed:

- Bottleneck in research has shifted to the validation and functional analysis of these candidate factors

Contact: Nicole Lauzon, JTT – IITD,^{s.22}

- Many promising candidate genes are not followed up on nor validated
- s.13
- Genome editing = cost-saving opportunities; testing variability in gene function on a population level;
- This strategy could minimize the dependency on a shrinking list of major crops associated w/ nutrient deficiency, limited genetic diversity and lower crop resilience;
- Accelerate the rate of bringing healthier orphan crops to the consumer;
- Crop optimization strategies based on genome editing can aid classical breeding strategies, work on genes related to yield, stress tolerance, nutrition etc.
- Editing multiple genes in parallel – alteration of more complex traits.

Other Applications for CRISPR-editing and food security:

- Fermentation – e.g. Lactobacillus sp. – improve their resistance against stress conditions and increase the productivity of the fermentation process.
- Engineering microbial consortia
- Potent and programmable antimicrobials
- Designing vaccination of microorganisms against invasive genetic elements
- Controlling gene expression in inducible and reversible manner

CRISPR-edited crops:

In general, CRISPR as a technology for agricultural food security issues is complicated and can't be considered without the considerations of how the global community regulates GMOs, and whether they classify and regulate CRISPR-associated agricultural products under the GMO regulations.

- Definitions of GM crops varies
- Many countries have adopted a precautionary approach to gene-edited crops and regulate agricultural biotechnology differently.
- The environmental impact and safety of consumption of transgenes derived from other species are generally the main points of debate in the context of GM crops.
- Consensus in the scientific literature is that there are no dangers associated with GM crops when it comes to consumption. Approx. 25 yrs. since the first GMO was approved for food consumption.
- European discussion and the role of multinationals dominates this debate.
- Many consumers have a negative attitude towards GM crops
- Due to:
 - lack of trust in developers and/or regulators
 - Poor risk-benefit communication
 - Low science literacy
 - Ethical values
- Issue:
 - Off-target mutations unintentionally created by artificial nucleases are **not always investigated**.
 - **No consensus** about the assessment methodology.

- DEFINITION: Genetically modified Organism (GMO) = an organism to which genes of known function are transferred, which are integrated into RANDOM locations along the chromosome
- DEFINITION: Genetically edited organism = organism that is inserted w/ specific alterations of gene functions target in PRECISE locations of the genome to silence or improve its expression - avoiding non-specific random changes.

CRISPR and Genome editing regulatory frameworks and intellectual property (Ishii, 2018):

When developing a framework surrounding food security^{s.13}

s.13

Regulatory Framework:

- Since 1992 – **Principle 15 of the Rio Declaration** on environment and development has been influencing global approach to public policy pertaining to GMOs.
- **Principle 15 states:** ‘In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.’
- This has led to the Precautionary Approach
- **EU Directive 2001/18EC** (GMO regulation) adopted the ‘precautionary principle’
- EU - GMOs are classified based on the way by which the alterations have occurred
 - CRISPR/Cas included in this classification
 - recent ruling by the European Court of Justice (ECJ) includes CRISPR-edited crops within the GMO category.
- **Cartagena Protocol on Biosafety (CPB) to the Convention on Biological Diversity** (United Nations Environment Programme):
- <http://bch.cbd.int/protocol>
 - International treaty adopted in 2000; entered into force in 2003
 - Adopted the precautionary approach to ensure the safe use of living modified organisms (LMO) – the legal technical term equivalent to GMO.
 - Objective: ‘to contribute to ensuring an adequate level of protection in the field of the safe transfer, handling and use of living modified organisms resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity’
 - 171 countries ratified the CPB
 - LMO = ‘any living organism that possesses a novel combination of genetic material obtained using modern biotechnology’
 - Modern biotechnology = ‘the application of *In Vitro* nucleic acid techniques, including recombinant deoxyribonucleic acid (DNA) and direct injection of nucleic acid into cells or organelles
 - **Canada** and **USA** have **NOT** ratified the CPB

Canadian regulations:**(Health Canada; Law Library of Congress)**

- Canada is the third largest producer of GMOs in the world
- Largest producer of GM canola oil and other crops including maize, soybean and beet
- 1993 – Federal Regulatory Framework for Biotechnology; rather than creating new regulations, novel products produced through biotechnology will be regulated under existing regulations that cover traditional products
- all foods that are genetically modified, including conventional breeding, are considered “new foods”
- New foods require notification to the Health Department of Canada before marketing.
- Complete safety assessment is then required
- GMOs used either as food or animal feed must be approved before entering the market
- Regulations enforced by Health Canada for foods; the Canadian Food Inspection Agency (CFIA) for seeds and livestock (both locally produced and imported).
- GM or genetically engineered (GE) foods are primarily regulated by the **Novel Foods Regulation** under the **Food and Drug Act**
- Novel foods = products that have never been used as food, “...from a process that has not previously been used for food; or, foods that have been modified by genetic manipulation.” This last category of foods have been described as genetically modified foods (often referred to as GM foods, genetically engineered foods or biotechnology-derived foods).
- The CFIA “is responsible for regulating the environmental release of a plant with a novel trait (PNTs).” - the Plant Protection Act, Plant Protection Regulations, the Seeds Act and Seed Regulations (Part V)
- 2012 – 81+ GMO foods have been approved by CFIA.
- Review the PRODUCTS not the METHOD used to introduce the traits.

Global perspectives on GMO and GEO regulations (Ishii, 2018; Es et al. 2019):**USA:**

- has 3 agencies that regulate GMOs
- FDA - regulate genetically altered foods; regulated according to their components.
- USDA – regulate genetically modified plants and crops; regulate planting, transportation and importation. Plants edited with similar techniques are NOT considered to be regulated as GMOs. Recently allowed the cultivation and commercialization of CRISPR-edited mushrooms and waxy corn.
- EPA - regulation of microorganisms and pesticides developed with genetic engineering.
- American Association for the Advancement of Science (AAAS) - 88% of scientists consider genetically edited or modified foods safe for consumption (2015 - Pew Trust).

Argentina:

- Adopted a resolution in 2015 to exclude plants that are free of transgenes or foreign DNA from the product-based GMO regulations.

New Zealand:

- Amended its process-based GMO regulation to regulate plant gene-editing w/o introducing exogenous DNA

Korea:

- Define LMO and modern biotechnology similarly to the CPB
- Partly include the use of CRISPR/Cas9 ribonucleoprotein
- s.13

Japan:

- Differently defined GMO as 'an organism that possesses nucleic acid obtained through using modern biotechnology'
- Plants w/ an insertional mutation produced using CRISPR/Cas9 ribonucleoprotein can be subject to the law
- s.13

China:

- Ministerial regulation defines GMOs as plants and their products whose genomic structures have been modified by genetic engineering technologies for the use of DNA-free gene-editing for plant breeding is subject to regulation

Italy:

- Complies w/ EU Directive
- Defined GMO as 'an organism whose genetic material has been altered in a way that does not occur in nature'

CRISPR Global Market:

(Es et al. 2019)

- funding involving CRISPR system supported by the US National Institutes of Health (NIH) – recent sharp increase
- 25% of the total biochemical research companies w/ CRISPR are focused on the use of this technology in plants, influencing agriculture to obtain more sustainable crops
- Caribou Bioscience – (2011) \$11 M to focus on CRISPR & agriculture; (2015) signed and agreement w/ DuPont – to improve agricultural production and food security
- Bayer (2016) – efforts to obtain exclusive rights for the use of CRISPR in agriculture.
- Monsanto/Harvard/Broad Institute of MIT (2017) - CRISPR/Cpf1 - greater efficiency in insertion, less off-target activity and smaller size
- BASF (2017) – agreement w/ 2 institutions to investigate the use of CRISPR-Cas in agriculture.
- Arcadia Biosciences and Syngenta (2017) – obtained licences for CRISPR-Cas research in the field of agriculture.
- Monsanto (2018) – paired w/ Pairwise Plants – improve wheat, corn, cinnamon, cotton, soybean crops.
 - 100\$ M investment w/ option to commercialize products
- CHINA - second behind the US in CRISPR patent application
 - Public research organizations and universities have stronger patents than private industry in China

Contact: Nicole Lauzon, JTT – IITD,^{s.22}

- Worldwide there are 2052 registered patents related to CRISPR, with **344 registered in Canada**, and 1239 in the US.

RE: FSTF Research Theme packages

From: Doyle, Rosabelle JTT:EX <Rosabelle.Doyle@gov.bc.ca>, Doyle, Rosabelle JERI:EX <Rosabelle.Doyle@gov.bc.ca>
To: Smith, Siobian JTT:EX <Siobian.Smith@gov.bc.ca>, Smith, Siobian JERI:EX
Attachments: Global value chains and agriculture policy brief.docx, Canada's Competitiveness Scorecard.docx, British Columbia Manufacturing Export Review.docx, Making trade work for the environment, prosperity and resilience.docx, Global Agritech Sector Research Summary.docx, Taking Canada's Agricultural Trade to the Next Level.docx, B.C. Export Trends over the past decade.docx, Agricultural trade policy brief.docx

Hi Mica,

I just realized my emails were getting stuck in my inbox all morning. My apologies for the delay. Please see attached. The last two were drafted by Dara.

Please note that we have pulled out the "Sector Action Plan 18-19 – Agritech – Oct 2018 – final" from the list of articles since this is an internal document to our division.

Regards,

Rosabelle Doyle
Trade Readiness and Services Manager, ICT and Wireless
International Trade Division
T: 604 775.2184

From: Smith, Siobian JTT:EX
Sent: September 4, 2019 10:00 PM
To: Doyle, Rosabelle JTT:EX <Rosabelle.Doyle@gov.bc.ca>
Subject: FW: FSTF Research Theme packages

Can you reply with your email to Mica on this, then I can share with Tracy as requested....thanks!

From: McKenzie, Dara JTT:EX
Sent: August 30, 2019 4:31 PM
To: Munro, Mica JTT:EX <Mica.Munro@gov.bc.ca>
Cc: Smith, Siobian JTT:EX <Siobian.Smith@gov.bc.ca>; Doyle, Rosabelle JTT:EX <Rosabelle.Doyle@gov.bc.ca>
Subject: RE: FSTF Research Theme packages

Hi Mica – Attached are several of our annotated sources.

Several more will be sent over to you on Tuesday by Rosabelle, who worked together with me on these.

s.22
steps.

regarding any next

Dara

From: Munro, Mica JTT:EX
Sent: August 27, 2019 10:12 AM
To: Smith, Siobian JTT:EX <Siobian.Smith@gov.bc.ca>
Cc: McKenzie, Dara JTT:EX <Dara.McKenzie@gov.bc.ca>
Subject: Re: FSTF Research Theme packages

Sorry, I didn't properly answer your question - phone email can be so non-user friendly!

Next week is meant to be a touch point.

Dara - If anything, are you able to share what you have ^{s.22}

Siobian - unless you have been involved in the completion of templates, don't worry about attending the call.

Sent from my iPhone

On Aug 26, 2019, at 8:48 PM, Smith, Siobian JTT:EX <Siobian.Smith@gov.bc.ca> wrote:

Do you know if this will be just a check in? I am not sure what the expectations would be.

-----Original Appointment-----

From: McKenzie, Dara JTT:EX **On Behalf Of** Munro, Mica JTT:EX

Sent: August 26, 2019 4:54 PM

To: Smith, Siobian JTT:EX

Subject: FW: FSTF Research Theme packages

When: September 4, 2019 11:00 AM-11:30 AM (UTC-08:00) Pacific Time (US & Canada).

Where: MAH 800 J 512 Brd, (8) MAH:EX

Hi Siobian – the Food Security Task Force will meet ^{s.22}

Would somebody on our team be available to attend this meeting, or shall I just follow up and resume this work when I return?

Thank you,

Dara

-----Original Appointment-----

From: Munro, Mica JTT:EX

Sent: August 21, 2019 10:05 AM

To: Munro, Mica JTT:EX; Doyle, Rosabelle JTT:EX; Woods, Matthew JTT:EX; McKenzie, Dara JTT:EX; Cowden, Samantha JTT:EX

Cc: Lauzon, Nicole JTT:EX

Subject: FSTF Research Theme packages

When: September 4, 2019 11:00 AM-11:30 AM (UTC-08:00) Pacific Time (US & Canada).

Where: MAH 800 J 512 Brd, (8) MAH:EX

Hi all,

I am moving this to the first week of September... just as a touch base to see how things are going.

Samantha / Dara - if you are able to send me a filled out template or two, I can give feedback on level of detail, etc.

Thanks again for your help on this one!

Cheers,

Mica

Food Security Task Force Theme Research Findings - Annotated Outline template

Theme:

Competitiveness, Economic Growth

Document / Article Title:

Global value chains and agriculture

Author(s) / Organization:

OECD

Link to full article:

<http://www.oecd.org/agriculture/topics/global-value-chains-and-agriculture/>

Summary:

- For agriculture and food sectors, participation in agro-food value chains helps enhance overall sector growth – improving the returns to farmers and food makers along the value chain. In particular, making use of inputs from other countries to produce agro-food products, and having access to foreign consumers through these chains, has helped to grow agro-food sectors and increase the share of gains flowing to farmers and producers.
- Differences across agro-food sectors around the world indicate that much of what determines the gains from agro-food global value chain participation relates to policy factors.

Linkages to the FSTF mandate:

- Among the food security strategies FSTF is looking at is identifying barriers that may be negatively impacting sector growth (#3), and that topic is covered in this policy brief.

Key Considerations / Findings

- Trade and investment policies are a key influence on GVC participation and domestic value added creation
- Non-tariff measures can similarly reduce participation and export earnings if they lead to frictions between trading partners.
- Enabling policies in agriculture are important.
- Agriculture policies that do not distort market decisions are also important for both GVC participation and domestic value added generation by agro-food exports.

Related Readings / Research:

Contact:

Dara Mckenzie, International Trade Division, JTT

Food Security Task Force Theme Research Findings - Annotated Outline template

Food Security Task Force Theme Research Findings - Annotated Outline template

Theme:

Competitiveness, Economic Growth

Document / Article Title:

Canada's Competitiveness Scorecard

Author(s) / Organization:

Deloitte

Link to full article:

<https://www2.deloitte.com/content/dam/Deloitte/ca/Documents/finance/ca-bcc-deloitte-scorecard-interactive-pdf-aoda-en-updated-final.pdf>

Summary:

- To understand how Canada compares and competes with its peers, Deloitte analyzed more than 500 data points across a set of 12 key countries: US, UK, Sweden, Italy, Mexico, Netherlands, South Korea, Germany, Australia, France, Spain, and Japan.
- With a broad lens, Deloitte assessed competitiveness in the following eight dimensions: talent, economic stability, capital and investments, customers, infrastructure, innovation, tax and regulation

Linkages to the FSTF mandate:

- This report looks at overall measures of competitiveness, many of which will be relevant to analyzing the competitiveness of BC's agricultural sector.

Key Considerations / Findings

- Talent: Canada's labour force is globally competitive
- Economic stability: Canada's macroeconomic stability underpins economic growth
- Capital and investments: weak investment continues to drag on productivity
 - Canadian businesses invest less than their peers - A key factor restraining Canadian business competitiveness is under-investment in productivity-enhancing machinery and equipment.
 - The pool of venture capital in Canada has improved in recent years, but challenges remain
- Customers: Canadian firms are losing global market share and private sector debt is climbing
 - Canadian firms are constrained by a small domestic economy, which is also fragmented by interprovincial trade barriers. Canada's economy is only 1.4 percent of the world economy. Accordingly, while taking maximum advantage of the domestic market, Canada's economic competitiveness is contingent upon businesses achieving success in global markets. Today, roughly 70 percent of Canadian goods and services exports are delivered to the United States. While this can be explained by geographic proximity and common market features, approximately 83 percent of global GDP is outside the

Food Security Task Force Theme Research Findings - Annotated Outline template

United States, suggesting Canada may be missing out on valuable opportunities in other markets.

- Infrastructure: the quality of infrastructure lowers Canada's competitiveness:
 - The perceived quality of Canada's general infrastructure reported in the Global Competitiveness Index is just below that of its peers on average and has decreased in recent years, reflecting of a lack of confidence in the Canadian business community about the efficacy, coverage, or accessibility of national infrastructure.
- Innovation: Canada has fallen behind its peers in its innovation performance
 - Despite successive attempts to stimulate innovation, the share of innovation-related activities has not increased in Canada's economy.
 - On a per-capita basis, Canada produces fewer patents than its peers
 - Canadian exports are less technology intensive compared to those of its peers
- Tax: The Canadian tax environment can be uncompetitive relative to the US
 - US corporate income tax cuts put Canada at a disadvantage
- Regulation: Canadian firms can encounter a higher regulatory burden than their peers
 - Canada's position on the World Bank's Doing Business report has fallen since 2006
 - Compared with its peers, Canada can be viewed as relatively restrictive toward foreign investment.
 - It takes 168 more days to obtain a permit for new construction in Canada than in the United States

Related Readings / Research:

Contact:

Dara Mckenzie, International Trade Division, JTT

Food Security Task Force Theme Research Findings - Annotated Outline template

Theme:

- *Consumer demands (global)*
- *Sustainability*
- *Competitiveness*
- *Economic growth*

Document / Article Title:

British Columbia Manufacturing Export Review (November 2018)

Author(s) / Organization:

R.A. Malatest & Associates Ltd.

Link to full article:

Please speak to Siobian Smith regarding full document.

Summary:

- *R.A. Malatest & Associates Ltd. ("Malatest") was contracted by the B.C. Ministry of Jobs, Trade and Technology to conduct mixed-methods research to support the development of a multi-year export growth strategy for the B.C. manufacturing sector.*
- *The findings of this research were detailed in an interim report and validated by industry and government representatives.*

Linkages to the FSTF mandate / Key Considerations / Findings:

- *In looking at **global demand trends**, it can be argued that this review's noted reasons for the growth of the manufacturing sectors since the Great Recession of 2009 in many global regions (North America, Asia, and Western Europe) could be the same for the potential growth of the agritech sector in the same regions. Some of the major growth drivers in global manufacturing include:*
 - *A growing middle class in Asia, particularly China and India;*
 - *Global moves towards clean energy and other sustainability initiatives;*
 - *Aging baby boomers in industrialized countries.*
- *The same can be argued for its findings on **global trends in manufacturing supply**. Manufacturing transformation, or the move to "Industry 4.0" (also referred to as the Industrial Internet of Things (IIoT), is reshaping manufacturing throughout the world. This transformation is not unique to the manufacturing sector. With the growing adoption of the Internet of Things (IoT), connected devices have penetrated every aspect of our life, from health and fitness, home automation, automotive and logistics, to smart cities, etc. Thus, it is only logical that IoT, connected devices, and automation would find its application in agriculture and, as such, tremendously improve many facets of the farming practice.*
 - *The review's findings on the major implications of this transformation for manufacturers can be applied to the agriculture sector.*
 - *Increasing automation of manufacturing processes;*

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- *Better integration and management of the supply chain, with more autonomous decision-making by computers controls systems;*
- *Greater flexibility in locating mass production operations;*
- *Greater flexibility in small-run and custom-designed manufactured solutions.*

Related Readings / Research:

<https://dzone.com/articles/iot-in-agriculture-five-technology-uses-for-smart>

Contact:

Rosabelle Doyle, Ministry of Jobs, Trade and Technology, Rosabelle.Doyle@gov.bc.ca

Food Security Task Force Theme Research Findings - Annotated Outline template

Theme:

Competitiveness, Economic Growth

Document / Article Title:

Making trade work for the environment, prosperity and resilience

Author(s) / Organization:

World Trade Organization and UN Environment

Link to full article:

https://www.wto.org/english/res_e/publications_e/unereport2018_e.pdf

Summary:

- This publication considers how international trade can support efforts to protect the environment, strengthen resilience to environmental risks and build prosperity
- This report looks at the links between the broader economy (of which trade is an integral part) and the environment. It does so by exploring the shifts in government policies and business models that are giving rise to trade opportunities to simultaneously boost the economy and protect the environment.
- The report also provides an overview of the many ways that trade interacts with the natural environment, and how trade can bolster efforts to make production and consumption more sustainable and economies more prosperous and resilient to environmental risks.

Linkages to the FSTF mandate:

- FSTF's definition of food security involves maintaining competitiveness in the face of climate change and resource scarcity – and this report looks at the role of international trade in supporting this type of resilience.

Key Considerations / Findings

- There is an important role for trade in helping countries to cushion the impact of climate change on the agricultural sector
- The role of trade in promoting the dissemination of environmental goods and services is closely related to its role in fostering innovation. Trade strengthens the incentives to innovate through its effects on the size of the market, competition and cross-border flows of knowledge. Access to a larger market for environmental goods and services, in particular, provides companies with an opportunity to reap higher profits from their innovations, thereby increasing their incentive to invest in research and development.
- Stringent and well-designed environmental policy can support countries' ability to compete in the expanding global green market – for example, by boosting domestic demand for innovative green solutions. Overall, however, the effects of environmental policy measures on exports – both positive and negative – have so far been found to be small compared with other factors, such as natural endowments, market size and degree of trade openness.

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Related Readings / Research:

Many related readings are listed at the end of this report.

Contact:

Dara Mckenzie, International Trade Division, JTT

Food Security Task Force Theme Research Findings - Annotated Outline template

Theme:

Competitiveness, Economic Growth

Document / Article Title:

Global Agritech Sector Research Summary: Recommendations for Growing British Columbia's Agritech Sector

Author(s) / Organization:

This research was completed by the B.C. Ministry of Jobs, Trade and Technology in collaboration with the B.C. Ministry of Agriculture.

Link to full article:

Internal document

Summary:

- s.13

-

-

Linkages to the FSTF mandate:

- s.13

Key Considerations / Findings

- Please contact for further information.

Related Readings / Research:

Contact:

Dara Mckenzie, International Trade Division, JTT

Food Security Task Force Theme Research Findings - Annotated Outline template

Theme:

Competitiveness, Economic Growth

Document / Article Title:

Taking Canada's Agricultural Trade to the Next Level

Author(s) / Organization:

Policy Options (published by the Institute for Research on Public Policy)

Link to full article:

<https://policyoptions.irpp.org/magazines/april-2017/taking-canadas-agricultural-trade-to-the-next-level/>

Summary:

- To increase agri-food exports significantly by 2025, the Canadian Federation of Agriculture suggests focusing on two immediate areas: expanding markets and streamlining regulations.

Linkages to the FSTF mandate:

- This report looks at ways to improve the competitiveness of Canada's agricultural sector and is therefore closely related to FSTF's mandate.

Key Considerations / Findings

- Removing barriers to competitiveness: Even when tariff barriers are been reduced or eliminated, non-tariff trade barriers often create major obstacles. Asymmetrical regulatory regimes can very quickly create a non-tariff trade barrier or create higher production costs, which result in insurmountable competitiveness issues.
 - One example of different regulations resulting in higher production costs is the difference between Canada's and the US's generic pesticide registration regulations. Canada is one of the most difficult countries in the world in which to register a lower cost, generic brand of crop protection product, which increases the cost of production for Canadian grain producers and lowers their competitiveness in international markets.
- Because of Canada's small market and its vast capacity for production, it is imperative that we increase our profitable market access around the world.
 - In trade negotiations and agreements, we must take a multi-faceted approach. A combination of access through lower tariff rates, harmonization of various regulatory regimes, and our own due diligence with regard to production, transportation and marketing costs, is needed, as the lack of success in these areas can severely hinder our competitiveness.

Related Readings / Research:

Contact

Dara McKenzie, International Trade Division, JTT

Food Security Task Force Theme Research Findings - Annotated Outline template

Theme:

Competitiveness, Economic Growth

Document / Article Title:

B.C. Export Trends Over the Past Decade

Author(s) / Organization:

Cecilia Liu, International Trade Division, JTT

Link to full article:

Internal document

Summary:

- This document covers B.C. export trends both overall and by market over the past 10 years (2008-2018)
- Includes an overview of export value figures for 'Agriculture and Food other than Fish' is for each market alongside other commodities.

Linkages to the FSTF mandate:

- Export trends to specific markets are relevant for understanding BC's global competitiveness and current state for this sector.

Key Considerations / Findings

- In the past decade, the composition of B.C.'s goods exports remained relatively constant. Measured by proportion of total export value, forestry exports remained at the top, accounting for 33% of total export value in 2018; this is followed by energy products, accounting for 24% of total exports in 2018, metallic mineral products, 12%, and machinery and equipment, 11%.
- B.C. is diversifying its export portfolio. In 2008, 53% of all B.C. exports were destined for the U.S., whereas in 2018, 49% were U.S.-bound. While still B.C.'s most major export partner, our reliance on the U.S. has decreased due to the province's strategic efforts to enter new markets in Asia. As a result from 2008 to 2018, value of exports to China has increased 187%, and proportionate share of exports to China increased 8 percentage points; value of exports to India has increased 829%, and proportionate share of exports to India increased 3 percentage points.
- From 2008 to 2018 (January-November for 2018), Agriculture and Fish has increased from 7% of BC's export value to 10% of its export value
- The top three categories of export increases to China since 2008 were Wood Products (488% increase), Energy Products (423% increase), and Agriculture & Food other than Fish (417% increase).
- The composition of B.C. exports to the U.S. has shifted from 2008 to 2018. Top commodity categories that decreased in exports were pulp and paper products (12% to 4%) and energy products (24% to 18%); top commodity categories that increased in exports included wood

Food Security Task Force Theme Research Findings - Annotated Outline template

products (20% to 26%), agriculture and food other than fish (6% to 10%), and metallic mineral products (5% to 8%).

Related Readings / Research:

Contact:

Dara Mckenzie, International Trade Division at JTT

Food Security Task Force Theme Research Findings - Annotated Outline template

Theme:

Competitiveness, Economic Growth

Document / Article Title:

Agricultural Trade

Author(s) / Organization:

OECD

Link to full article:

<http://www.oecd.org/agriculture/topics/agricultural-trade/>

Summary:

- Among the changes seen in agro-food markets, there has been a significant increase in trade among emerging and developing countries, which are increasing in importance, both as suppliers and markets for agro-food products.
- Increasing trade has also been accompanied by deeper integration of the world's food system.
- Trade and domestic support measures continue to constrain trade and further integration of agro-food markets

Linkages to the FSTF mandate:

- Among the food security strategies FSTF is looking at is identifying barriers that may be negatively impacting sector growth (#3), and that topic is covered in this policy brief.

Key Considerations / Findings

- Most countries continue to provide support and impose barriers through measures that distort trade and limit the benefits that international agro-food markets can deliver for consumers. These measures continue to have significant and negative effects on the welfare, resilience and food security of consumers and producers, as well as on agricultural sustainability, and also reduce agricultural and food trade volumes. While an objective of many trade and domestic support policies is to increase food production, there is little evidence that they achieve this goal: global agricultural and food production would be higher if distorting support was removed.
- New and closer linkages between agricultural and food sectors, and between these and other sectors of the economy, mean that the impacts of trade and domestic support measures are transmitted more widely. Globally, around 24% of agro-food export value comes from imported inputs: industrial inputs (machinery and fertiliser) and services, as well agriculture and food. Trade policies that act as barriers to imports directly reduce the competitiveness of a country's own agro-food exports by raising input costs.
- Other measures that affect the flow of agro-food products across borders can also reduce trade. Non-tariff measures (NTMs) – those related to laws, regulations and requirements such as sanitary and phyto-sanitary measures (SPS), technical barriers to trade (TBT) and customs procedures – can increase trade costs. Since agro-food products in GVCs may cross borders

Food Security Task Force Theme Research Findings - Annotated Outline template

multiple times before reaching final consumers, those trade costs can have significant ripple effects and are most problematic for smaller businesses.

Related Readings / Research:

Contact:

Dara Mckenzie, International Trade Division, JTT

Follow Up - BC Gov Support with Export Development

From: Bertrand, Francois JTT:EX <Francois.Bertrand@gov.bc.ca>, Bertrand, Francois
: EDUC:EX <Francois.Bertrand@gov.bc.ca>
To: Steve Slater <Steve.Slater@terramera.com>
Cc: Coyne, Alison G JTT:EX <Alison.Coyne@gov.bc.ca>, Bingham, Brittany JTT:EX
<Brittany.Bingham@gov.bc.ca>, Johnson, James JTT:EX
<James.Johnson@gov.bc.ca>, Bubrick, Sebastian JTT:EX
<Sebastian.Bubrick@gov.bc.ca>, Coyne, Alison G JERI:EX, Bingham, Brittany
JERI:EX, Johnson, James JERI:EX, Bubrick, Sebastian JERI:EX

Steve:

Nice to chat with you earlier this week.

As part of an overall drive to explore how provincial government can support Terramera in continuing to scale up, we discussed investigating how BC's network of trade and investment representatives overseas may assist in broadening the customer base for the Company's existing product line.

From reviewing my notes, I recall we had identified opportunities in at least 3 international markets, with some caveats as outlined below. Can you please have a look, confirm your interests and identify a contact we can work with to secure more information we can use to activate our network?

Thank you,
Francois

Markets (for complete list of offices, see weblink at bottom of table)	Key Considerations	Questions Requiring Attention
Europe	s.13	
India		
China		

Location of BC Trade and Investment Representatives Overseas
<https://www.britishcolumbia.ca/>

Francois Bertrand
Executive Director
Sector and Regulatory Competitiveness
Ministry of Jobs, Trade and Technology
Cell: 250-415-1970

MINISTRY OF JOBS, TRADE AND TECHNOLOGY
MEETING NOTE

Cliff #: 145625
Date: July 3, 2019

PREPARED FOR: Honourable Bruce Ralston, Minister of Jobs, Trade and Technology

DATE AND TIME OF MEETING: July 9, 11:00am – 12:30pm

ATTENDEES: Heather Hildebrant, Communications Specialist, Terramera

ISSUE: Tour of Terramera in Vancouver

BACKGROUND: Terramera is a Vancouver based Life Sciences company that develops plant based replacements to synthetic chemical pesticides. The company's unique and proprietary technology, Actigate™, makes organic inputs more efficient and delivers active ingredients directly into target cells. Terramera expands its scientific capabilities by using software, machine learning, and robotics that facilitate laboratory tasks, rapid phenotyping, and compound discovery.

Currently, Terramera has three products spanning agriculture, consumer, and professional markets:

- **RANGO**
Terramera develops high-performance, plant-based pest control and crop protection products with the goal of helping farmers grow affordable, clean food for everyone. Designed for broad-range control, Terramera's agricultural products provide farmers with sustainable solutions for the management of pests and diseases.
- **PROOF®**
Suite of innovative, plant-based total solutions for consumers. Products are 100% effective, US Environmental Protection Agency registered, and extensively lab-tested. They kill and control infestations from bed bugs, dust mites, and their eggs.
- **CIRKL®**
Plant-based, smarter, and safer way to kill bed bugs for professionals. Actigate™ Targeted Performance technology replaces the need for conventional chemical pesticides by delivering non-toxic modes of pesticide directly into cells, effectively killing bed bug adults, nymphs and eggs on contact.

DISCUSSION: BC is globally recognized for its diverse agricultural landscape, variety of commodities, thriving tech sector and strong research community. These competitive advantages have propelled emerging opportunities for the development, adoption and commercialization of agritech – the fusion of innovation and technology applied to the agriculture, agrifood and seafood sectors.

BC has a cluster of over 150 agritech companies, including in the areas of food processing, precision agriculture, bioproducts, food safety/traceability and soil/crop technology.

Terramera is a key player in this space and has significant potential to address production issues, climate change and labour challenges, while contributing to the sector's competitiveness, efficiency, sustainability and resilience.

BC is supporting the growth of the agritech sector, and companies like Terramera, through targeted initiatives, cost-shared funding such as the Canada/BC Agri-Innovation Program, and ongoing connections with major strategic agritech cluster areas.

Digital Technology Supercluster

Terramera is one of the founding members of the Supercluster. Steve Slater, VP Products Research and Development is on the Supercluster Board.

The Supercluster builds on a suite of BC's key competitive strengths and advantages and moves the province forward in addressing current and future challenges. The Supercluster is built with the goal to unlock the great potential of data in the era of the intelligent enterprise.

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1. *Computational Chemistry Platform for Crop Health (Technology Leadership Project)*
To advance Terramera's mission towards use of non-synthetic pesticides, this project will combine robotics, computer vision and machine learning to generate computational chemistry models built on genomics and combinatorial chemistry to predict formulations that kill specific fungi with a dramatic reduction of applied pesticide.
2. s.13

Terramera has received numerous accolades in recent years:

- In February of this year, Terramera was awarded The BC Life Sciences Company of the Year Award.
- The Company was named on the Global Cleantech Top 100 list in January 2019.
- One of Financial Post Innovation's Top 150 companies in November 2018.
- In October of 2018, Terramera received The Innovate BC Ignite Award of \$241,500.
- Global Cleantech Top 100 list in 2018.
- In January 2018, the company was named as one of THRIVE Top 50's Scaling Agtech companies.
- Won Best Innovation category at the 2018 Small Business BC Awards .

KEY MESSAGING:

- Terramera's contributions to the technological innovation and advancement of BC agritech sector are an excellent example of BC's world-class capacity and innovation.
- The Province values the role that Terramera plays in bringing unique and proprietary technologies to BC's life sciences and agritech sectors.
- The Province recognizes the unprecedented opportunity presented by Canada's Digital Technology Supercluster to BC's innovation ecosystem through public, private and academic partnerships and application of innovative technological solutions to foster better outcomes and demonstrate BC's leadership in sectors such as agritech.
- The Ministry looks forward to working alongside Terramera throughout their participation in the Digital Technology Supercluster.

ATTACHMENTS:

- Attachment A – Attendee Biographies

ADM Contact: Silas Brownsey, Investment, Innovation & Technology, 250 217-1683
Prepared by: Meghan Hilton, Research Coordinator, Planning and Innovation

Reviewed by			
Dir: N/A	ED: MD	ADM:	DM:

Attachment A – Attendee Biographies

Heather Hildebrant, Communications Specialist, Terramera

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