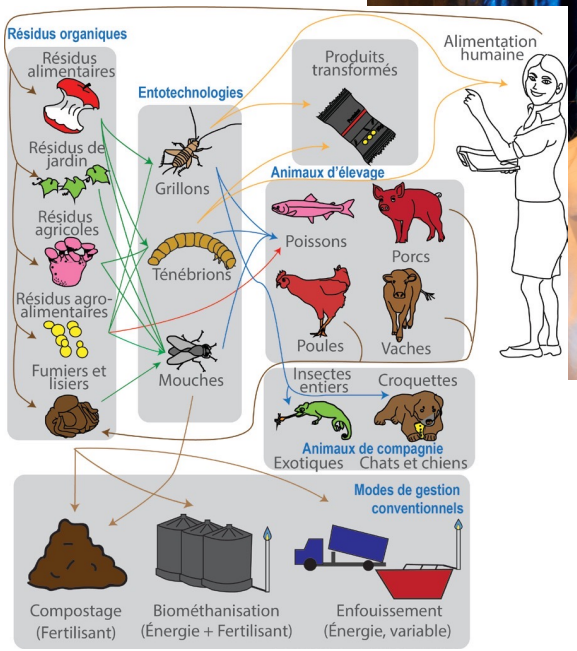
UNIVERSITÉ LAVAL

CHAIRE EN LEADERSHIP
EN ENSEIGNEMENT EN PRODUCTION
ET EN TRANSFORMATION PRIMAIRE
D'INSECTES COMESTIBLES

Faculté des sciences de l'agriculture
et de l'alimentation



Structuring initiatives on edible insects in Quebec.

Marie-Hélène Deschamps (PhD)

Assistant Professor
Dept. of Animal Sciences, Université Laval

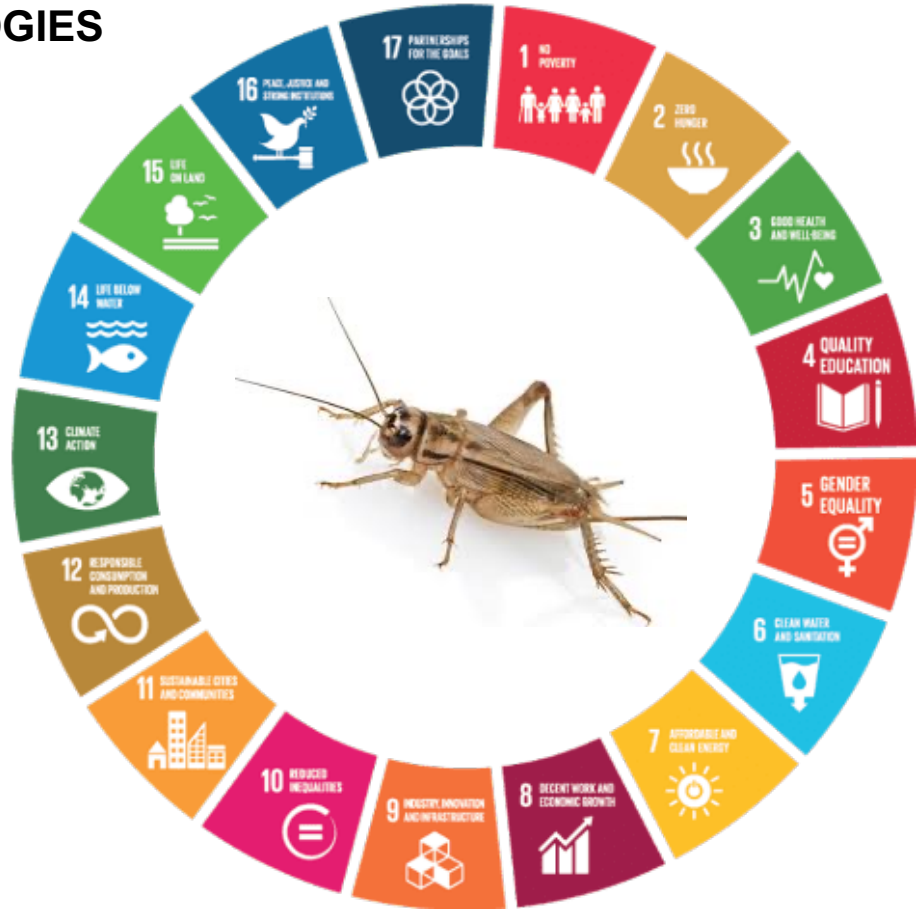
Leadership Chair in Edible Insect Production and Processing at Université Laval (CLEIC: https://cleic.fsaa.ulaval.ca).

President of the table filière des insectes comestibles du Québec (https://insectescomestibles.ca)

ENTOMOPHAGY & ENTO(MO)TECHNOLOGIES

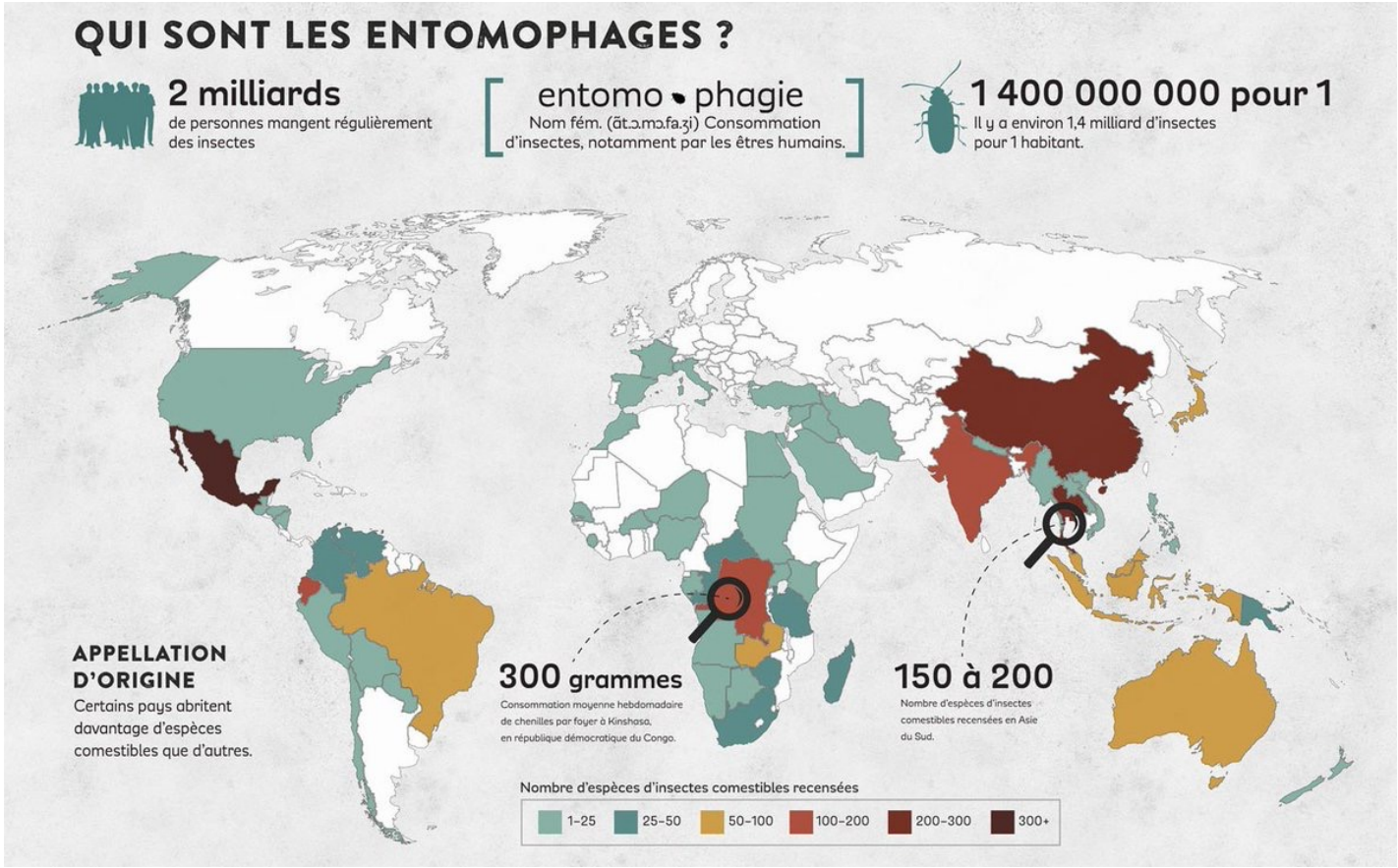
CONTRIBUTE DIRECTLY TO THE ACHIEVEMENT OF THE UNITED NATIONS (UN) SUSTAINABLE DEVELOPMENT TARGETS BY 2030.

01 - Fighting poverty
02 - Reduce hunger
03 - Improve health and well-being
06 - Clean water and sanitation
08 - Decent work and economic growth
12 - Responsible consumption and production
13 - Combating climate change
14 - Preservation of aquatic life
15 - Preservation of terrestrial life

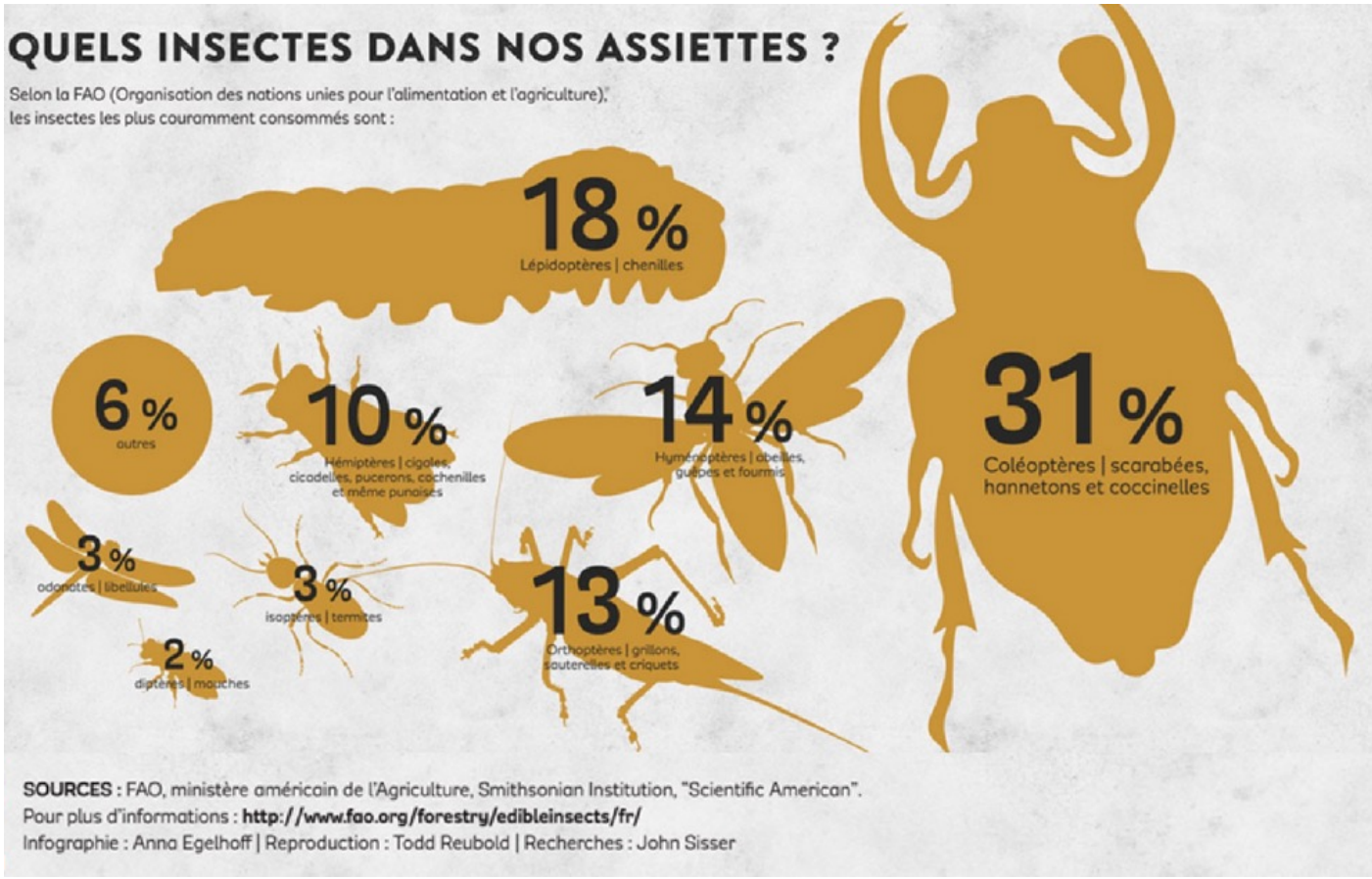


Tiré de 17 objectifs pour sauver le monde, ONU 2021

ENTOMOPHAGY



ENTOMOPHAGY



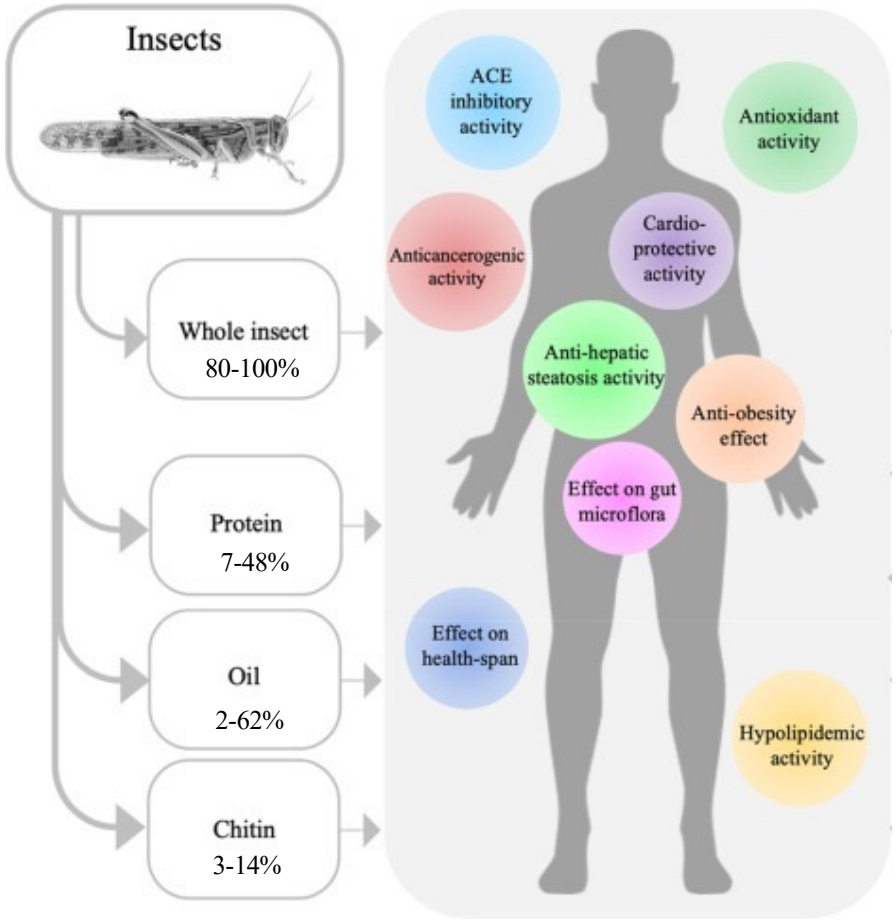
BENEFITS OF INSECT FOODS

NUTRITIOUS FOOD

- High in protein
- Fatty acid profiles similar to vegetable oils or animal fats
- Rich in unsaturated fatty acids in many species
- Cholesterol levels comparable to other conventional meat sources
- Rich in minerals (iron, copper, manganese and zinc)
- Rich in vitamins (riboflavin - B2, pantothenic acid - B5, biotin - B7)

FUNCTIONAL FOODS (PROMOTE HEALTH)

- Antihypertensive (e.g. Angiotensin converting enzyme)
- Antioxidant (ex. phenolic compounds)
- Cardio-protective (e.g. median indices of arthrogenicity and thrombogenicity)
- Anti-carcinogenic (e.g.: alkaloids, chitin, ...)
- Anti-obesity



Mishyna et Glumac, 2021 Journal of Functional foods 76 104316

ENTOMOPHAGY

Humans have been collecting and producing a myriad of insects for food since time immemorial.

In North America, 90 species of insects have been traditionally consumed by indigenous peoples.

Schrader et al., 2016

The future of entomophagy will be through mass production of insects, not through traditional harvesting practices.

INSECT PRODUCTION AND ECOLOGICAL FOOTPRINT

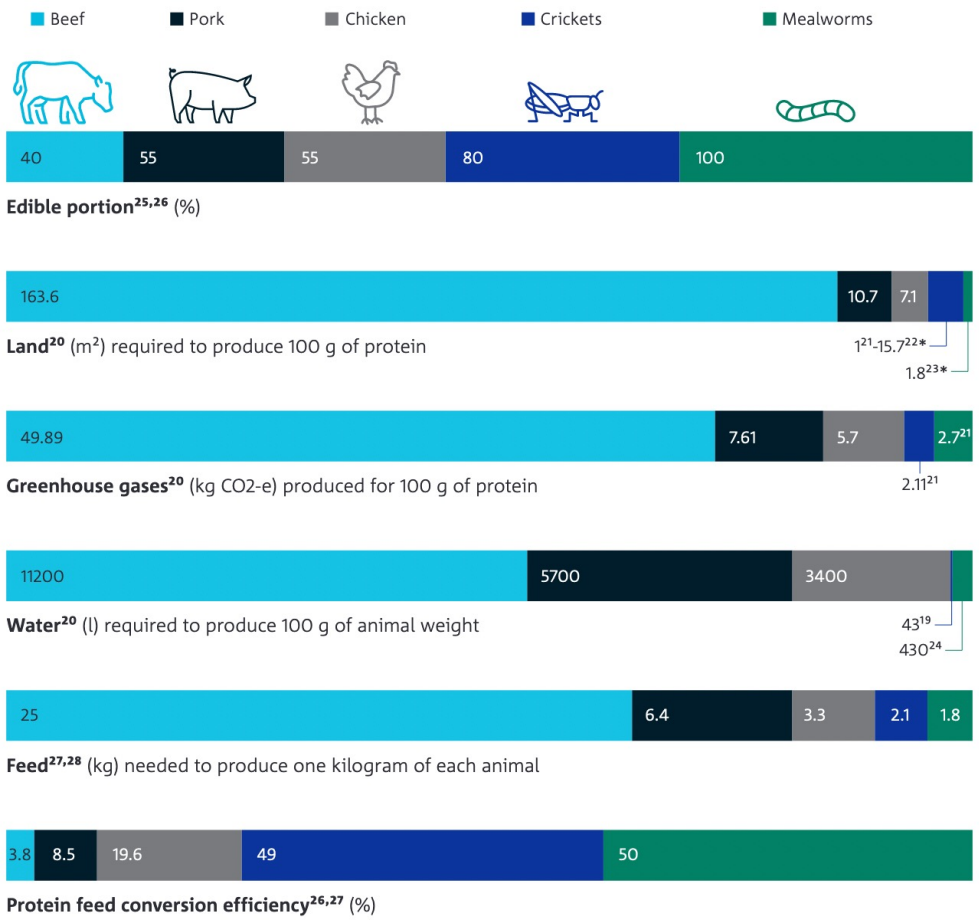
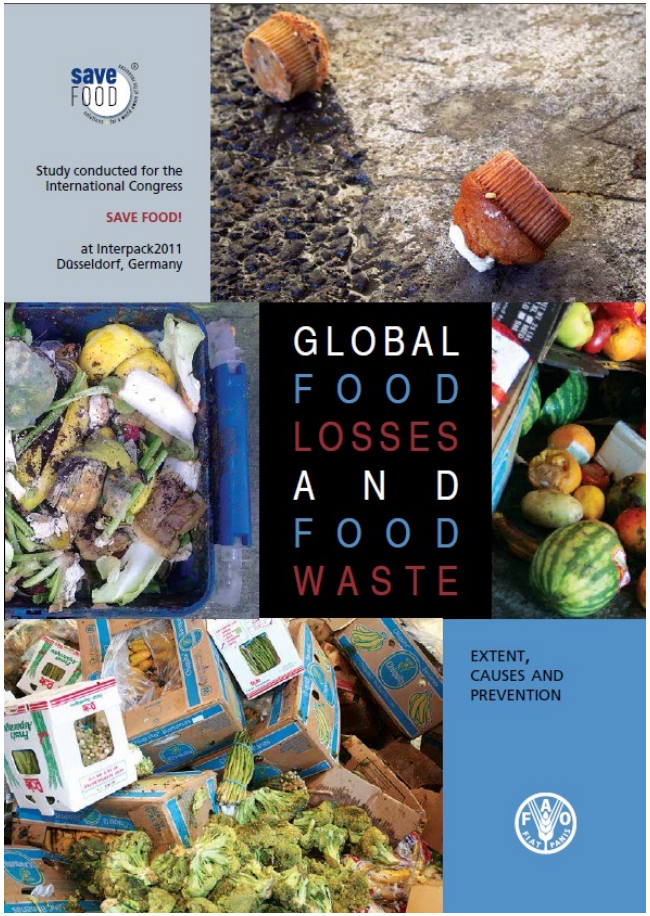


Figure 5: Environmental footprint of crickets and mealworms compared to conventional farmed animals.

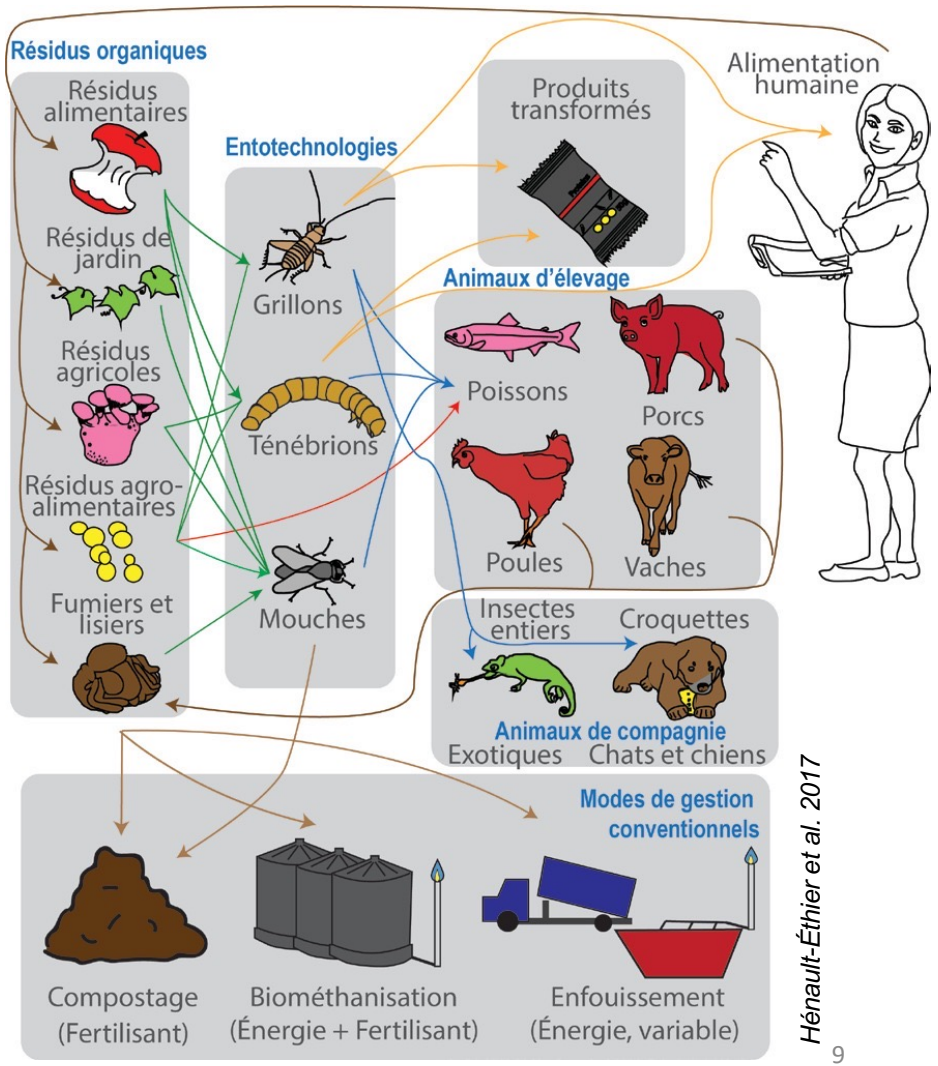
*Land usage for crickets and mealworms is much lower than conventional farmed animals, since they can be stacked vertically other in industrial warehouses.

TACKLING FOOD WASTE



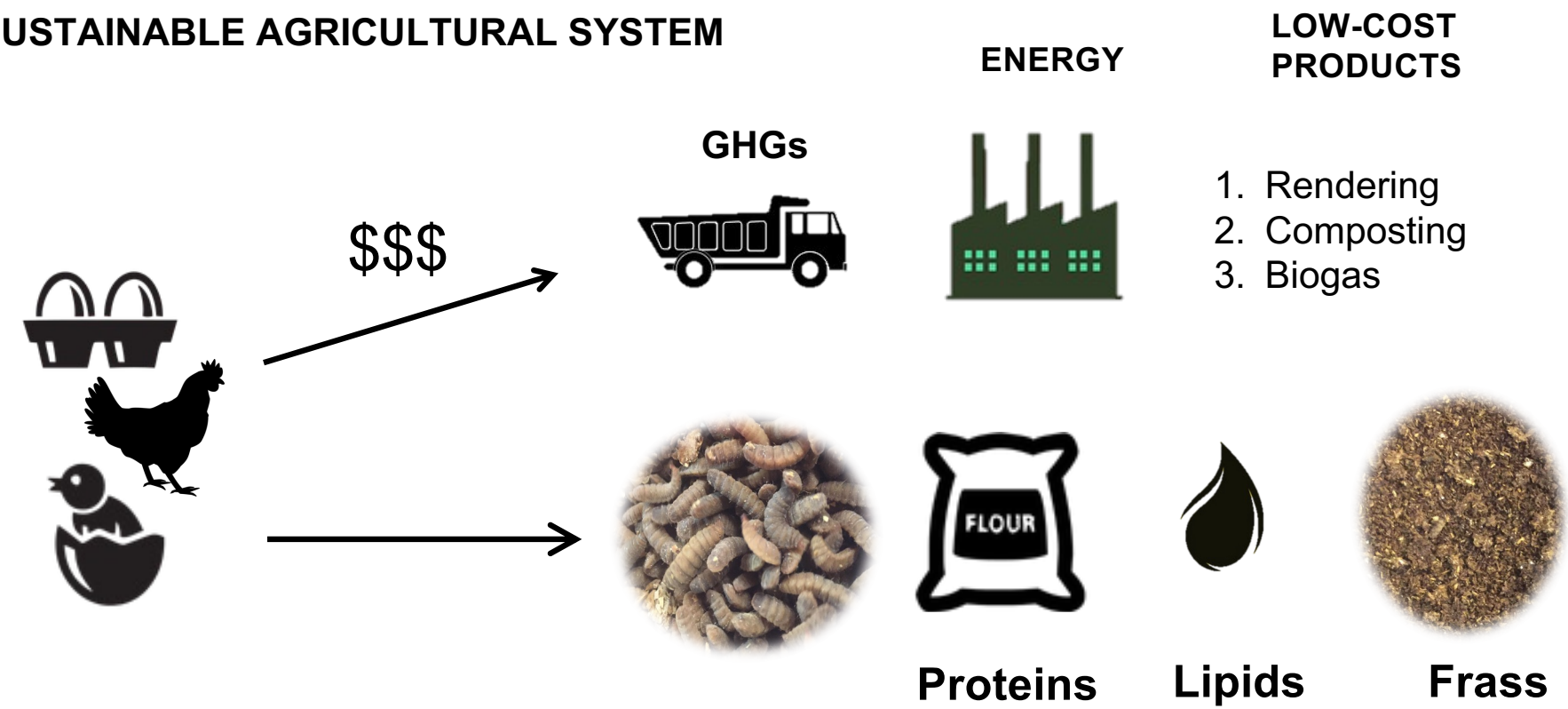
REINTEGRATING INSECTS INTO THE FOOD PRODUCTION CHAIN

- Alternative to conventional waste management of organic matter
- Production of animal proteins with low environmental footprint
- Production of alternative quality food for animals and humans



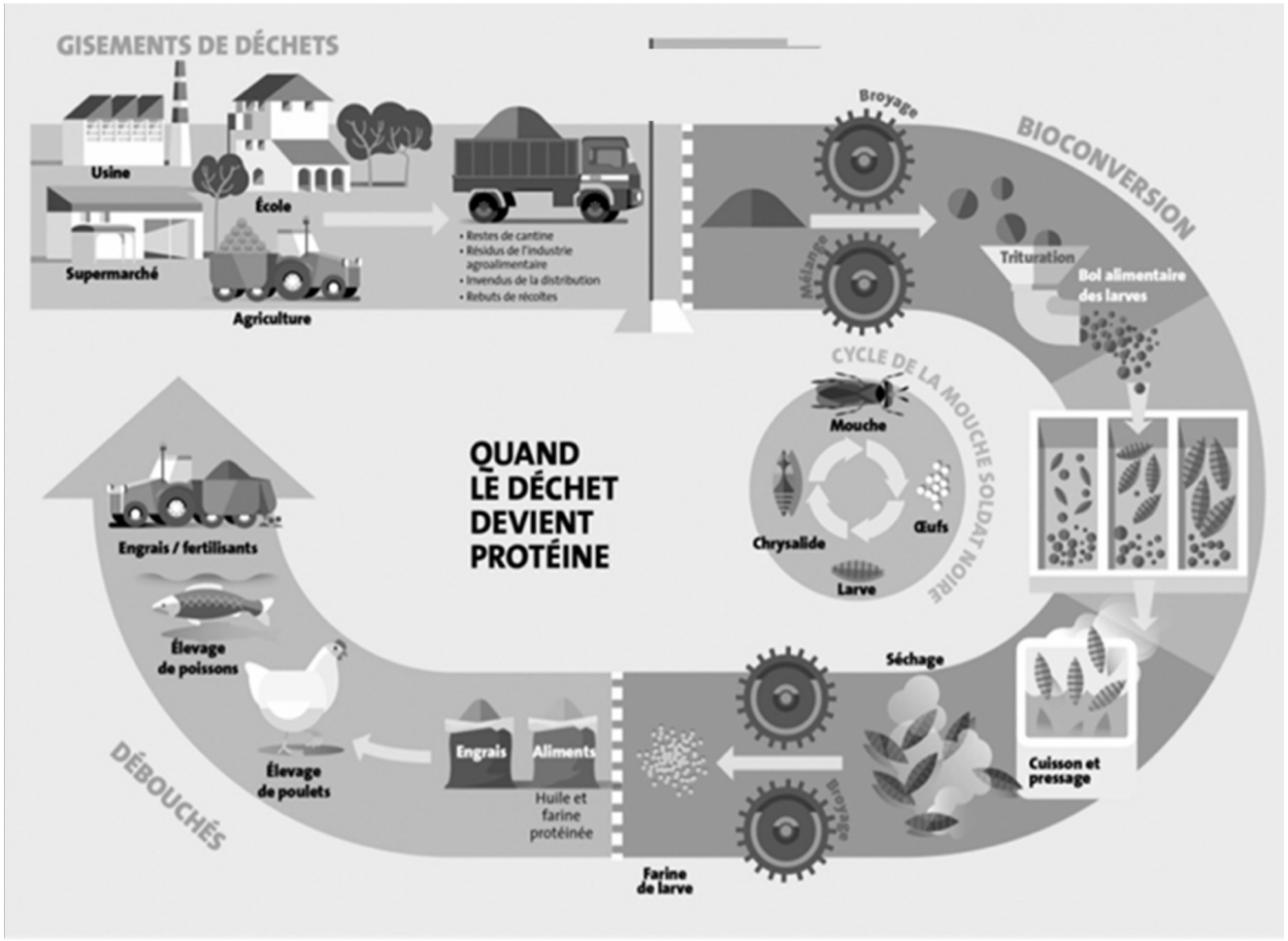
Hénault-Éthier et al. 2017

SUSTAINABLE AGRICULTURAL SYSTEM



IMPLEMENTATION OF NEW CIRCULAR ECONOMY MODELS

- Produce agricultural products using minimal external inputs
- Close nutrient loops and reduce negative environmental discharges
- Valorize agri-food waste



SUSTAINABILITY OF INPUTS

CHOICE OF INSECT FEEDS

- Total abundance
- Spatial disponibility
- Collection and transport system
- Seasonal variations
- Economic value
- Potential for other value-added products
- Nutritional quality
- Homogeneity
- Physical, chemical or biological risks (e.g. contaminants)

TYPE DE DÉCHETS ORGANIQUES POUR L'ALIMENTATION DES INSECTES	ÉLEVAGE D'INSECTES DESTINÉS À LA CONSOMMATION		DÉFIS OU BÉNÉFICES														
	Humaine	Animale	Abondance totale (tonnage)	Volume/Concentration par générateur	Collecte	Variations saisonnières	Non récolté au champ	Gisement urbain	Faible coût d'acquisition	Déjà réutilisé (alimentation animale)	Déjà recyclé (compostage ou biométhanisation)	Qualité nutritionnelle	Homogénéité	Contaminants biologiques (pathogènes)	Autres contaminants (corps étrangers, toxiques)	Présence d'emballage
Résidus résidentiels mixtes (alimentaire résidentiel et résidus de jardin)	-	+	●	●	●	●	▬	●	●	▬	●	●	●	●	●	●	●
Résidus ICI préconsommation (ex. : résidus de préparation de repas)	+	++	●	●	●	●	▬	●	●	●	●	●	●	●	●	●	●
Résidus ICI postconsommation (ex. : restes d'assiettes en restaurant)	-	+	●	●	●	●	▬	●	●	▬	●	●	●	●	●	●	●
Résidus de mise en marché des aliments (ex. : détaillants, distributeurs, etc.)	++	++	●	●	●	●	▬	●	●	●	●	●	●	●	●	●	●
Résidus issus de l'agriculture urbaine (ex. : serres, champignonnières, sans les résidus de jardin, etc.)	++	++	●	●	●	●	▬	●	●	●	●	●	●	●	●	●	●
Produits agricoles hors catégorie selon les normes de l'industrie agroalimentaire (ex. : légumes moches, non standards)	+++	+++	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Résidus industriels agroalimentaires (ex. : farine, levures, lies, etc.)	+++	+++	●	●	●	●	▬	●	●	●	●	●	●	●	●	●	●
Résidus d'épuration des eaux usées (ex. : boues municipales)	-	-	●	●	●	●	▬	●	●	▬	●	●	●	●	●	●	●
Fumiers et lisiers d'animaux d'élevages (ex. : bovin, porcin)	-	+	●	●	●	●	▬	●	●	▬	●	●	●	●	●	●	●

Hénault-Éthier et al. 2017

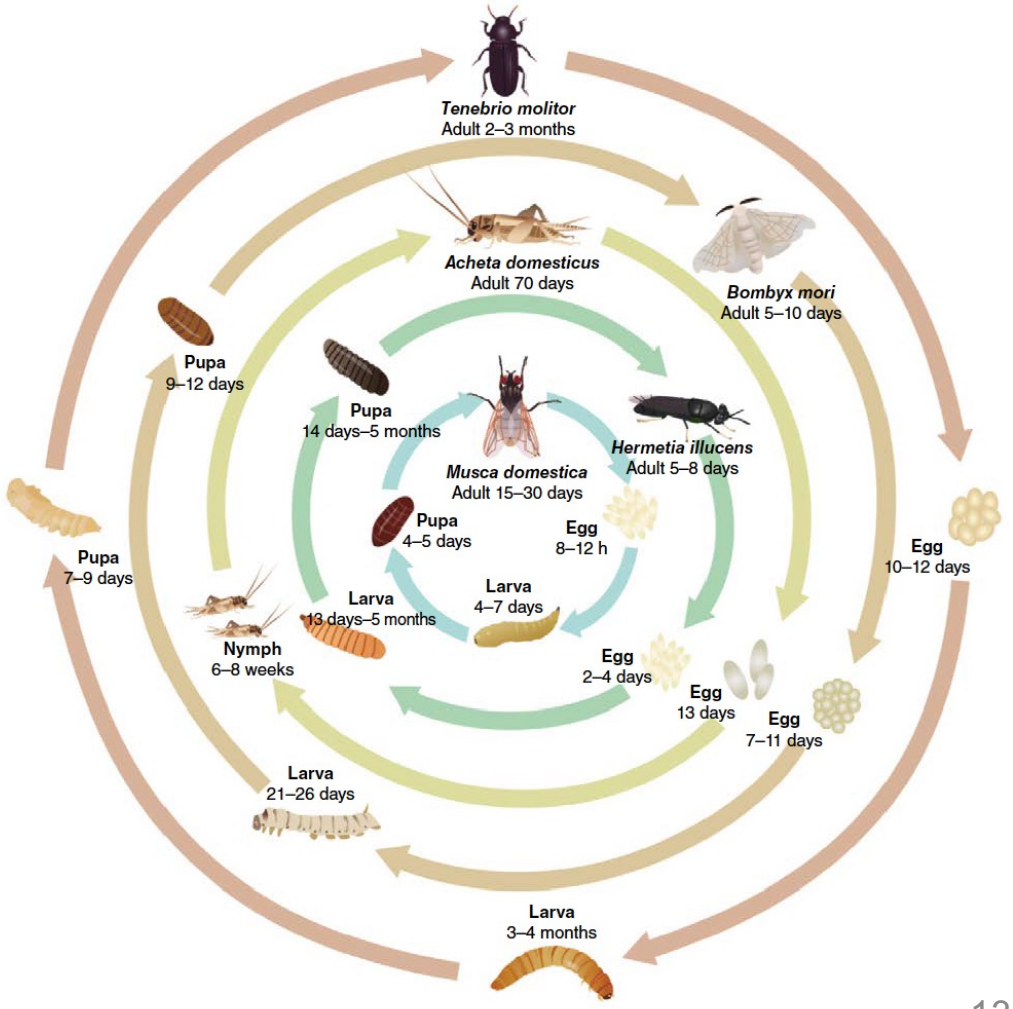
CHOICE OF SPECIES

THE MAIN SPECIES PRODUCED

- Silkworm (Bombyx mori)
- Black soldier fly (Hermetia illucens)
- Housefly (Musca domestica)
- Mealworms (Tenebrio molitor)
- Crickets (Acheta domesticus)

THEIR CHARACTERISTICS

- Short life cycle
- High food conversion
- Very high fecundity
- Ability to grow at high densities
- Ability to feed on low value inputs



Tiré de Bjone et Fitches, 2021

CHOICE OF THE MARKET

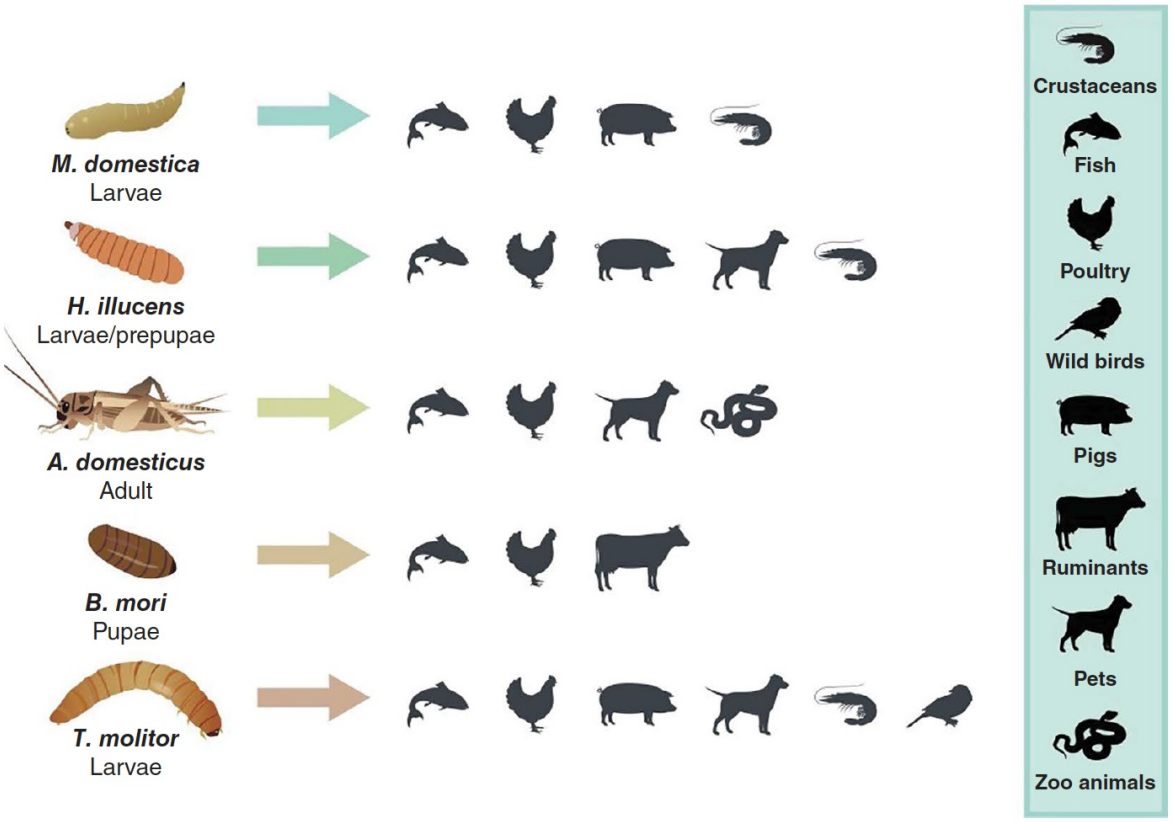
NUTRITIONAL QUALITY

- Species
- Life stage
- Processing methods
- Targeted diets

MARKET INTEREST

- Need for alternative feeds
- Values
- Consumer acceptability

Potential for inclusion of insect products in pet and farm animal diets



Tiré de Bjone et Fitches, 2021

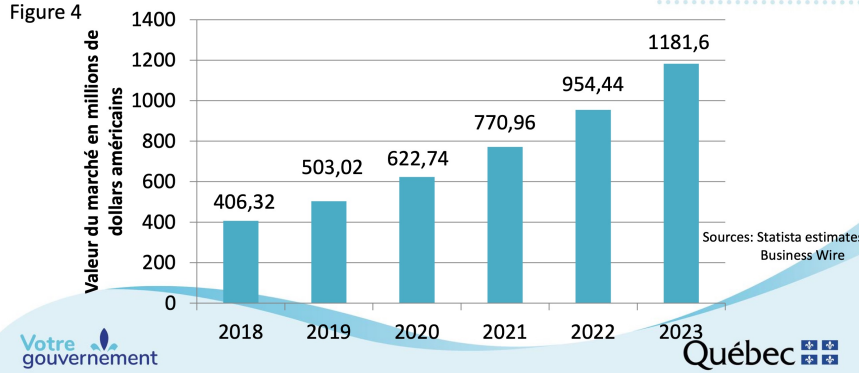
INSECT MARKET

A PRODUCTION IN FULL EXPLOSION

- Global market value to more than double from 2018 to 2021
- Expected to reach $13.1 trillion CAD by 2030
- Affects all target markets (animal and human) and types of insect products sold

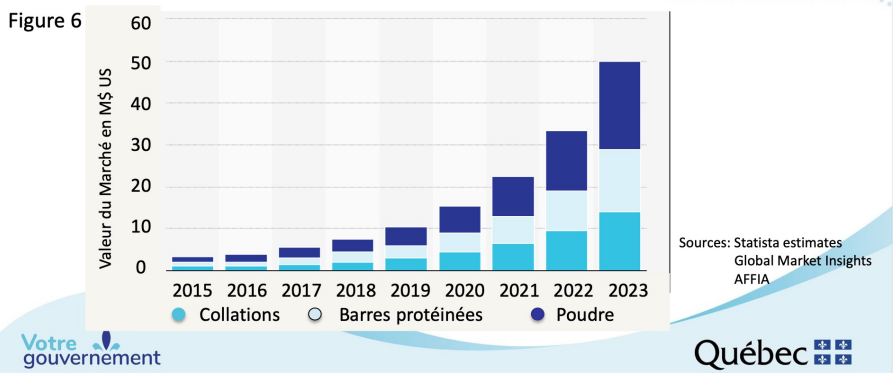
PRÉVISION: VALEUR DU MARCHÉ MONDIAL DES INSECTES COMESTIBLES DE 2018 À 2023 (EN M$ US)

Figure 4



VALEUR ESTIMÉE DU MARCHÉ DES INSECTES COMESTIBLES AUX ÉTATS-UNIS DE 2015 À 2023, POUR 3 CATÉGORIES ALIMENTAIRES (EN M$ US)

Figure 6



Horticulture

- Canada's fertilizer industry of
- 17 billion CAD (1.2 billion in Quebec)
- Fertilizer Regulations, CFIA (2020 reform)
- If size >50 L, application required to MELCC regional branch to identify if a certificate of authorization is required (MRF guide).

Unsplash, Erwan Hesry

WORLD MARKET IN 2023

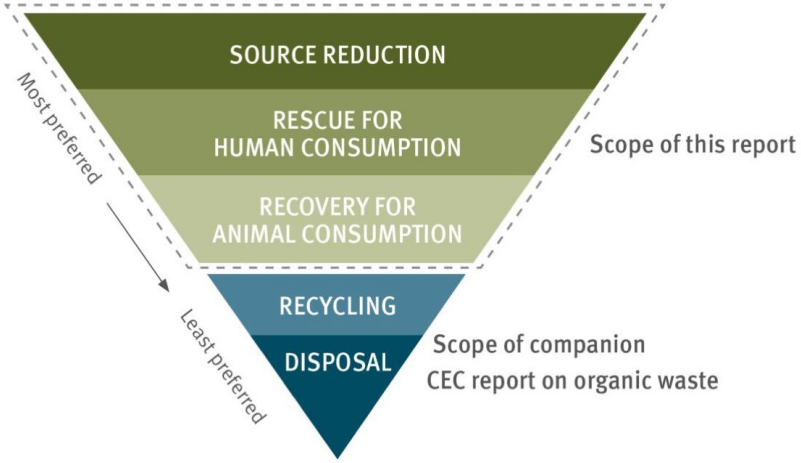
- World market expected to reach CAD 13.1 billions
- > 3 million tons of insects
- Average annual growth of 31
- Faster growth in North America

TOP 10 COMPANIES IN EDIBLE INSECTS MARKET

- Ynsect (France)
- Protix B.V. (Netherlands)
- Entomofarms (Canada)
- Aspire Food groups (Canada)
- All Things Bugs LLC (USA)
- Global Bugs (Thailand)
- Global bugs Asia Co. Ltd (Thailand)
- JR Unique Foods Ltd (Thailand)
- InnovaFeed (France)
- EnviroFlight, LLC (USA)
- Nutrition technologies group (Singapore)

AGRICULTURE PRODUCTION AND FOOD LOSS IN CANADA

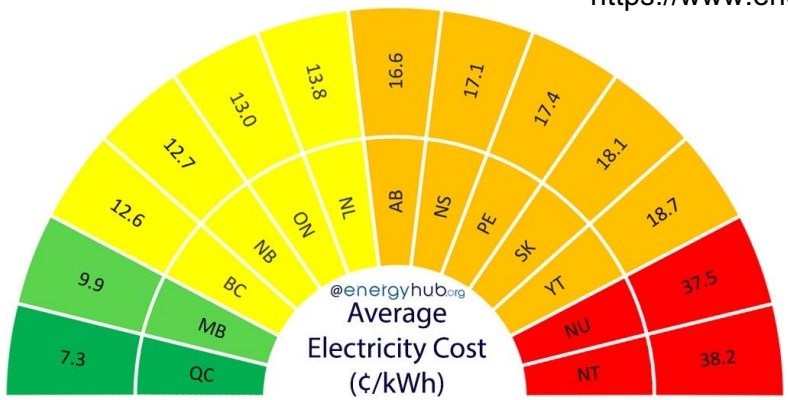
		FOOD LOSS AND WASTE, FOOD AND INEDIBLE PARTS (million tonnes/year)					
Agricultural production	**Available food for human consumption**	**Food production (pre-harvest)**	**Food production (post-harvest)**	**Processing**	**Distribution (Includes Retail and Food service)**	**Consumer**	**Total**
95.7	34.6	3.8	1.3	1.4	1.0	5.6	13.1

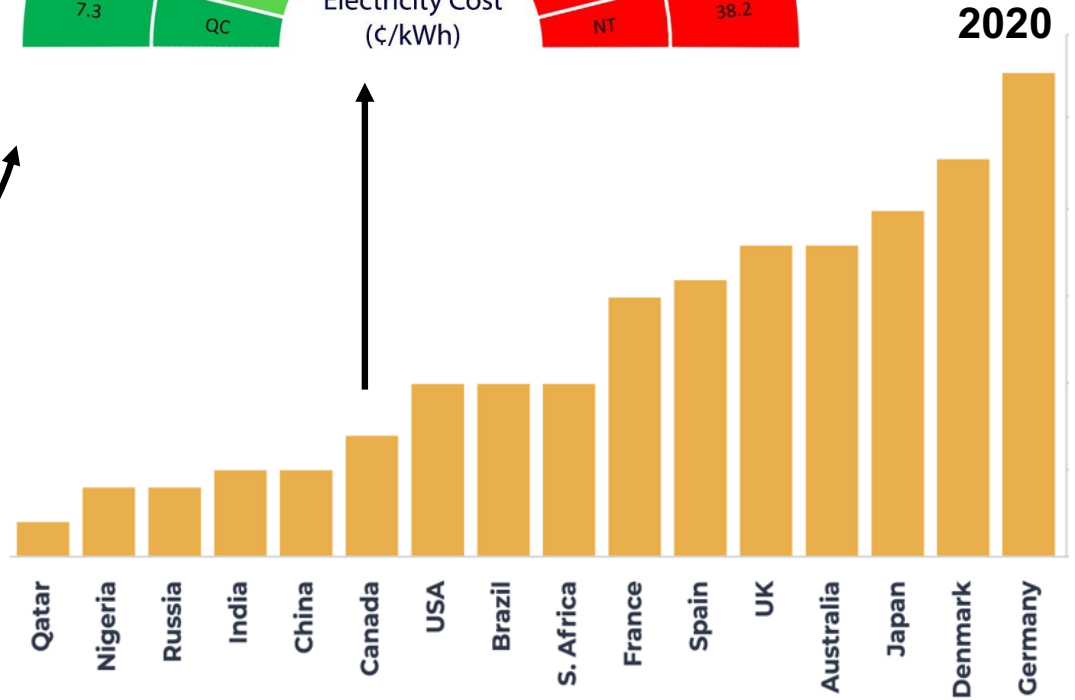


https://www.energyhub.org/electricity-prices/

ELECTRICITY COSTS IN CANADA

63 hydroelectric power stations





www.globalpetrolprices.com

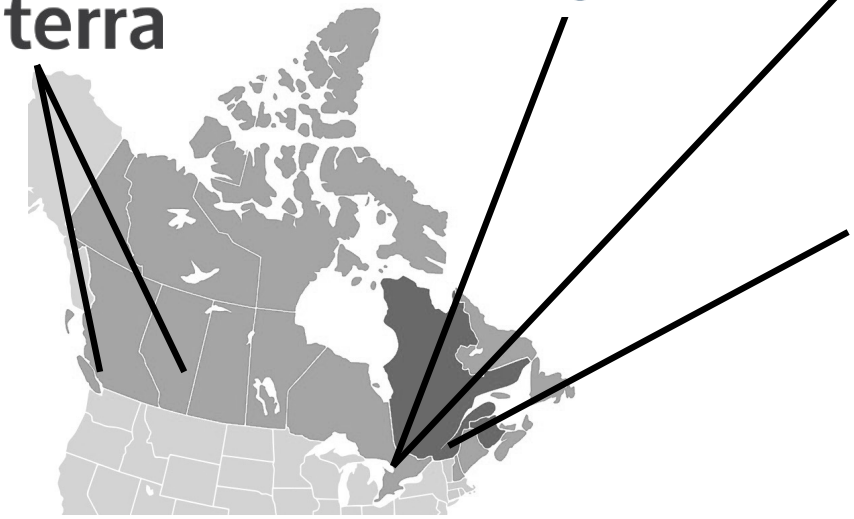
PORTRAIT OF THE CANADIAN INDUSTRY

> 30 000 tons/year

Enterra

ENTOMO FARMS
THE FUTURE OF FOOD

ASPIRE
FOOD GROUP



entosystem

PORTRAIT OF THE CANADIAN INDUSTRY

NPC (2022) estimates the number of companies at 30

www.insectescomestibles.ca

TABLE FILIÈRE DES INSECTES COMESTIBLES

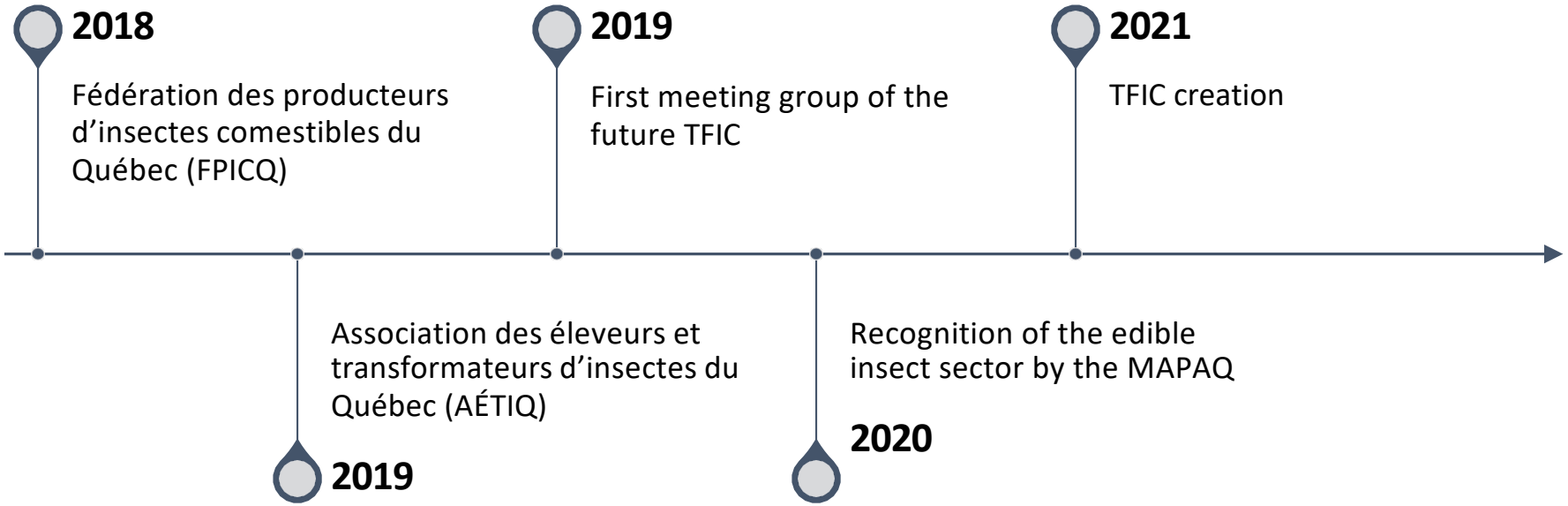
tficqc@gmail.com

www.InsectesComestibles.ca

L'Accord Canada-Québec de mise en oeuvre du Partenariat canadien pour l'agriculture représente un financement du gouvernement fédéral et du gouvernement du Québec totalisant 293 millions de dollars répartis sur une période de 5 ans, soit de 2018 à 2023. Cet accord appuie des initiatives stratégiques qui aideront les secteurs à croître, à innover et à prospérer.

Agriculture, Pêcheries et Alimentation
Québec

Structuring initiatives in Quebec

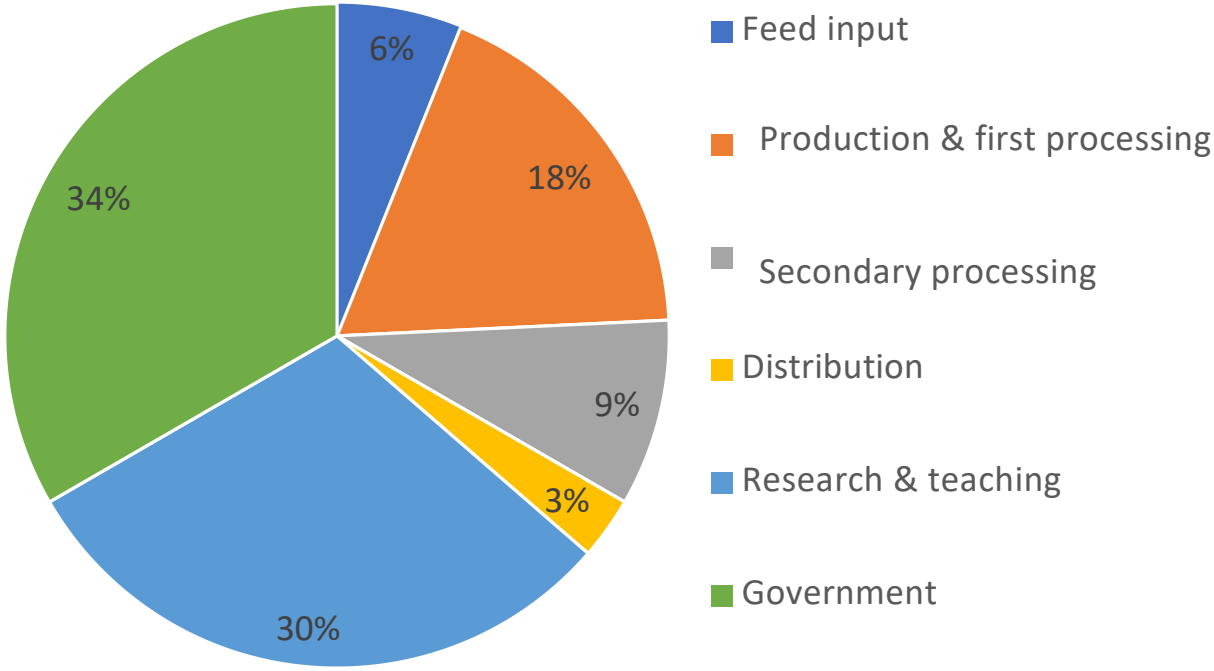


Agriculture, Pêcheries et Alimentation Québec

Sector table (definition):
Association whose mandate is to ensure the sustainability and reputation of an agri-food sector on the markets by promoting synergy between the various links in the sector with the common goal of meeting the requirements of consumers and society…

33 members

Constitution of the members of the Edible Insects Sector Table (2022)



The Board of Directors

Marie-Hélène Deschamps, présidente

Professeur adjoint, Chaire de leadership en enseignement en production et transformation primaire d'insectes comestibles, Université Laval

Marc-André Hébert-Briand, Vice-président

Président, Entologik &
Vice-président, Association des producteurs et transformateurs d'insectes du Québec (AÉTIQ)

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Directeur général, Hagen

Christopher Warburton, Administrateur

Directeur scientifique, Entosystem

Dimitri Fraeys, Administrateur

Vice-président Innovation et Affaires économiques, Conseil de Transformation Alimentaire du Québec (CTAQ)

Louise Hénault-Ethier, Administratrice

Directrice du Centre Eau Terre Environnement et professeure associée, Institut National de la Recherche Scientifique (INRS) &
Directrice R&D et innovation, Tricycle

Judith Lavoie, Observatrice

Ministère des Pêcheries, de l'Agriculture et de l'Alimentation du Québec (MAPAQ)

Yan Martel-Kennes, Administrateur

Directeur innovation, Sollio Agriculture

Problematic

Companies active in the insect industry are not well known.

Previous work has painted a picture of the industry in Quebec (2020, entotechnology showcase), but the industry is evolving rapidly.

An updated picture of the industry is needed in order to prepare a relevant strategic plan.

Objectives

Directory & map of organizations

Publish a free, accessible and evolving directory and map of all organizations involved in the edible insect industry in Quebec (Website 2022)

Industry Profile

To draw up an updated portrait of the edible insect industry in Quebec (Industry report 2022)

Strategic plan

Draft a 3-year strategic plan to help develop the industry in Quebec (2023)

Action plan

Carry out the action plan (2024)

Methodology

Portrait de l'industrie des insectes comestibles du Québec en 2022

TABLE FILIÈRE DES INSECTES COMESTIBLES

Inventory of all companies involved in the edible insect industry.

Consolidation of public data (CTAQ, Registre des entreprises du Québec, Panier bleu)

Contacting all stakeholders directly by e-mail, phone call and social networks (Facebook & LinkedIn) to answer the survey

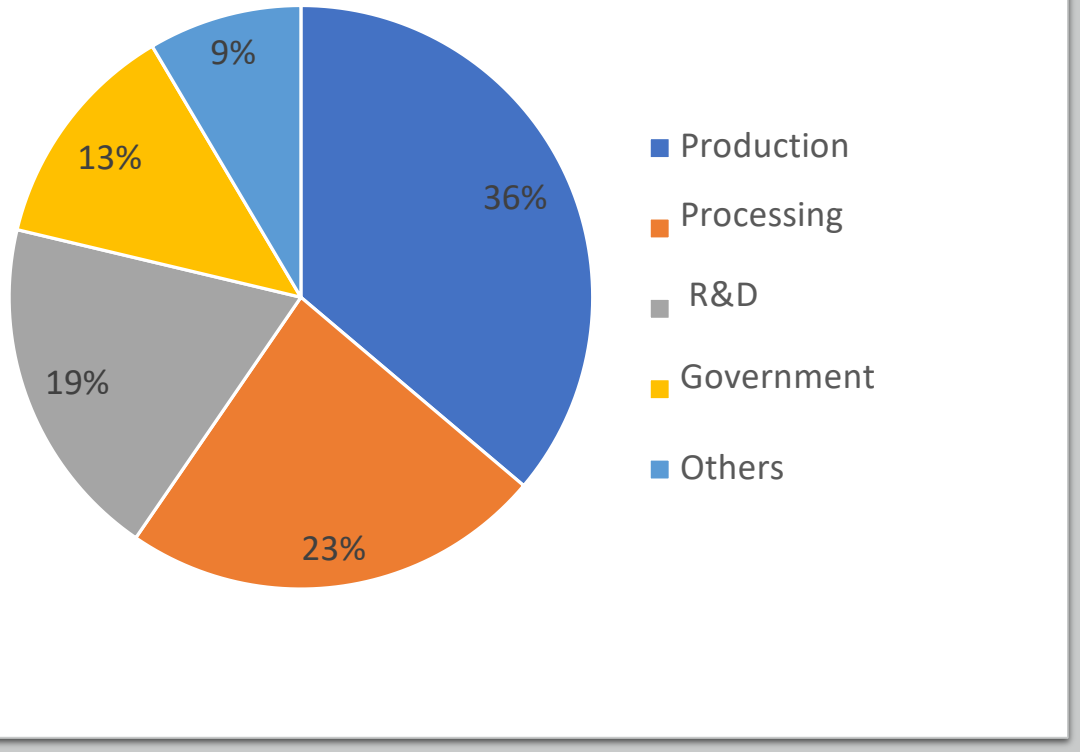
Descriptive analysis of data by sector

Methodology

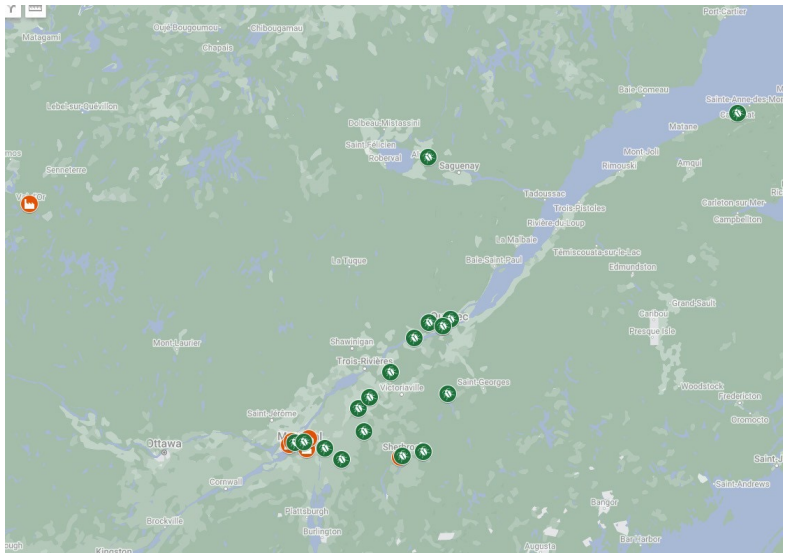
75 organizations contacted

Portrait de l'industrie des insectes comestibles du Québec en 2022

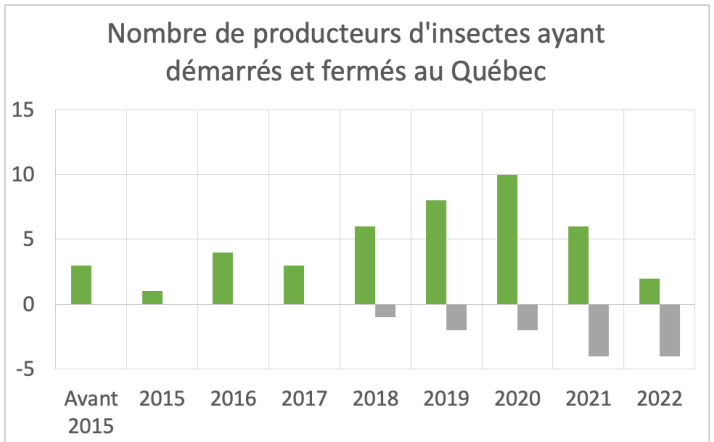
TABLE FILIÈRE DES INSECTES COMESTIBLES



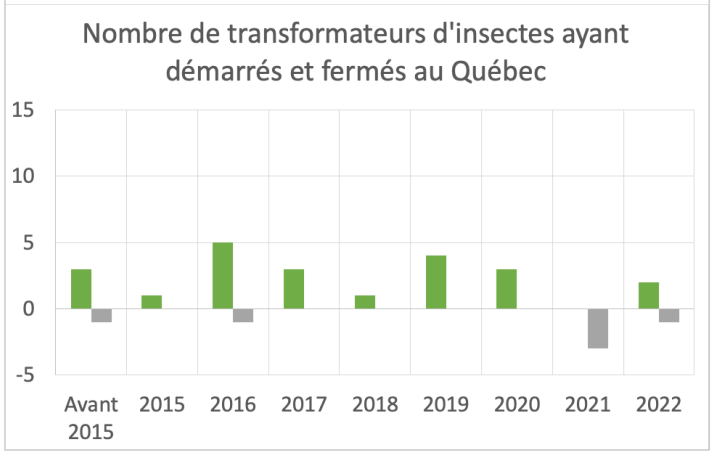
Insect companies in Quebec in 2022



https://insectescomestibles.ca/cartographie



30 producers in 2022



16 processors en 2022

TABLE FILIÈRE DES INSECTES COMESTIBLES

Number of insect producers and processors registered and active in the Quebec Business Register

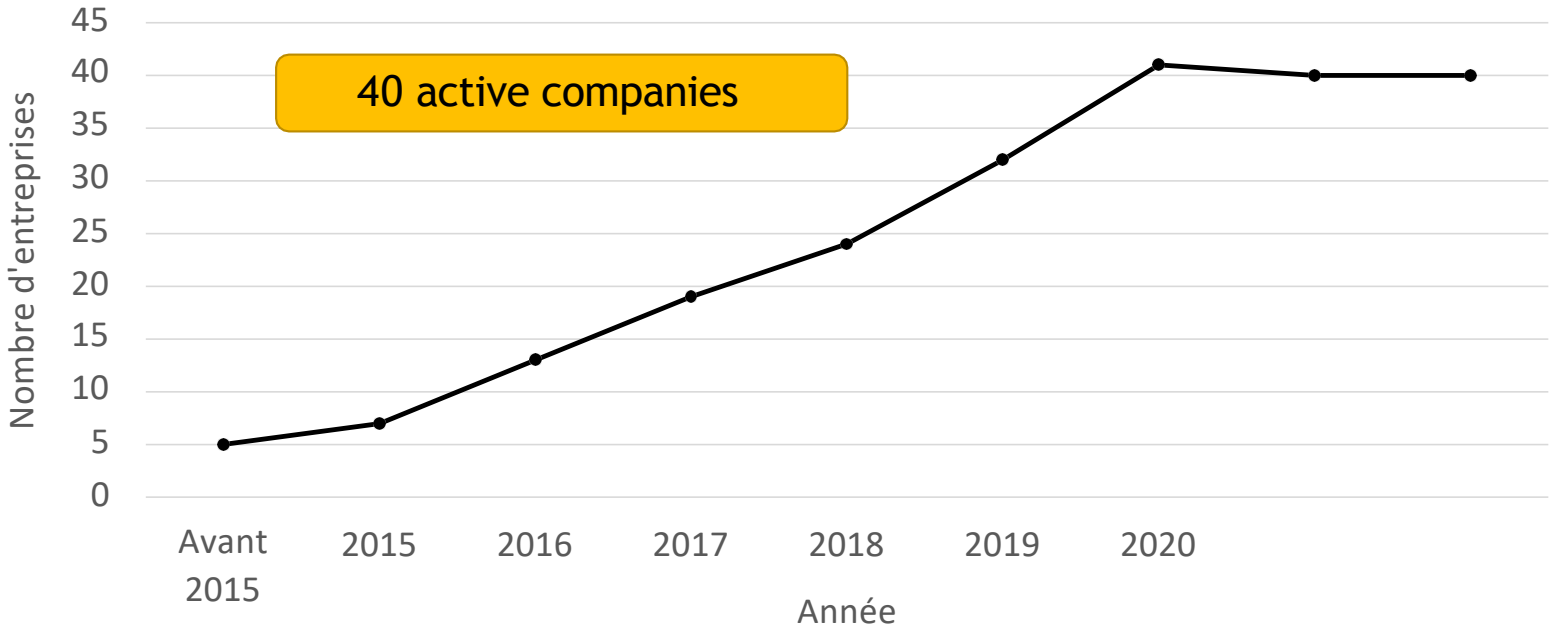
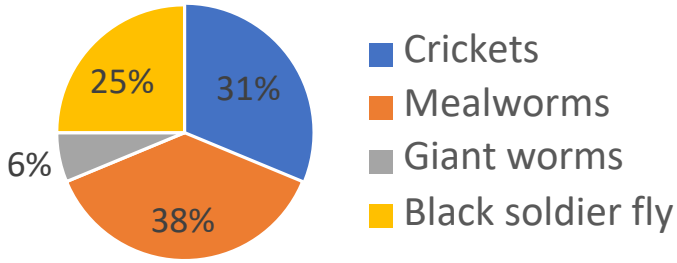


TABLE FILIÈRE DES INSECTES COMESTIBLES

Insect species produced in Québec



In Canada, only these species are considered to be non-novel foods:

- Mealworms
- Giant worm
- Small mastworm
- House cricket
- Banded cricket
- Silkworm

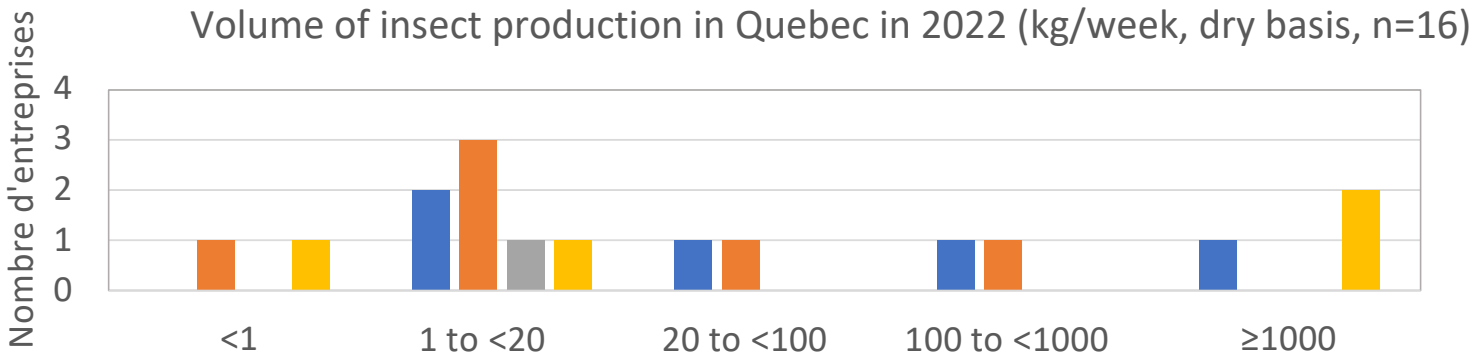
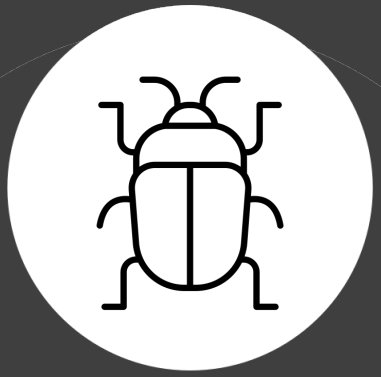


TABLE FILIÈRE DES INSECTES COMESTIBLES

Insects feed

Crickets
- Poultry meal (n=4)
- Mixed grain products (n=1)

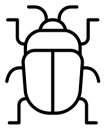


Mealworms
- Residual organic matter (n=3)
- Mixed grain products (n=3)

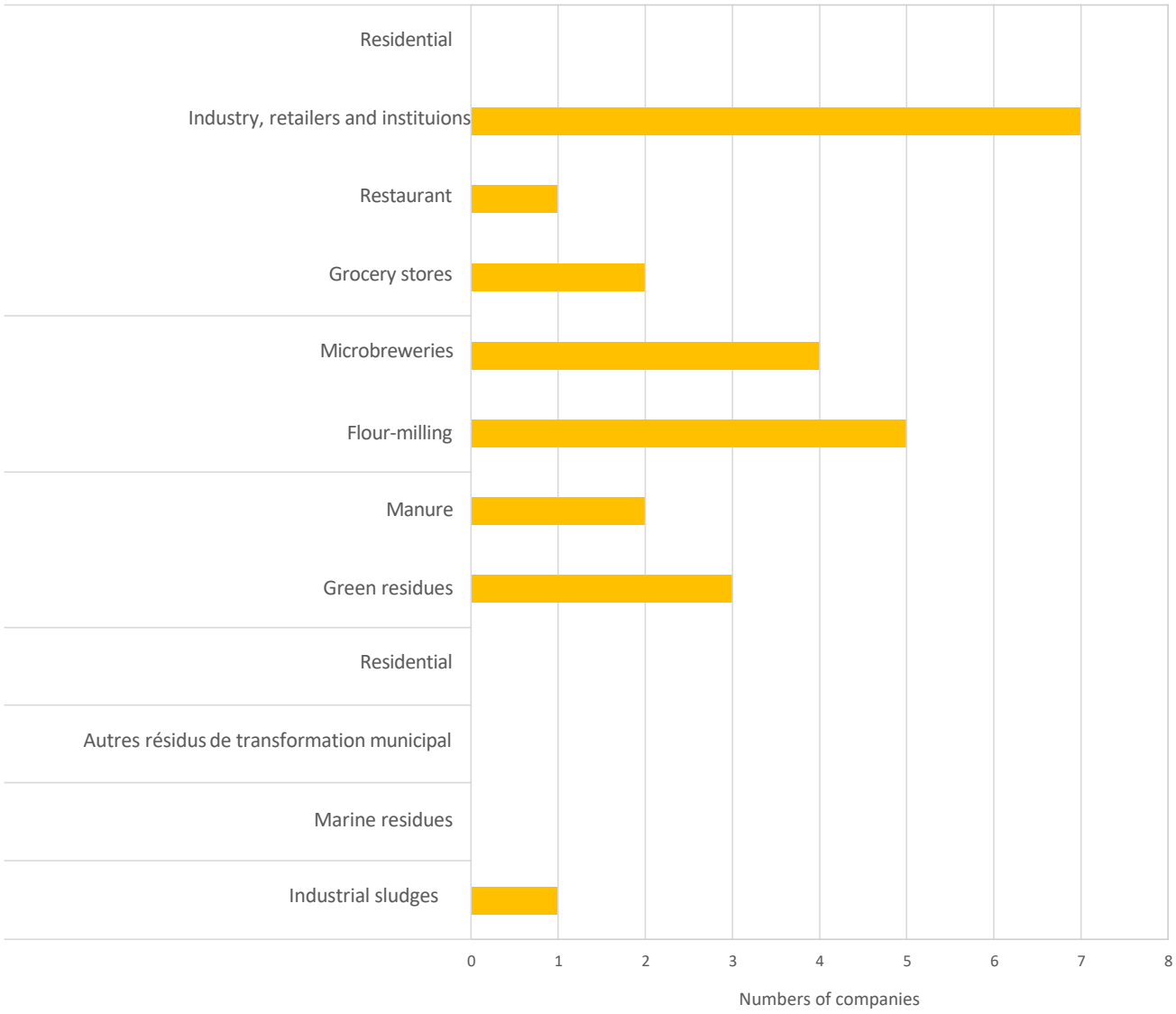
BSF
- Residual organic matter (n=3)

Does your company operate in a circular economy?

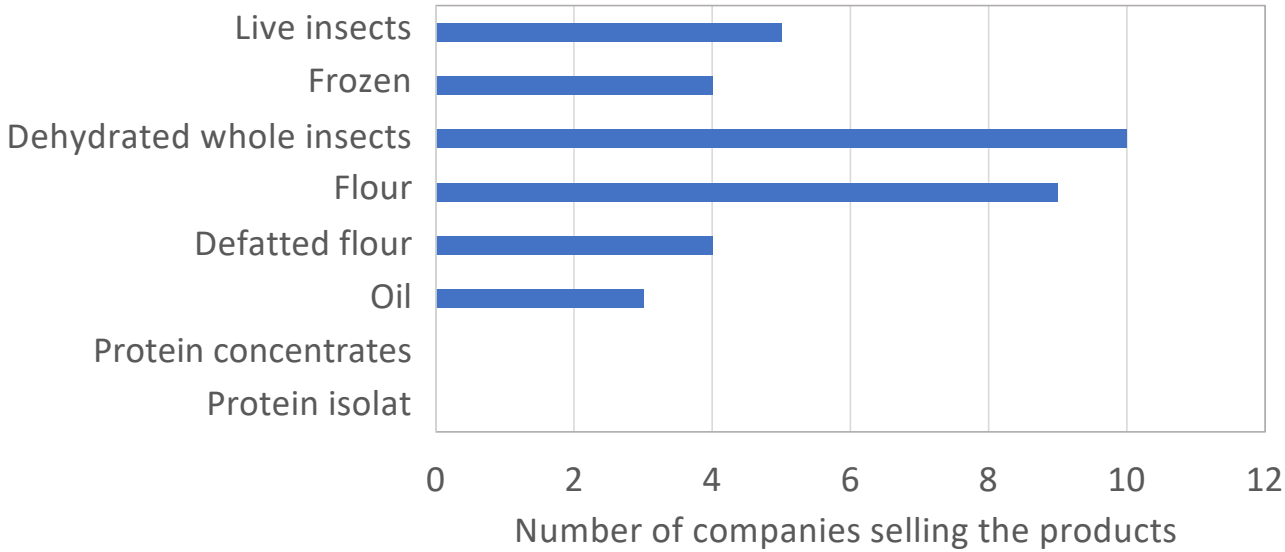
40 T of organic waste is recovered by insects each week in Quebec (27.5 T flies, 12.1 T mealworms and 0.1 T crickets).

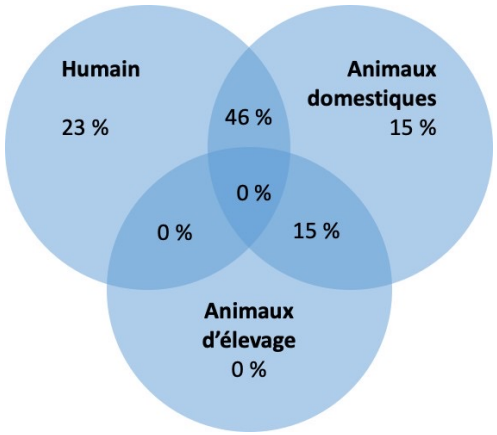
% inclusion of co-products into insect feed	 Mealworm (n = 6)	 Cricket (n = 5)	 Flies (n = 3)
No	0	80	0
Yes, from 1 to 25%	33	20	33
Yes, from 26 to 50%	0	0	0
Oui, from 51 to 75%	17	0	0
Oui, from 76 to 100%	50	0	67

Types of co-products



Insect ingredients in Quebec in 2022 (n = 15)

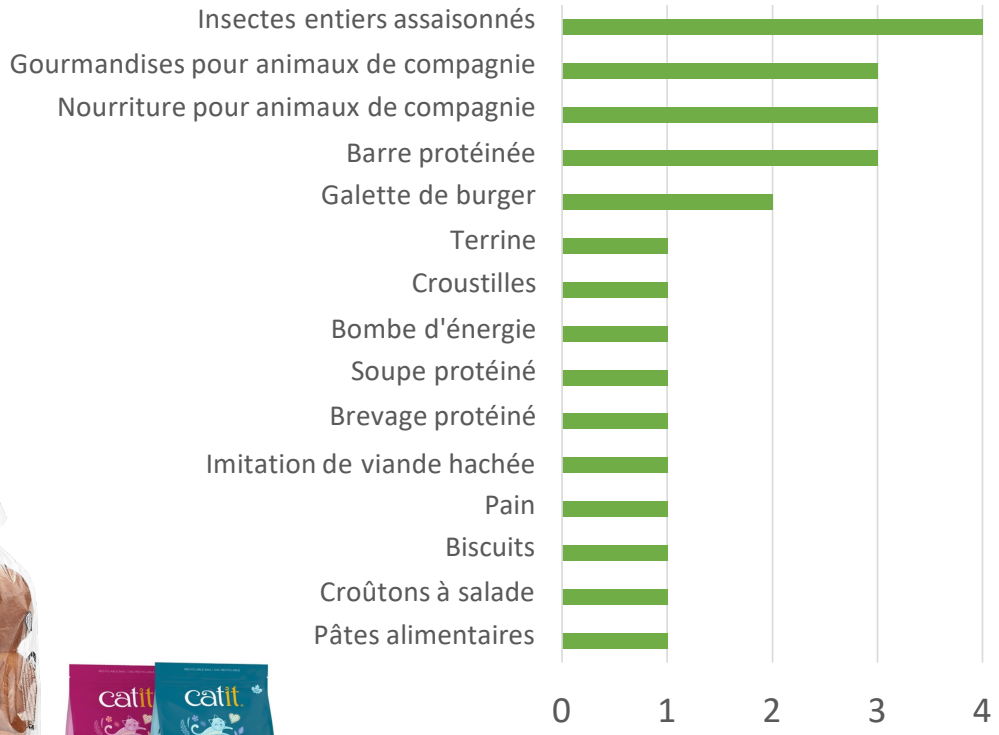




Prices of insect ingredients (CAD) for human consumption available to consumers online and produced in Quebec (n = 7 companies surveyed)

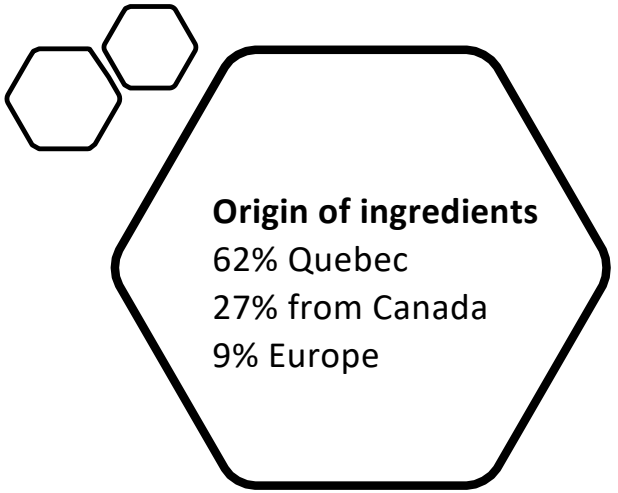
Insect species	Price by kg		Package size (g)	
	Min	Max	Min	Max
Dehydrated				
Crickets	65.00	160.00	25	5000
Mealworms	75.00	133.20	75	1000
Flour				
Crickets	65.00	140.00	50	5000
Mealworms	75.00	171.43	35	1000

Insect products in Quebec (secondary processing, n = 11)



Why import insect ingredients (n = 4)?

- The ingredient is not available in Quebec (n=3)
- Production in Quebec is not stable enough to develop a product (n=1)
- I have long-time suppliers outside of Quebec (n=1)
- Quebec insect ingredients are too expensive (n=1)
- Quebec insect ingredients do not have the necessary certifications for the use of my products (n=1)



Frass | Horticulture

73% want to sell to farmers
45% sell online & 55% sell in store
27% gave away & 9% threw away

Selling price of frass (CAD) to consumers in Quebec available online
(n = 5 companies listed on the web).

	Frass price by kg (CAD)			Package Size (kg)	
Insect species	Min	Max	Moyenne	Min	Max
Crickets	6.96	19.98	11.55	0.5	25.0
Mealworms	9.00	30.00	17.80	0.5	8.0

Implications in the associations

45%

Table Filière des Insectes comestibles

40%

Association des Éleveurs et transformateurs d'insectes

11%

North American Coalition for Insect Agriculture

9%

Société d'entomologie du Québec

39% of producers and processors were not members of any association

Courses and training in edible insects

26% on edible insects

https://insectescomestibles.ca/documentation

- 12 % college
- 14 % university

66% on food processing

- 44 % MAPAQ (Hygiène et salubrité)
- 17 % HACCP
- 9 % university
- 5 % ITAQ (Institut de Technologie Agroalimentaire du Québec)

Incubation of companies

35%

producers

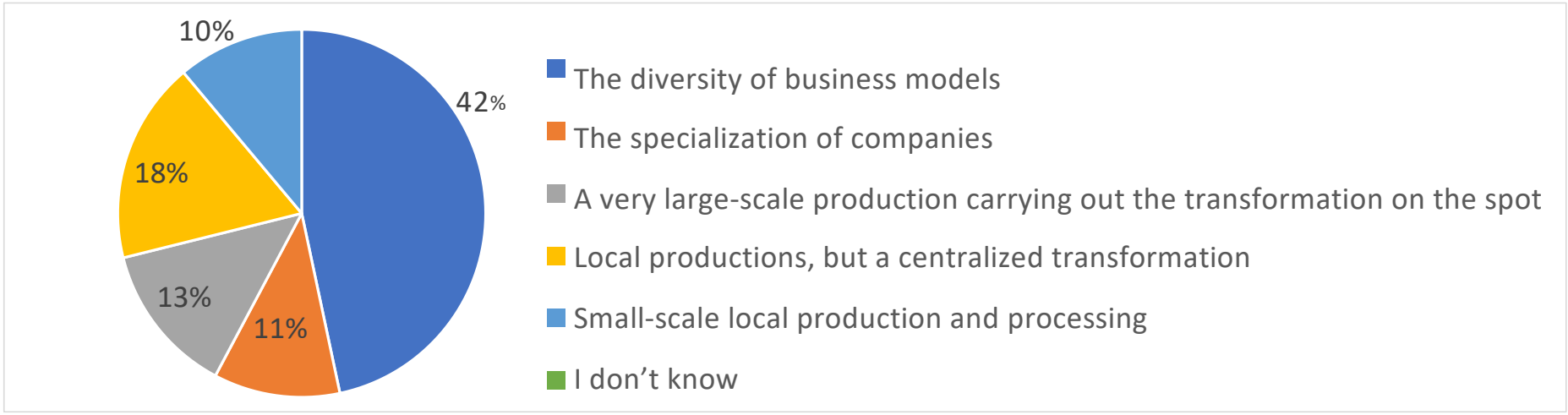
55%

processors

According to a NACIA report, 52% of participants were incubated.

29% of producers and processors would have preferred insect-specific business support

In your opinion, which business model should be favored for the edible insect industry? (n = 47)



We must be open to the diversity of business models!

Perspectives

Directory & map of organizations

Publish a free, accessible and evolving directory and map of all organizations involved in the edible insect industry in Quebec

Industry Profile

To draw up an updated portrait of the edible insect industry in Quebec

Strategic plan

Draft a 3-year strategic plan to help develop the industry in Quebec (2022)

Action plan

Carry out the action plan (2023)

Priority issues for the sector

1. Weak implementation of quality management systems, leading to marketing issues (standardization of the methods)
2. Risk of tarnishing the reputation of the entire industry in the event of a problem (toxi-infections, allergens, etc.).
3. Limited funding for insect production/processing
4. Disinformation/propaganda (pressure groups)

Vue d'ensemble

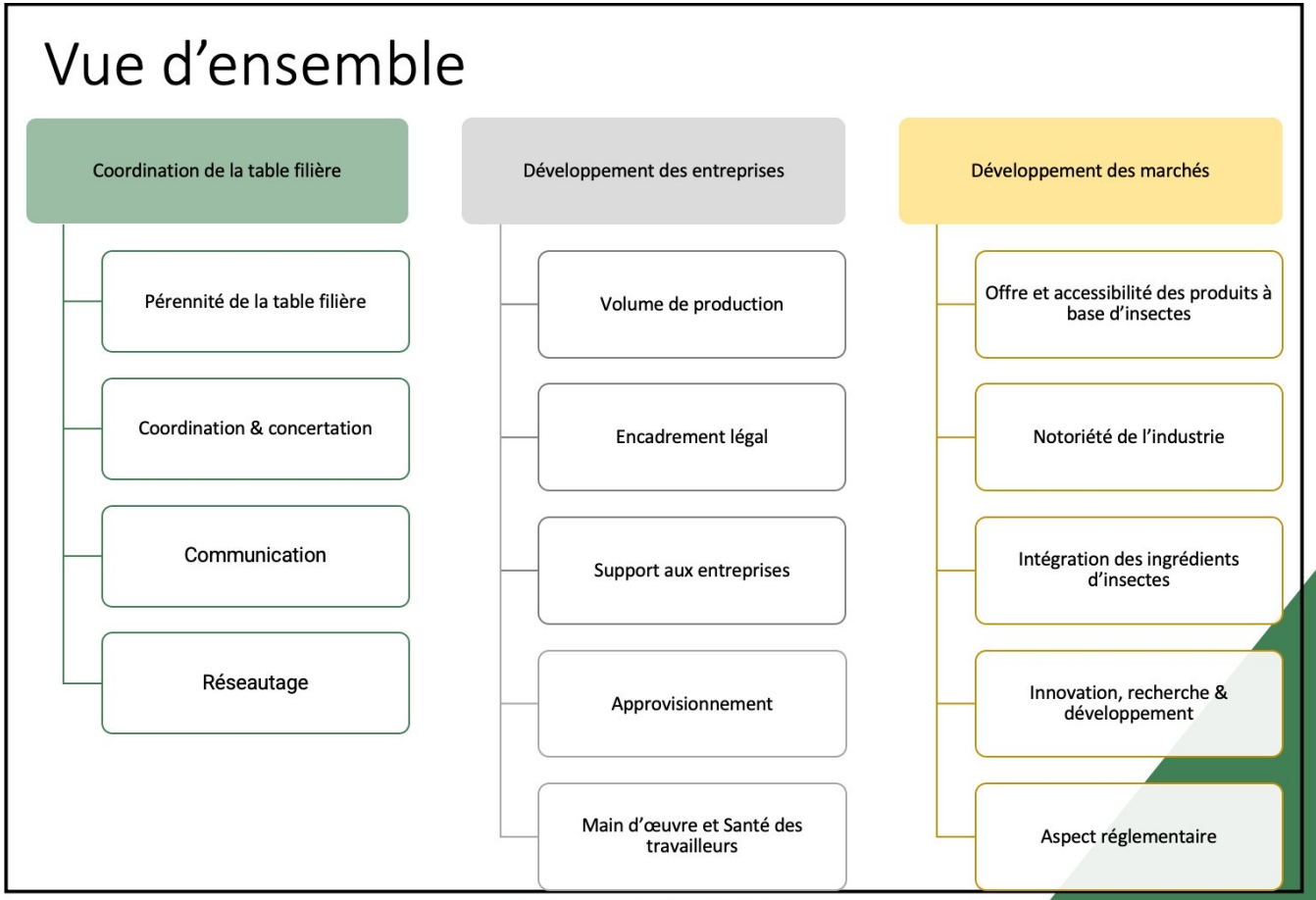


TABLE FILIÈRE DES INSECTES COMESTIBLES

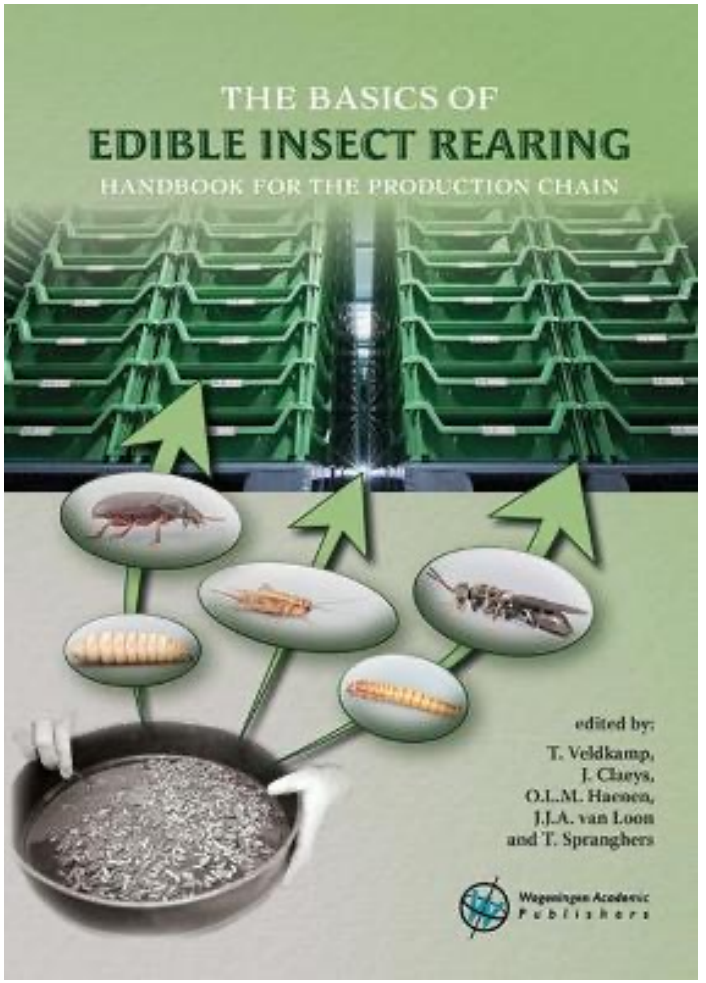
ISSUES AND CHALLENGES OF THE SECTOR

- Identification of high potential substrates (low-value, high nutritional content)
- Optimization of production and processing
- Simplification of regulations and accreditation processes
- Setting up product distribution
- Lobbying
- Product positionning and sales
- Raising public awareness

EDUCATION & TRAINING

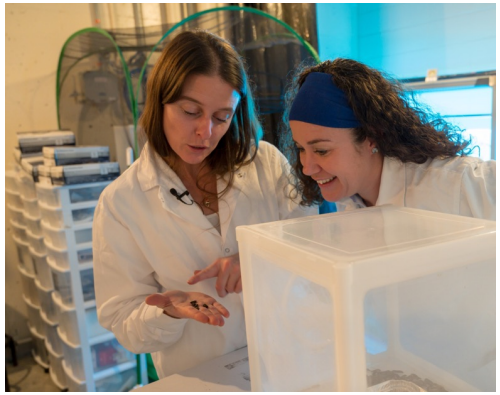
TRANSFER & LEADERSHIP

RESEARCH & DEVELOPMENT



EDUCATION & TRAINING

- INTEGRATION OF MODULES IN ONGOING COURSES (Agriculture and Food Faculty)
- CREATION OF A NEW COURSE ON EDIBLE INSECTS (FROM FARM TO TABLE)
- SUMMER COURSE
- ADVANCED COURSES FOR AGRICULTURAL WORKERS
- TRAINING COURSES FOR YOUNG PEOPLE

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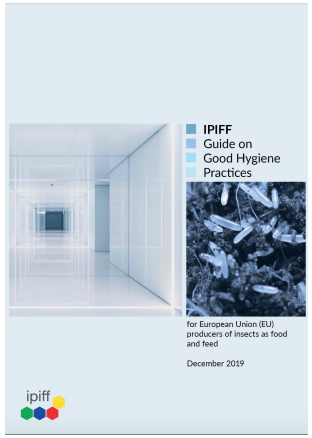
TRANSFER & LEADERSHIP

- CREATION OF AN EDIBLE INSECT INDUSTRY CONSULTATION TABLE IN QUÉBEC
- CREATION OF AN ACADEMIC NETWORK IN CANADA
- ADAPTING THE IPIFF GOOD PRACTICE GUIDE TO THE NORTH AMERICAN INDUSTRY
- ORGANIZING IFW 2020 AND 2022
- SUPPORTING DE CREATION OF AN INTERNATIONAL ACADEMIC NETWORK

TABLE FILIÈRE DES INSECTES COMESTIBLES

Agriculture, Pêcheries et Alimentation Québec



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RESEARCH & DEVELOPMENT

- OPTIMIZATION OF PRODUCTION TECHNIQUES
- RECOVERY OF MUNICIPAL ORGANIC WASTE
- VALORIZATION OF LIVESTOCK WASTE
- DEFINITION OF ECONOMIC & TERRITORIAL MODELS
- DIVERSIFICATION OF EDIBLE SPECIES PRODUCTION

UNIVERSITÉ LAVAL

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Présidente de la Table filière des insectes comestibles TFIC: https://insectescomestibles.ca

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Faculté des sciences de l'agriculture et de l'alimentation

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