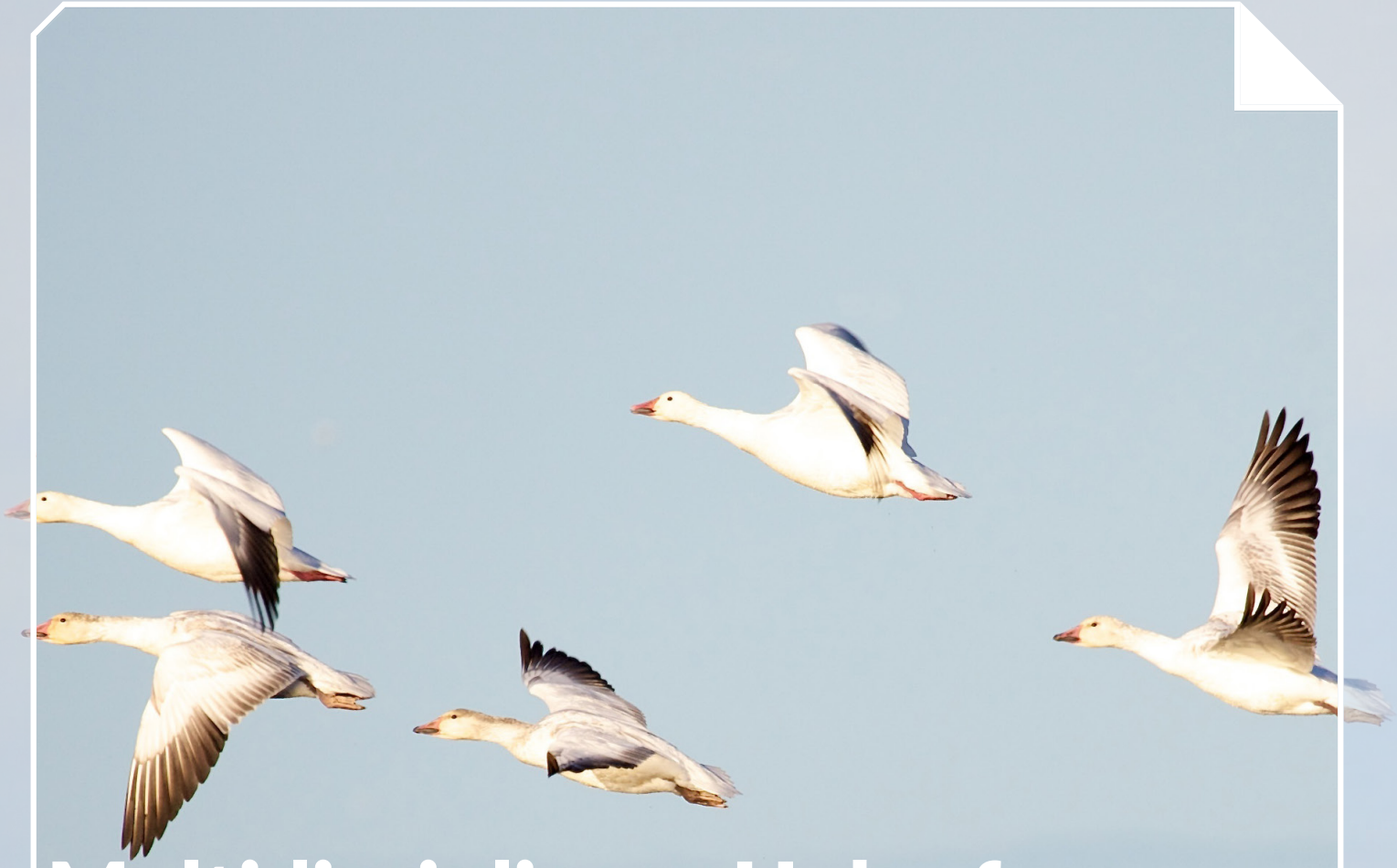

# Multidisciplinary Hub of Expertise on the Sustainable Management of the Littoral Zone of Lake Saint-Pierre in Québec

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## Introduction

The United Nations General Assembly has declared the UN Decade on Ecosystem Restoration (2021-2030). It is a call to action for the protection and restoration of ecosystems all around the world, which would be beneficial for both people and nature. It strives to halt ecosystems' deterioration and degradation and restore them in order to meet global goals. It is not possible to improve people's lives, combat climate change, or halt the extinction of wildlife without maintaining healthy ecosystems.

Within this framework, wetlands are essential ecosystems because they support a diverse range of species and provide critical benefits to society and nature across several areas, such as agriculture, fisheries, water, forestry, health, energy, recreation, transportation, education, development, and indigenous and local communities.

Anthropogenic activities continue to erode and destroy the world's wetlands at an alarming rate. To deal with this, actors have invested in initiatives that aid in the research, planning, implementation, support, and coordination of local restoration efforts.

## Project Summary

The "Multidisciplinary hub of expertise on the sustainable management of the littoral zone of Lake Saint-Pierre in Québec" (Pôle d'expertise multidisciplinaire en gestion durable du littoral du lac Saint-Pierre) is a project created within the 2018-2023 Action Plan, as part of the Québec Water Strategy.

The project was created to develop sustainable agriculture and protect the ecosystem of Lake Saint-Pierre. This is done through research and a collaborative approach between different ministries and universities in the region. The main objective is to develop an intervention strategy in the floodplain that fosters the implementation of a sustainable and adapted agriculture that takes into account the ecosystem of Lake Saint-Pierre and supports the restoration of priority sites.

This project initiates a dialogue about the main challenges facing this fragile ecosystem and enables stakeholders to participate actively in the process.

The project is expected to generate beneficial spillovers in socio-economic, environmental and wildlife terms.

## Key Information

**Location**
Québec, Canada

**Areas of focus**
Research, adaptation, stakeholders collaboration and governance

The project is based on three main themes: agriculture, environment and wildlife, and socioeconomy

**Founded in**
2018

**Investment**
A total of 5.5 million Canadian dollars (US$4.19 million) for 4 years of activity

**Aichi Biodiversity Targets addressed**
Strategic goals A, B, C, D and E

**Sustainable Development Goals addressed**
SDGs 12, 14, 15 and 17

## Author

Québec's Ministère de l'Environnement et de la Lutte contre les changements climatiques

Littoral zone of Lake Saint-Pierre during spring flooding. © P.-A. Bordeleau, UQTR.

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# BACKGROUND AND CONTEXT

## Floodplain of Lake Saint-Pierre

Lake Saint-Pierre is located on the St. Lawrence River, between Sorel-Tracy and Trois-Rivières, in Québec, Canada. It is almost 30 km long and 13 km wide, and is the last freshwater basin of the St. Lawrence River upstream of the estuary. The low topography of the area resulted in the formation of the largest freshwater floodplain in Québec. Its littoral zone (i.e., the shoreline and near-shore area) comprises wetlands, swamps and cultivated land. It fulfills important ecological functions for the ecosystem of Lake Saint-Pierre.

## The biodiversity of Lake Saint-Pierre

The Ramsar Convention recognized Lake Saint-Pierre as a wetland of international importance in 1998 and UNESCO included it in the list of Biosphere Reserves in 2000. The lake and its archipelago also encompass a network of 57 protected areas included in Québec's register of protected areas.

The littoral zone presents exceptional biodiversity: repeated floods created a wide range of wetlands that provide critical habitats for the breeding, nesting and feeding of a varied fauna such as waterfowl, fish and aquatic invertebrates.

The wetlands of Lake Saint-Pierre account for almost 63% of the total wetlands of the St. Lawrence River. The area is used by 40 species of mammals, 288 species of birds (72% of Québec's bird species) and 79 species of fish (70% of Québec's freshwater fish species).

## Agriculture in the littoral zone

The fertile land in the littoral zone has been cultivated since the seventeenth century. It was first used to grow wheat to produce flour, and then it was turned into grass in the mid-nineteenth century to sustain the fledgling dairy industry. In recent decades, the land has been converted for annual corn and soybean crops. At present, these crops largely dominate the agricultural landscape in the littoral zone.

## Growing human pressure

Since the 1960s, human activities, from road infrastructure construction to expanding vacation resorts, encroached on the lake's floodplain. Changes in agricultural practices also transformed the landscape and modified crucial habitats for wildlife. Conventionally grown corn and soybeans require extensive tillage and leave the land bare after harvest, resulting in a significant loss of biodiversity. This type of land use is not conducive to spawning fish during the spring or to nesting waterfowl and farmland birds.

Wetlands were drained and converted to farmland at a time when the straightening of watercourses and disappearance of riparian strips led to habitat loss, shore erosion, stream sedimentation and siltation. Agricultural pollutants affecting water quality in the tributaries were regularly washed into the lake, where they had an impact on aquatic life and development opportunities. In recent decades, new threats have also appeared with the introduction and expansion of invasive alien plant and animal species.

## Historic initiatives

Past efforts and initiatives in the drainage basins and their direct tributaries did limit some anthropic pressures on Lake Saint-Pierre, in particular: industrial waste from the pulp and paper, mineral and metal processing industries, as well as municipal effluents

in the 1980s. The agriculture and aquaculture sectors also made efforts through government programmes, especially with regard to pollution related to the management and storage of solid and liquid manure, and the reduction of pollution from non-point sources.

### An ecosystem under surveillance

However, the health of the Lake Saint-Pierre ecosystem is worrying. The situation has become so critical for some species that, in 2012, a five-year moratorium was introduced for sport and commercial fishing of the yellow perch (*Perca flavescens*), which was renewed in 2017 until 2022. This temporary measure reduces pressure on the species and helps maintain its population, but at a level of abundance too low to support a sustainable fishery. Given the lack of recovery of the species, the scientific committee for the management of yellow perch in Lake Saint-Pierre recommended in 2019 that measures to restore quality habitats for the species be intensified. Numerous challenges remain to restore this ecosystem, a jewel of Québec biodiversity, and the strength of partnerships is key.

### An intervention strategy for Lake Saint-Pierre

In 2013, Québec launched an intervention strategy for Lake Saint-Pierre to set up initiatives aimed at improving ecosystem health in collaboration with community stakeholders. This commitment was renewed in the 2018-2023 Action Plan as part of the Québec Water Strategy. Since 2018, the strategy has been deployed in two complementary main components: (1) the Lake Saint-Pierre conservation programme; and (2) the multidisciplinary hub of expertise on sustainable management in the littoral zone of Lake Saint-Pierre (hereinafter referred to as the "Hub").

### Part 1: The Lake Saint-Pierre conservation programme

This programme provides financial support to initiatives that seek to preserve and restore natural sites or habitats to protect and improve water quality and biodiversity in Lake Saint-Pierre and encourage the restoration of ecological functions in its littoral zone and tributaries. It is managed by the Fondation de la faune du Québec and funds wetland and shore restoration projects in agricultural environments, as well as wildlife management initiatives and the enhancement of habitat connectivity. Through this programme, the Fondation de la Faune also supports the participation of agricultural companies that make their land available to the scientific projects of the Hub.

### Part 2: The multidisciplinary hub of expertise on sustainable management in the littoral zone of Lake Saint-Pierre

To develop sustainable agriculture and protect the rich and diverse ecosystem of Lake Saint-Pierre, the Government of Québec announced the creation of the Hub in July 2018. This case study focuses on the Hub.

Aerial photo of the littoral zone during flooding. The coloring indicates the differences in turbidity depending on the source of the water masses. © Pierre-André Bordeleau

Biomass sampling of alternative crops at the end of the growing season. © Élise Smedbol.

# KEY ACTIVITIES AND INNOVATIONS

## Purpose and objectives

The Hub aims to develop an intervention strategy in the littoral zone that fosters the implementation of a sustainable and adapted agriculture that takes into account the ecosystem of Lake Saint-Pierre and supports the restoration of priority sites.

To this end, the Hub pursues three objectives:

- Develop crops and agricultural practices adapted to the specific context of the extensive cultivated shores of Lake Saint-Pierre that have a positive impact on the quality of its ecosystem
- Assess the performance and social, economic, environmental and fauna impacts of agricultural activities and restoration projects
- Based on research findings, propose to the government an agricultural management approach that fosters the implementation of sustainable agriculture in the littoral zone of Lake Saint-Pierre

## A collaborative approach

The Hub brings together researchers working collaboratively under the scientific coordination of Université Laval, McGill University and the Université du Québec à Trois-Rivières (UQTR). The universities ensure compliance with the Hub's mandate, in partnership with three of Québec's ministries: Ministère de l'Agriculture, des Pêcheries et de l'Alimentation (MAPAQ), Ministère des Forêts, de la Faune et des Parcs (MFFP) and Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC).

## Research programme

Following a stakeholder consultation, the Hub presented in February 2019 its 2019-2022 research programme, comprising 20 projects led by almost 30 researchers from the aforementioned universities. Twenty agricultural producers are actively involved in scientific work by making farmland available and, in some cases, by conducting field operations.

The programme is re-evaluated each year. The research team ensures its continued adaptation to challenges and issues that may arise during its activities, including climate risks and restrictions related to the COVID-19 pandemic. Thus, as the work progresses, some projects can be modified, while new ones can be elaborated.

Three themes structure the research programme:

- Theme 1: Agriculture
- Theme 2: Environment and wildlife
- Theme 3: Socioeconomics

**Agriculture** is the central axis. It comprises eight research projects focused on the establishment of various farming systems, alternative crops and trials of agricultural practices in the littoral zone of Lake Saint-Pierre.

It features large-scale projects covering entire fields, allowing six cropping systems to be compared according to an agricultural intensification gradient: recent and long-term grasslands; corn (*Zea mays*) and soybean (*Glycine max*) crops with interspersed cover crops and perennial strips bordering the field along trenches; and conventionally managed corn and soybean crops.

This experimental design serves as a test for known crops and agricultural practices for which adaptation to the specificity of the littoral zone poses challenges. In the systems studied, phytosanitary monitoring is carried out, which includes the detection of insect pests, diseases and weeds. The design is also facilitating a study aimed at clarifying the interactions between flooding and the management of cultivated land in the littoral zone with respect to the solubility and retention of phosphorus, nitrogen and carbon.

Natural habitats, such as wet meadows and forests, are used as monitoring sites to assess the environmental and wildlife aspects of large-scale projects.

This project also includes trials on small plots to test different types of crops with interesting potential in the littoral zone:

- cover crop species interspersed with annual crops, such as corn and soybeans, and planted mid-season to simulate prolonged flooding;
- forage species according to different cutting and fertilization management schemes;
- alternative crops, such as shrubs and perennial and annual herbaceous plants that offer varied uses (grain, fruits and aromatic or medicinal plants).

The agricultural practices studied also include the following trials:

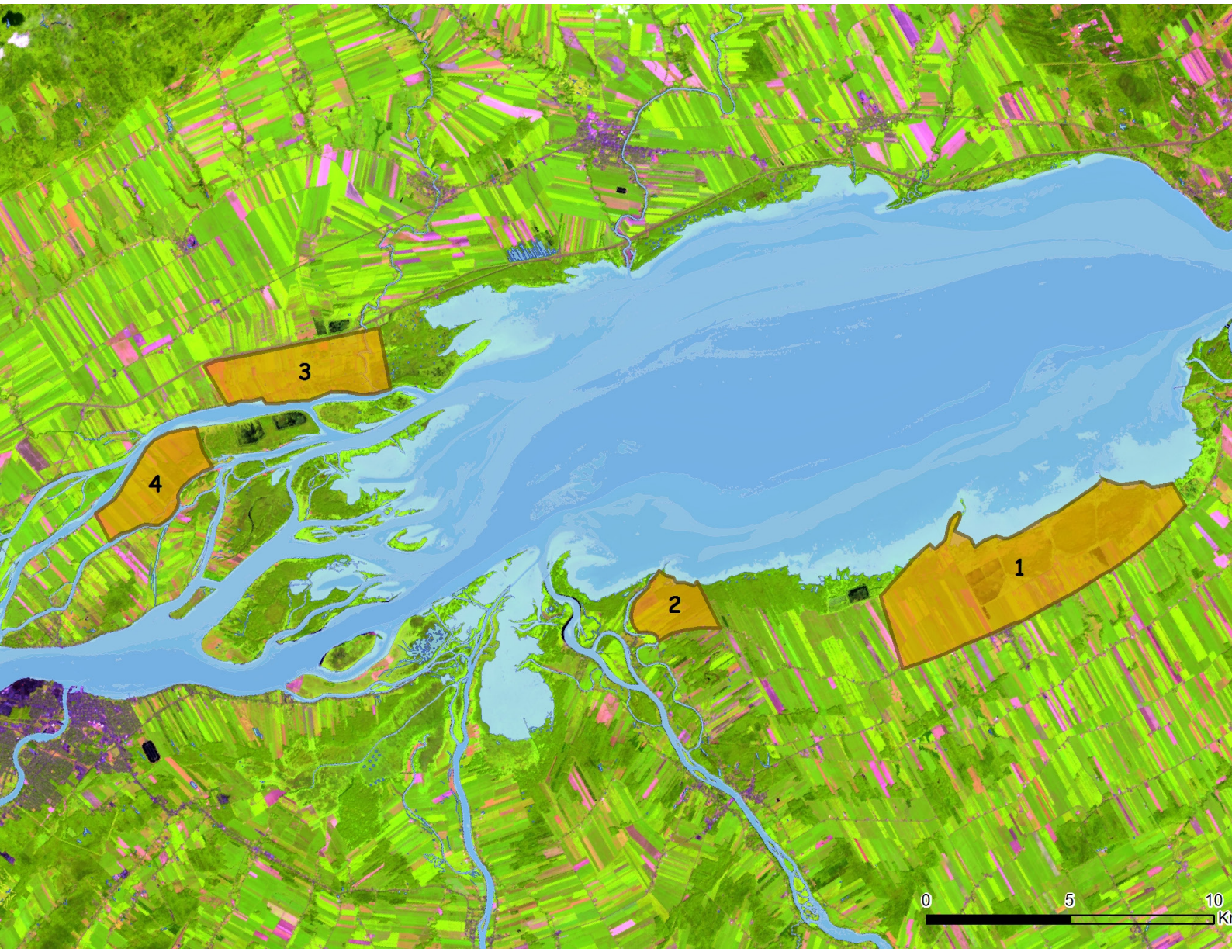
- the establishment of perennial herbaceous strips along agricultural drainage ditches and subsequent monitoring of water quality in ditches;
- a comparison of different types of soil cultivation;
- an assessment of the potential of buckwheat (*Fagopyrum esculentum*) in an integrated management strategy to combat seedling pests, such as wireworms, white worms and seed worms, in large crops.

The sites are subject to an assessment of agronomic performance in terms of their adaptation to the specific conditions of the littoral zone and the environmental, wildlife and socioeconomic impacts, which are studied respectively within the framework of the themes of environment, wildlife and socioeconomics.

## Research site

Four priority sites have been selected to complete the work of the Hub so that they include a range of land uses and represent both shores of Lake Saint-Pierre. Baie-du-Febvre, Pierreville, Saint-Barthélémy and Île Dupas are the four localities identified (figure below).

As for the projects focusing on drainage ditches and herbaceous strips along them, other sites have been selected in the Baie-du-Febvre area, in Saint-Cuthbert and Yamachiche.




Location of the priority sampling areas of the Hub: 1) Baie-de-Febvre, 2) Pierreville, 3) Saint-Barthélémy and 4) Île Dupas.

# ENVIRONMENTAL IMPACTS

The **environment and wildlife theme** seeks to:

- Characterize the origin of the expanses of water that flow into Lake Saint-Pierre and affect floods.
- Measure the impact of tested and monitored crops, farming practices and fauna of Lake Saint-Pierre.
- Assess the role of natural wet meadows and forests in the shoreline dynamics of Lake Saint-Pierre.
- Analyze the toxicity of water and soil according to the different uses of the littoral zone.

This theme covers 11 research projects:

- One of the projects aims to map water flow patterns in the littoral zone of Lake Saint-Pierre during floods (April and May) and in the dry period (June to September), and then characterize the tributary water bodies of the lake.
- Another project is assessing the impact of agricultural practices on water quality based on multi-scale remote sensing data with drones and satellites and, conversely, the impact of flooding on agricultural productivity.
- The other projects under this theme monitor environmental variables in agricultural plots within the large-scale projects and in natural habitats used as control sites. They focus on the following elements:

- *Vegetation*: The height and biomass of residual vegetation once the water has retreated. These data are of interest since a residual crop that offers a high density vegetation cover and reaches a height of at least 30 cm would represent a suitable spawning habitat for yellow perch during spring freshet.
- *Soils*: The physical and microbiological properties and biodiversity of soils, and the dynamics of phosphorus and nitrogen in soil.
- *Water*: The physicochemical and microbiological properties of water and the toxicity to fish of chemical compounds found in water.
- *Wildlife:* The productivity of aquatic microorganisms, fish larvae and adult fish, especially yellow perch and pike (*Esox lucius*), and a study of breeding birds, song insects and pollinating insects.

Yellow Perch. © MFFP, Gouvernement du Québec.

## Research findings and possible solutions

The initial findings and possible solutions aimed at fostering sustainable agriculture practices in the littoral zone of Lake Saint-Pierre are expected in March 2022. Given the high variability of climatic conditions and spring freshets, the full research programme must be completed before findings can be interpreted and convincing conclusions are drawn.

For updated information, please consult the www.polelsp.ca website.

Fish sampling in the spring. © Antoine Sénéchal.

# SOCIOECONOMIC IMPACTS

The five projects on the socioeconomic theme seek to better understand the social and economic impact of experimental crops and agricultural practices tested by the Hub at different social scales. To do this, they consider the point of view of:

1) **Producers and agricultural companies** on the costs of implementing the crops and practices tested by the Hub, the impact of their implementation on the financial situation of the companies, the sociotechnical challenges associated with their implementation and their potential rate of adoption by producers.

2) **The littoral zone and its stakeholders** on the individual and collective financial costs and benefits of scenarios for changing or adapting land use and practices across the littoral zone, the challenges faced by agricultural advisers, the levers they can use to encourage change by producers and the sociopolitical challenges presented by the collective management of the littoral zone.

3) **Environmental policies and programmes** on the value of ecological goods and services associated with the littoral area of Lake Saint-Pierre and the design of government incentives or programmes to encourage changes in agricultural practices.

Researchers leading projects in the socioeconomic field meet with agricultural producers, agricultural advisors and professionals from organisations actively involved in the management of Lake Saint-Pierre. In addition, the sociopolitical analysis of governance issues and collective management of the littoral zone involves the engagement of public representatives from four administrative regions and numerous private sector actors.

Working the soil in the dry period. © Julie Ruiz.

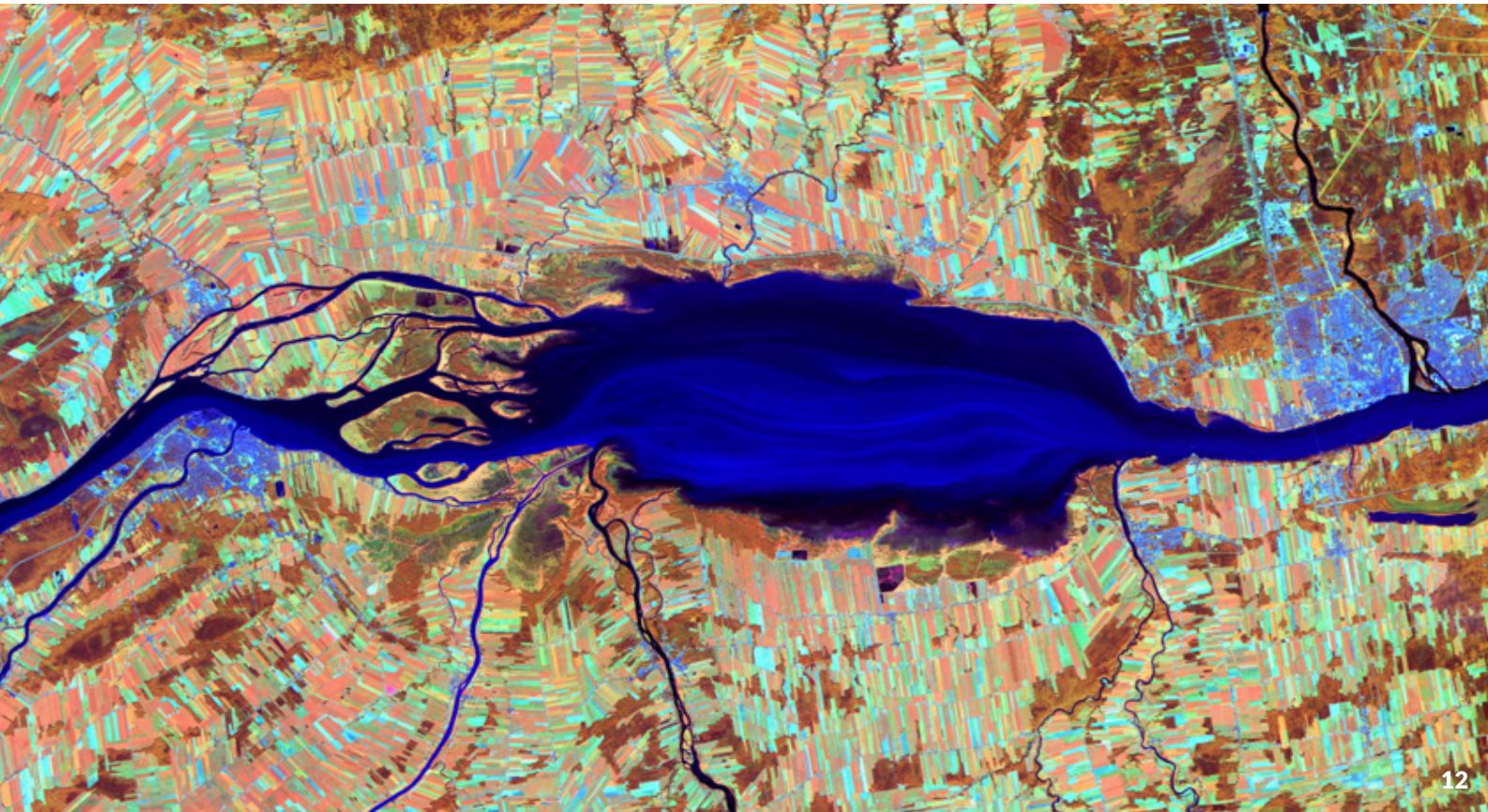
## POLICY IMPACTS

Although the results of the projects of the 2019-2022 research programme are still partial and preliminary at the time of writing, the research of the Hub already points to a positive indirect effect through the establishment of a productive collaboration between the partners involved and the beginning of a dialogue regarding the main challenges facing the ecosystem of Lake Saint-Pierre and its littoral zone. The dialogue, initiated with the development, planning and deployment of a number of research projects, enables all stakeholders to participate actively in the preliminary steps essential to implement sustainable agriculture in the littoral zone of Lake Saint-Pierre that generates beneficial spillovers in socioeconomic, environmental and wildlife terms.

Major flooding affected several regions of Québec in the spring of 2017 and 2019. This revealed a series of deficiencies in the regulations based on the Policy for the Protection of Lake Banks, River Banks, Littoral Zones and Floodplains. This policy provides a minimum regulatory framework that specifies the types of interventions that can be carried out in aquatic habitats. The Government of Québec is working to replace this policy with a framework based on a new risk management approach and updated maps of flood zones.

Pending the adoption of a permanent framework, a new interim regime is proposed and aimed, in particular, at gradually reducing the impacts of soil cultivation in littoral zones. The provisional regime will evolve on the basis of the latest knowledge, including data acquired in the framework of the Hub projects. In fact, several of the conditions considered in the provisional regime are based on the same scientific premises that guided the development of the Hub research programme, such as sustainable fertilization, soil cover in autumn and the planting of strips of protective vegetation. The conclusions and proposals of the Hub will feed in the coming years the reflection of the government on the evolution of the framework that regulates the cultivation of the soil in the littoral zones.

Satellite photo with colorization highlighting land use around Lake Saint-Pierre. © P.-A. Bordeleau, UQTR.



## FINANCIAL SUSTAINABILITY

The Québec government is directly supporting the creation and research of the Hub, which will underpin and influence future local, regional and provincial policies governing human activities in the Lake Saint-Pierre ecosystem, but also to generate positive socio-economic, environmental and wildlife benefits, all of which fall within provincial competence (exclusively or shared with the federal government).

The Hub is thus supported by a four-year funding period initiated in July 2018 with CA$2.66 million from MELCC and CA$2.222 million from MAPAQ.

In the same period, as part of the Québec Water Strategy's 2018-2023 Action Plan, MELCC also awarded CA$400,000 to UQTR in fiscal years 2018-2019 to 2022-2023 to support Hub research focused on assessing the environmental performance of the farming practices tested.

Finally, the participation of agricultural companies that allowed the use of their cultivated land for Hub research is financially supported by the Lake Saint-Pierre conservation programme, administered by the Fondation de la Faune du Québec through a grant from MELCC. Twenty agricultural businesses received CA$207,000 in financial aid during the 2019 and 2020 growing seasons.

## PARTNERSHIPS

### A concerted approach to Lake Saint-Pierre

The Hub is carried out within the framework of a government collaboration between three of Québec's ministries: MAPAQ, MFFP and MELCC. Government ministries established the mandate, objectives and governance structure of the Hub. Three Québec universities (Université Laval, McGill University and UQTR) oversee compliance with the Hub's mandate and objectives.

### Governance Structure

**From a strategic point of view,** a Steering Committee composed of a representative from each ministry (MAPAQ, MELCC and MFFP) and from each university (Université Laval, McGill University and UQTR) manages the Hub. UQTR, a university established in the region and knowledgeable about local concerns, is responsible for administrative management. A Partners' Discussion Table supports the Hub's Steering Committee through its knowledge of the agricultural, socio-economic, wildlife and environmental issues related to Lake Saint-Pierre. The table includes a seat for regional and governmental actors directly interested in the sustainable management of the littoral zone of Lake Saint-Pierre. The Partners' Table facilitates the sharing of expectations and concerns of the community and stakeholders. It thus promotes strategic development in keeping with the needs of the community.

*Integrated management and consensus building:*

- Regional consultation table of Lake Saint-Pierre
- Basin agencies: representatives of organizations active on the north and south shores

*Agriculture:*

- Agriculture and Agri-Food Canada
- Financière agricole du Québec
- Union of Agricultural Producers: representatives of its central confederation and the regional federations of Centre-du-Québec, Lanaudière, Mauricie and Montérégie

*Environment and Wildlife:*

- Ducks Unlimited Canada
- Comité ZIP du Lac Saint-Pierre
- Regional Environmental Councils
- Nature Conservation Canada
- Canada's Environment and Climate Change
- Fondation de la faune du Québec

*Socioeconomics:*

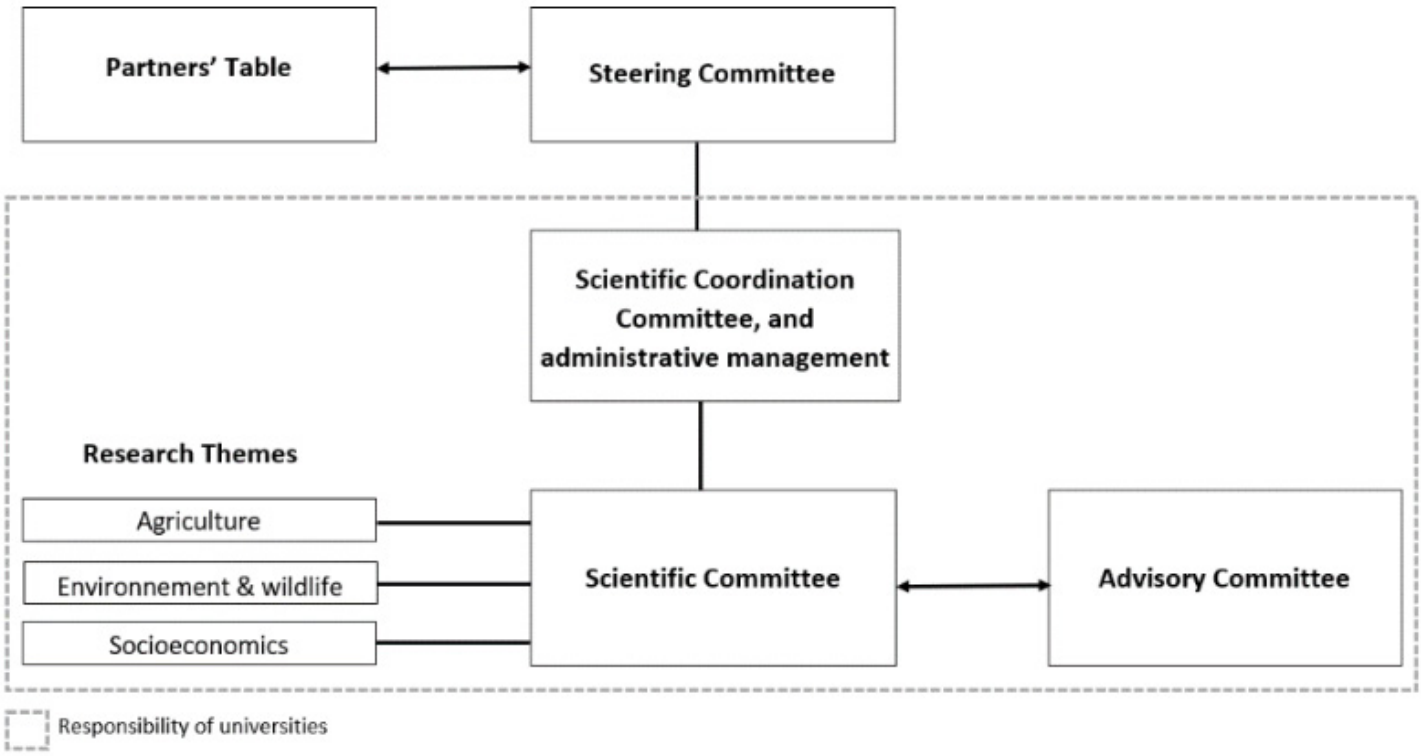
- Regional county municipalities (MRC): RCM D'Autray, RCM of Maskinongé, RCM of Nicolet-Yamaska and RCM of Pierre-De-Saurel
- City of Trois-Rivières
- Great Council of the Waban-Aki Nation
- Lake Saint-Pierre Biosphere Reserve

**From an operational point of view**, the Scientific Coordination Committee, composed of three representatives of the universities in the Steering Committee, coordinates the scientific research of the Hub.

A Scientific Committee and an Advisory Committee advise the Scientific Coordination Committee. The Scientific Committee is made up of six researchers from the Hub who are directly involved in decision-making. The Advisory Committee is made up of professionals from the three government ministries and a representative of the Ordre des agronomes du Québec, who support researchers in establishing their research activities.

Workshop with members of the Steering Committee and various stakeholders contributing to the management of Lake Saint-Pierre. © Chantal Fournier.

## Illustration of the governance structure




Governance structure of the multidisciplinary hub of expertise on sustainable management in the littoral zone of Lake Saint-Pierre

Finally, through their collaboration in the establishment of experimental plots and their contribution to various research systems, agricultural enterprises are directly linked to the search for Hub solutions to promote harmonious cohabitation between agriculture and the environment on Lake Saint-Pierre. On several occasions, Hub researchers highlighted the essential involvement and participation of agricultural producers in the littoral zone and thanked them for their interest and availability.

The Hub research could not go ahead without this crucial collaboration. It is important not only to establish trust-based relationships and ensure transparent communication about ongoing and pending research, but also to inform farmers of the results obtained on their land and to consider with them the possible implications for their future practices.

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## REPLICATION AND APPLICABILITY

A part of the Hub's research and innovation focuses specifically on the local and regional environmental impacts affecting Lake Saint-Pierre and its littoral zone. However, its scope could extend to other large floodplains cultivated elsewhere in Québec and feed the reflection of decision-makers in other parts of the world. The multidisciplinary approach also facilitates the consideration of environmental issues from a sustainable development perspective.

The main strategy used worldwide to restore cultivated floodplains is to exclude annual crops and convert them into extensive grasslands or wetlands while restoring natural water regimes and establishing best agricultural practices upstream of drainage basins, i.e. outside of areas subject to regular flooding. The possibility of producing annual crops sustainably in the floodplains is yet to be determined.

Beyond the issue of sustainable management in a large cultivated floodplain, another key element of the work of the Hub is the participation of all major stakeholders at the very moment of its creation, when the research programme was being defined. Government departments, university researchers, agricultural producers and other agricultural sector partners, national, regional and local environmental sector partners, regional and local government authorities and affected indigenous communities were consulted from the very beginning of the creation of the Hub. This allowed all stakeholders and relevant partners to express their views, possible fears and expectations. The 2019-2022 research programme was defined based on the questions they raised. Once the projects are completed, and following the presentation of the results of the researchers, the implementation of relevant measures to adapt farming systems and agricultural practices will be greatly facilitated.

This approach seeks to mobilise all stakeholders and partners involved from the moment projects are designed, so that everyone is heard and involved from the outset in the smooth implementation of new or adapted agricultural practices and in the improvement of environmental performance, taking into account agronomic imperatives, as well as social and economic agricultural activities on Lake Saint-Pierre and its littoral zone.

### FOR MORE INFORMATION

For more information about this project, please visit the Hub's webpage.

You can also contact us at info@regions4.org to set up an informative meeting, solve doubts and get support in implementing similar projects.

Author: Québec's Ministère de l'Environnement et de la Lutte contre les changements climatiques.

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## ABOUT

Regions4 (formerly known as the nrg4SD) is a global network that solely represents regional governments (states, regions and provinces) before UN processes, European Union initiatives and global discussions in the fields of climate change, biodiversity and sustainable development. Regions4 was established in 2002 at the World Summit in Johannesburg and currently represents over 40 members from 20 countries in 4 continents. Through advocacy, cooperation and capacity building, Regions4 empowers regional governments to accelerate global action.

For more information visit: www.regions4.org

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