Environmental and Agricultural Sustainability: Scoping Review on Evaluating Effectiveness of Living Labs

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Agriculture's Environmental Justice Crisis

- Agriculture is centrally linked to Earth's carrying capacity because:
 - The food we grow is determined by ecosystem limitations and functions
 - Agriculture currently contributes to disruptions to ecosystem functions and stretches Earth's limits.

EX: 10% of Canada's greenhouse gas emissions are from crop and livestock production, excluding emissions from the use of fossil fuels or from fertilizer production (GOC 2020).

Change is needed -> Environmentally Beneficial management practices (BMPs) that reduce runoff or soil erosion, or increase soil organic matter content, help to reduce pesticide transport (RL Clearwater for AAFC 2016).

• This is an **Environmental Justice** issue, not just ecological or technical but deeply social.

EX: Funding for agricultural innovation in Canada is biased toward male-led "high tech" solutions instead of BMPs (see "Money where our mouths are" 2019)

Living Labs, a mechanism for change?

Living Labs (LLs) are a **participatory research approach involving diverse users** in the exploration, co-creation, testing and evaluation of innovations within real-world environments

The 3 Core Principles of Living Labs

1. User-centred innovation

Activities focus on the users' needs and users are involved throughout the development process

2. Working in partnership

Experts from various disciplines and backgrounds tackle a common issue

3. Real-life context

Testing takes place where the users would actually use the technology or practice





c/o Rock's End Farm

Living Labs, a mechanism for change?

 Living Labs show potential to bring forward usercentric solutions for solving complex environmental issue related to agriculture

- AAFC is leading a nation-wide agroecosystem LL initiative
 - Aims to accelerate response to climate change by accelerating adoption of BMPs
 - Opportunity for understanding its effectiveness and how it may be promoted to other environmental sectors

Potential to increase visibility and leverage LL approaches for environmental and agricultural sustainability, in Canada and globally.





c/o AAFC LL Initiative

Source: G20 MACS. 2019. *Agroecosystem Living Laboratories: Executive Report.* G20 Meeting of Agricultural Chief Scientists (MACS) International Agroecosystems Living Laboratories (ALL) Working Group.

Gap and Objectives

A gap exists in our understanding of how to evaluate and measure the processes that influence the effectiveness of LLs and their longer-term impacts – notably, environmental ones. Further, LLs for sustainability remain underexplored in literature and practice.

To fill this gap, our team set out to:

Objective 1: Synthesize best practices for evaluating impacts and effectiveness of LLs via a scoping review

Objective 2: Develop a research agenda (in context of sustainability) by eliciting expert knowledge on gaps and strengths of LLs (Delphi process)

Objective 3: Build and engage a network of cross-sectoral LL experts, stakeholders and partners interested in LLs for sustainability (in partnership with AAFC)

Obj 1: a scoping review identifying best practices for evaluating LLs





Moving toward Generalizability? A Scoping Review on Measuring the Impact of Living Labs

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Abstract: The living labs (LLs) approach has been applied around the globe to generate innovation within and suited to real-life problems and contexts. Despite the promise of the LL approach for addressing complex challenges like socio-ecological change, there is a gap in practitioner and academic community knowledge surrounding how to measure and evaluate both the performance of a given LL process and its wider impacts. Notably, this gap appears particularly acute in LLs designed to address environmental or agricultural sustainability. This article seeks to verify and address this knowledge gap by conducting an adopted scoping review method which uses a combination of tools for text mining alongside human text analysis. In total, 138 academic articles were screened, out of which 88 articles were read in full and 41 articles were found relevant for this study. The findings reveal limited studies putting forward generalizable approaches or frameworks for evaluating the impact of LLs and even fewer in the agricultural or sustainability sector. The dominant method for evaluation used in the literature is comparative qualitative case studies. This research uncovers a potential tension regarding LL work: the specificity of LL studies works against the development of evaluation indicators and a universal framework to guide the impact assessment of LLs across jurisdictions and studies in order to move toward generalizability.



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Keywords: living labs; evaluation; impact; environment; agriculture; sustainability; scoping review



Figure 1. Flow diagram of scoping review using Prism-ScR checklist in this study.

Summary of Findings: *majority of articles were from Europe*

- Articles typically focus on more than one LL "site" or "sector"
- The majority of articles come from European authors or sites



Figure 3. The total number of articles included in the scoping review process. Figure (**A**) shows the total articles published (in no.) by year and (**B**) shows the countries involved in publishing articles on living labs (in no.).

Summary of Findings: very few studies on agricultural sustainability evaluation



Figure 4. No. of articles published on living labs focusing on innovation, social impact and agricultural sustainability. Articles are not mutually exclusive. Source: Scoping review.

Summary of Findings: a *plurality of evaluation methods*



Figure 8. Summary of different evaluation approaches used in LL studies which discuss evaluation.

Table 2. Summary of relevant evaluation frameworks and models used in LLs evaluation literature.

Evaluation Framework/Principles/Model	Key Focus	Key Elements	Authors
Digital Co-Creation Index (DCCI) framework for evaluation in EU	A systemic understanding of the basic factors shaping the co-creative processes in LLs.	Emphasize the interplay between places, technology, and people within LLs.	Mačiulienė & Skaržauskienė [38]
The four-capital method of sustainable development evaluation, originally developed by Ekins et al. 2008	Relationship between the needs, objectives, inputs, operations, and output	Consists of four capitals: human, financial, environmental, and manufactured.	Ondiek & Moturi [21]
Conceptual framework: mixing user-centred strategy and participatory strategy	Conceptualise the impacts of the user-centred and participatory strategies on innovation performance outcomes by assessing the project performance and transfer performance.	In user-centred strategy, observing user's behaviours, capturing users' insights, and receiving users' feedback are considered. Co-designing and collaborating with users and enabling users' experience through prototypes are the major elements of participatory strategy.	Dell'Era et al. [35]
Logical effect model for LL projects	For the evaluation of small and medium sized enterprises, potential effects of LL projects are categorized as short-term, mid-term and long-term.	Key elements are use, usefulness and value of LL project, initial objectives and achieved effects, effects on investments, revenues, and employment because of LL project results.	Ballon et al. [2]
A maturity grid-based assessment tool	Framework developed by reviewing eight frameworks that focus specifically on innovation laboratories	Guidance tool to evaluate the maturity degree of an innovation laboratory or to adapt an existing LL project	Osorio et al. [41]
Harmonization cube	LL Harmonization Cube created, in alignment with the structure of the "Rubik" cube	The columns of the cube describe the organizational, contextual, and technological issues, the rows represent the maturity level of LLs, as: setup, sustainability, and scalability.	Kovacs [37]

Key Takeaways from Scoping Review

Several large networks of LL initiatives have recently been formed in North America and across Europe that focus on **rural innovations and sustainability**

These larger research projects could work to develop a **unifying framework for evaluating sustainability LLs** by focusing on three key elements which we synthesized from best practices:

- (1) level of participant involvement and empowerment,
- (2) time-series analysis, and
- (3) long-term viability of the LL project.

Obj 2: Producing a Research Agenda with Delphi Approach





Delphi survey results, continued

What are the key elements to What are key elements to Which of these key elements promote the effectiveness of promote the social impacts need to be better known? of Living Labs? Living Labs? Clarify how we **define efficiency** Clarify how we **define social** Collaboration and co-creation governance impacts & how to measure social models **Collaboration and co-creation** during • impacts the Living Lab process **LL features**: adaptability/flexibility, capacity, feedback mechanisms Social innovations (e.g. changes in Which features of Living Labs can behaviors & attitudes, perceived ٠ promote effectiveness quality of life, social products & Co-creation of values, diversity of services) stakeholders, & social capital Many respondents mentioned • methods and processes Measuring creativity and well-**Evaluation methods** adapted for Living being Labs **Fewer respondents spoke of impacts** • Importance of users and **Impacts** tied to environmental protection, local outcomes and business models partnerships, new social ties, trust,

inclusion and equality, data sharing

Preliminary findings: Barriers and enablers to effective LLs (scoping review)

FACTORS ENABLING EFFECTIVENESS ALONG DIFFERENT DIMENSIONS

Individual	 Alignment of interests Incentives and upkeep motivation Dedication, proactivity & commitment (leadership)
Team	The right participantsMultidisciplinary
Relationship	 Trust, mutual goals, reciprocity Equal partnership Building networks/community
External	 Time and resource Human capital Geographical proximity
Processes	 Facilitate, communicate and empower Focus on community-based/user needs Adapt to local/regional context

PRACTICAL EXAMPLES FOR PROMOTING ENABLERS

- 1. Community of Practice
- 2. Kick off workshops for buy in
- 3. Focus groups, workshops, working groups
- 4. Good facilitation / third party broker
- 5. Long term plan/sustainability of partnership
- 6. Accessible platform (digital, face-to-face, apps)

Upcoming Delphi workshops (May 2021)

2 workshops with ~20 experts (1 French, 1 English)

1. Divergence activity

- -In smaller groups
- "fiction" design using concrete example ("What are the relevant tools AAFC should use?")

-Identify social science tools

1 goal (define research priorities regarding social dimensions of the evaluation of Living Labs) 2 activities

2. Convergence activity

-Confirm and validate priorities from Delphi survey

- Prioritizing exercise of important research themes and actions



Next step ightarrow

Establish the social research agenda (Themes, axes, activities, partners and collaborators)



Conclusion and Significance

 Publicly established and supported agro-ecosystem LLs could be a policy "lever" for positive socio-environmental change
 Leverage and expand model to other sectors

Early stages of LLs for agro-ecosystem sustainability; Canada currently a leader

- "Accelerating the adoption of climate-smart best practices in agriculture" AAFC news release March18, 2021
- \$185 million over 10 yrs commitment for Agriculture Climate Solutions

Study LLs in action!

Use agenda to frame investigations and new research on LLs within context of sustainability

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