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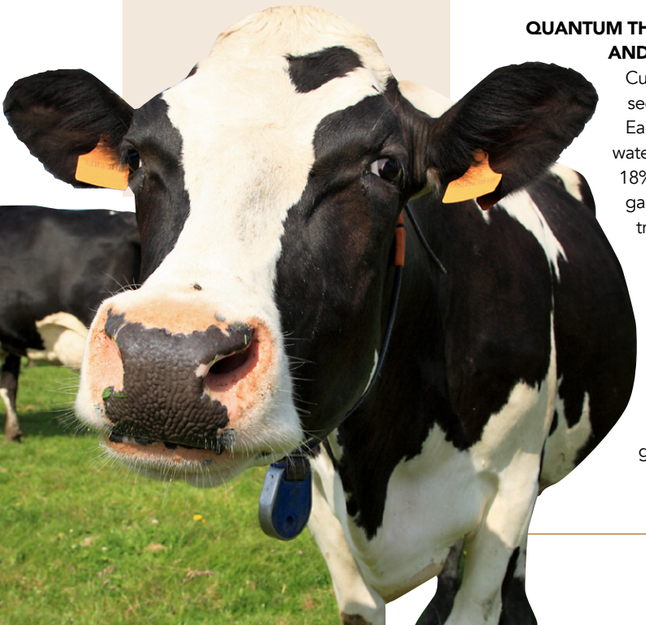
Quantum theory for sustainability transformations

Agriculture significantly contributes to environmental issues and requires deep and urgent transformations in order to be sustainable. Agroecological transition is not only technical but involves the evolution of farmers' ways of seeing and interpreting the world. Dr Cyrille Rigolot at the French National Research Institute for Agriculture, Food and the Environment (INRAE), explores the potential of quantum theory as a source of insight to foster deep sustainability transformations. His strategy is being put to the test through participatory projects with farmers, farm schools and extension services.



Dr Cyrille Rigolot is a scientist based at French National Research Institute for Agriculture, Food and the Environment (INRAE). His research draws upon transdisciplinarity and quantum theory to transform livestock farming.

Quantum theory offers insights and understandings on issues relating to 'strong sustainability', a model that considers preservation of the biosphere and its ecological processes to be of primary importance. A transdisciplinary approach is useful in studying and encouraging farming transformations through the integration of non-academic sources, such as farmers' experiences, in the production of knowledge. Therefore, through combining practical and theoretical perspectives, transformations in livestock farming toward more sustainable practices are being encouraged.

QUANTUM THEORY AND FARMING

Currently, the livestock sector uses 30% of the Earth's land, 32% of its water, and contributes 18% of greenhouse gas emissions. This trend contributes to the present era being defined as the Anthropocene epoch, due to the impact humans are having on the Earth's ecosystems. These global trends require transformations in farming practices, and also social change in the values farmers hold about the land and nature. Rigolot and colleagues are working with farmers to explore and research these values and the related farming methods they follow. The research is informed by the surprising premise that quantum theory provides a source of insights when working alongside stakeholders, such as farmers, in problem-solving projects.

To encourage strong sustainability, transformations in agricultural practices and a simultaneous shift in worldviews (the values and meanings a person gives to the world) are necessary. Even though they may farm in the same area or region, farmers can hold differing views on sustainability, and this factor influences agroecological transformations. Whereas modern farming practices seek to stabilise the farmed environment through technical and chemical means, in agroecology, farmers work with the land to improve soil quality, animal wellbeing, and biodiversity. The transdisciplinarity approach is a promising trend, as it seeks to understand not just the management of farmed land, but the complex web of interactions between farmers and their worldviews, the land, the livestock, and management practices.

TRANSDISCIPLINARITY: THEORETICAL AND PRACTICAL

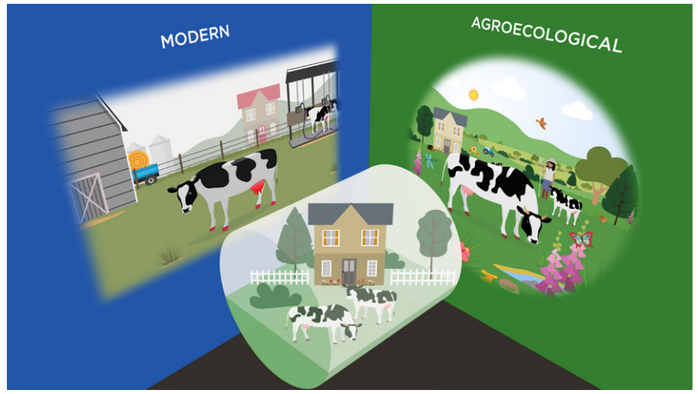
Two modes of transdisciplinary research have been identified: in Mode 1, a theoretical view is taken to gain a detached, generalised understanding of the world; in Mode 2, an involved, hands-on approach is taken, often working with stakeholders to solve problems. These two modes have mainly developed independently, with Mode 1 lacking tangible real-world impacts, whilst Mode 2 is too superficial given the sustainability challenges ahead; taking either stance on its own has the potential to exclude the other. Therefore, the quantum concept of complementarity may help to address the gap between these modes that appear to take very different paths - the former mode being theory-based, and the latter being practical. This quantum conceptualisation allows a co-existence of paths, such that an individual farmer may make choices according to context and current requirements, rather than following a simple linear, causal path.

Sustainability transformations, where a farmer shifts from one worldview to another, do not happen sequentially, meaning that there is no straightforward conversion route for farmers. Quantum approaches help to conceptualise this non-linearity, implying that there are multiple narratives for change. Farmers' preferences are often not well defined, but instead they exist in a state of possibilities, where the Self, until the point of action, is a mix of potential actions and options. The Self, or individual, is not entirely controlled by external forces, such as the political sphere, nor strictly driven by personal, internalised forces, rather, they are shaped by external and internal factors; recognition of these factors can illuminate how research is conducted and who is listened to. For example, indigenous knowledge or the use of biodynamic farming methods have so far been underexplored, yet through a quantum lens there may be insights from these practitioners that are relevant for sustainability and transformations.

QUANTUM CONSCIOUSNESS?

Fostering transformations in stakeholders' perspectives benefits from consideration of three spheres of transformation understood as the Political, the Personal and the Practical. Whilst it has been suggested that change must initially occur in the political sphere as part of sequential transformation, the personal sphere may be more significant than has been credited, with transformations at this level then scaling-out to effect transformations in the political sphere. The work of Karen O'Brien (2015) can be used to illustrate this personal, subjective transformation. She has proposed that somewhat like a ripple effect, small individual actions can have a global influence. Again, quantum theory helps to understand the subtlety and complexity of how transformations happen. 'Quantum consciousness' has been proposed as having something new to offer to the social sciences, with regard to understanding human consciousness, assisting comprehension of social issues, social change, and the subjectivity behind them. This idea is currently quite speculative, but taking it seriously reminds us that knowledge is forever open and evolving, not a firm ground to stand on.

This quantum approach conceives of the entangled, joined-together, and interacting ways in which spheres exist and are moved among and between by individuals. This also has implications for research methodologies that seek to understand farmers' worldviews



The "cylinder metaphor" illustrates the quantum principle of complementarity: a cylinder looks like a circle from one perspective and a rectangle from another perspective. To some extent, farmers' worldviews can be thought as having complementary features, i.e. features that exclude each other in such a way that prevents getting the full picture of the object considered (the farm).

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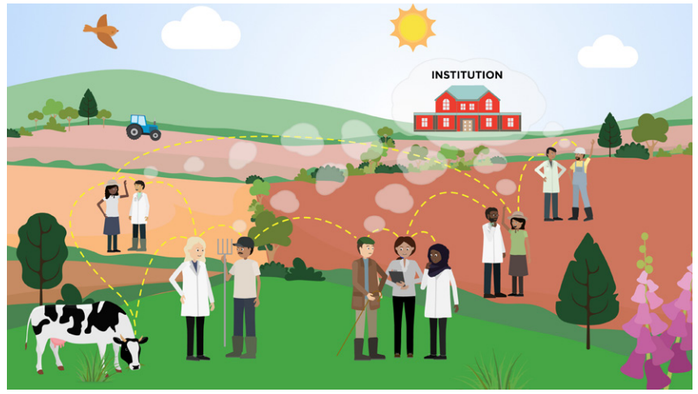
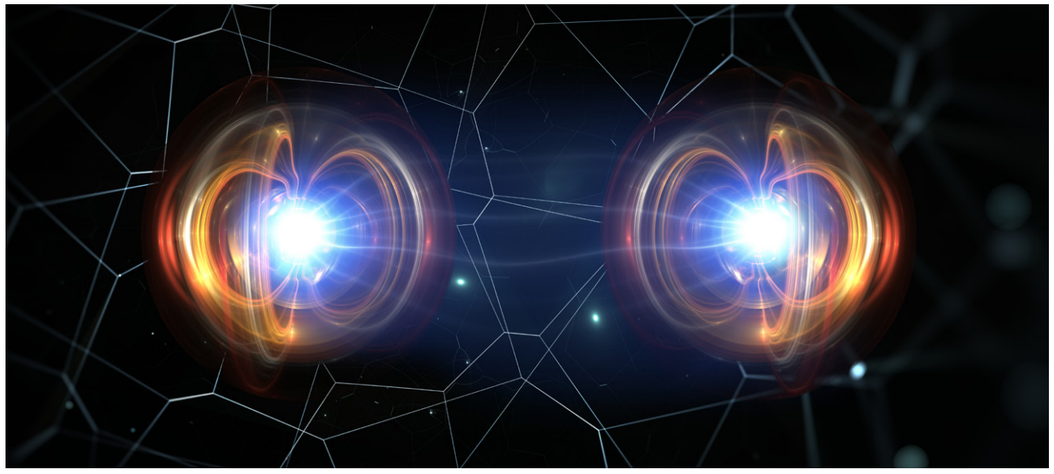


Following a quantum social approach, individuals are seen as "entangled" rather than fully separable entities. Social structures (i.e. institutions) are seen as both external and internal to human beings collectively.



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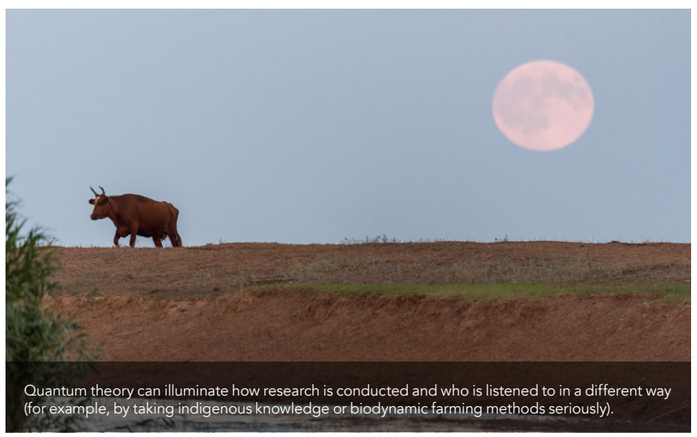
and transformations in their livestock farming practices and beliefs. Classical physics regards people as single units, with a limited or non-existent capacity for freewill or subjectivity, a somewhat restrictive perspective, whereas a quantum approach recognises the significance of subjectivity. The quantum consciousness hypothesis is supportive of this view: it explains the Self as only becoming determinate upon acting, as up until that point, multiple possibilities and routes exist. This attitude can help experts to shape the advice they give to farmers, working alongside and encouraging them to take steps to transform their farming methods in a dynamic way that permits for their own agency and actions.

Insights from quantum theory convey a radical meaning, which might be essential to foster deep sustainability transformations.

FARMER'S WORLDVIEWS

Rigolot and colleagues (2018) conducted comprehensive interviews with French dairy farmers to explore their worldviews, and four different types emerged. The Modern, which aims to maximise and control pastures and animal production, with a focus on efficient production and economic return; the Ecological Intensive, which seeks good productivity without controlling the environment through working with local soil characteristics. The Holist approach regards farming as a part of nature, whose protection is essential; whilst the Traditional distinguishes between a natural and a domesticated world, with ancestral farming habits being carried forward generation to generation. Within these four different types, farmers sometimes held coexisting worldviews, for example, using both traditional and modern farming techniques.

These results offer useful insights for technical experts who advise farmers; these experts have a key role to play in agroecological transformations as farmers value their guidance. Farmers' worldviews and the related management practices that accompany those views are instrumental in shaping sustainability transformations. Rigolot and colleagues' research indicates that supplying experts with simple information sheets containing ideas on worldviews could help them adapt their advice to each farmer. This is supported by the findings from workshops with farmers, which revealed that their perspectives can and do alter, demonstrating that transformations are possible at the personal level. Despite quantum theory being connected with laboratory-based and seemingly impractical theorising, it has the potential to explore and promote sustainable transformations, with farmers, technical experts, and academic advisors working together to develop sustainable transformations in farming practices.



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Quantum theory can illuminate how research is conducted and who is listened to in a different way (for example, by taking indigenous knowledge or biodynamic farming methods seriously).

Behind the Research

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Research Objectives

Cyrille Rigolot's research aims to find sustainable pathways for agriculture where people, animals and nature can thrive.

Detail

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Bio

Cyrille Rigolot is a scientist at INRAE, and deputy director of the joint research unit "Territoires". His research aims to understand and foster deep transformations of livestock farming in the context of global change. He is particularly interested in transdisciplinary approaches combining natural and social sciences together with stakeholders' knowledge outside the academia.

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Collaborator

- Patrice Cayre, French Agriculture Ministry, Research and Teaching General Division (DGER)
- Catarina Moreira, Queensland University of Technology (QUT), Brisbane, Australia

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Personal Response

Are dairy farming techniques becoming more sustainable due to your research findings and your proposed approach?

" My approach aims at activating what Donnella Meadows calls "deep leverage points", the level of worldviews and paradigms. These are very difficult to change, but a small change there can bring the radical system shifts that are required. This approach is complementary to incremental technical changes, which are easier but more superficial. In our participatory project, our transdisciplinary approach really helps some farmers engaged in difficult to achieve agroecological transitions. Some of these farmers are managing demonstration farms in farm schools, with direct implications for the education of the next generation of farmers. My hope is that the quantum approach could contribute to upscale radical sustainable change beyond this project. This is possible but uncertain: somehow this is a risk. "

Do you foresee other environmental sectors also benefiting from a quantum theoretical approach, for example forestry, fishing, crop farming?

" Absolutely. For example, quantum-inspired techniques such as "Q methodology" have been used for forestry, fishing and several other sectors. There are also promising quantum applications in other research domains, such as International Relations (Wendt, 2015). In fact, quantum approaches could be used potentially in every human-related domain: this is more about people than about any particular sector. "