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**“Engineering Ecological Modernization of Agriculture / Exploring the Potential of  
Tropical Biological Resources for Innovation / Towards a Bio-Economic  
Development of Caribbean Countries”**

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## FUTURE OF AGRICULTURE

### LAND USE AND FOOD SECURITY IN 2050 – THE AGRIMONDE-TERRA SCENARIOS

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#### Abstract

Land use and global food security are major issues because of uncertainties about the planet's capacity to feed a growing population (set to reach 9.7 billion in 2050) in a context of climate change and ongoing debates regarding land use change trajectories. What are the main drivers of land use changes and how do they interact and influence food and nutrition security? How will the agricultural land area change over the next 40 years, globally and regionally? What tensions will there be between food and nutrition security and climate change mitigation in 2050? After a first foresight study published in 2011 on 'World food security in 2050', CIRAD and INRA have turned their attention to a foresight exercise on 'Land use and food security in 2050' that seeks to answer these questions. Five scenarios of land use and food security in 2050 highlight levers that could modify ongoing land use patterns for improved food and nutrition security. This approach provides decision makers, stakeholders, non-governmental organizations and researchers with a tool for dialogue.

#### Materials and methods

Researchers firstly analyzed the long-term dynamics of the land use and food security system. Foresight analysis was conducted through a scenario approach based on morphological analysis. By identifying a range of variables influencing each driver and its dynamics, hypotheses on how each driver might evolve in 2050 were then produced. Secondly, five contrasted scenarios were built by combining one or several hypotheses per driver. Each scenario describes a situation of land use and food security in 2050 and has been translated into a narrative. Thirdly, the impacts of the scenarios in terms of land use, agricultural production and trade in the 14 world regions and globally have been assessed through quantitative simulations using the biomass balance model GlobAgri-AgT. The five scenarios and their outcomes were then appreciated both quantitatively and qualitatively.

#### Main results

Five scenarios have been built (Fig. 1), with an international expert group providing guidance on scenarios building. 'Metropolization' links the development of megacities with a nutrition transition led by global agri-food companies selling ultra-processed foods and an increase of animal products consumption, in a global context of development through market forces and rapid climate change. Small farmers are marginalized. 'Regionalization' relates the increase of medium-size cities and their networking with rural areas to the emergence of regional food systems based on family farming and traditional food diets, and a set of regional agreements, notably trade agreements. 'Households' links strong individual mobility between rural and urban areas and a development of non-farm employment to the emergence of hybrid diets based on both traditional and modern value chains, in a globalized world where family farms and cooperatives are major actors in land use. 'Healthy' assumes that due to the increasing cost of malnutrition, a radical move towards healthy diets occurs driven by global cooperation and public policies in a context of climate change stabilization, involving a re-configuration of agricultural systems backed by new alliances between stakeholders. 'Communities' assumes that in a context of recurrent crises, development based on small towns and rural communities occurs, focusing on managing common property in agriculture in order to ensure food security.

From those five scenarios and their simulation in term of land use, our main results are:

- Ensuring world food availability in 2050 will involve expanding the world's agricultural land area to the detriment of forests. Indeed only the 'Healthy' scenario is likely to be able to ensure sustainably world food security in 2050. 'Metropolization' and 'Communities' are not able to achieve this objective without deforestation and the two other scenarios, 'Regionalization' and 'Households', lead to ambiguous results.
- In terms of nutrition 'Healthy' contributes most to reducing overnutrition and related diseases, but also to diminishing undernutrition. 'Metropolization' contributes most to the expansion of overweight, obesity and related diseases. 'Communities' would create a reduction in food availability at the world and regional levels. 'Regionalization' works in favour of world and regional food and nutrition security, but leads to ambiguous results for world food availability. 'Households' contributes to both a decrease in undernutrition and some ambiguous effects on overnutrition.

- Whatever the scenario, international trade will play a key role in ensuring world food availability in 2050 and some regions, especially North Africa and Near & Middle-East, are likely to be highly dependent on food imports.
- Increasing food and nutritional diversity for healthier diets in 2050 while limiting the growth of agricultural land and deforestation will require greater diversification in cropping and livestock systems.

## Conclusions

- There is no given pathway to food and nutrition security. Because the challenge is complex, with many overlapping and interlinked issues that cut across sectors, territories and actors, changing the course of ongoing trends requires systemic transformation, public policies and consistent actions from a wide range of actors. Each country and region will have to find its own pathway in coherence with common responsibilities for facing global challenges. Organization of trade, access to land, farm structures, and rural transformations are major drivers for food security.
- Changes in both supply and demand are necessary for transition towards diversified and healthy diets and the reduction of waste and losses.
- Nutrition and food security are a cornerstone issue for the future of cropping and livestock systems.

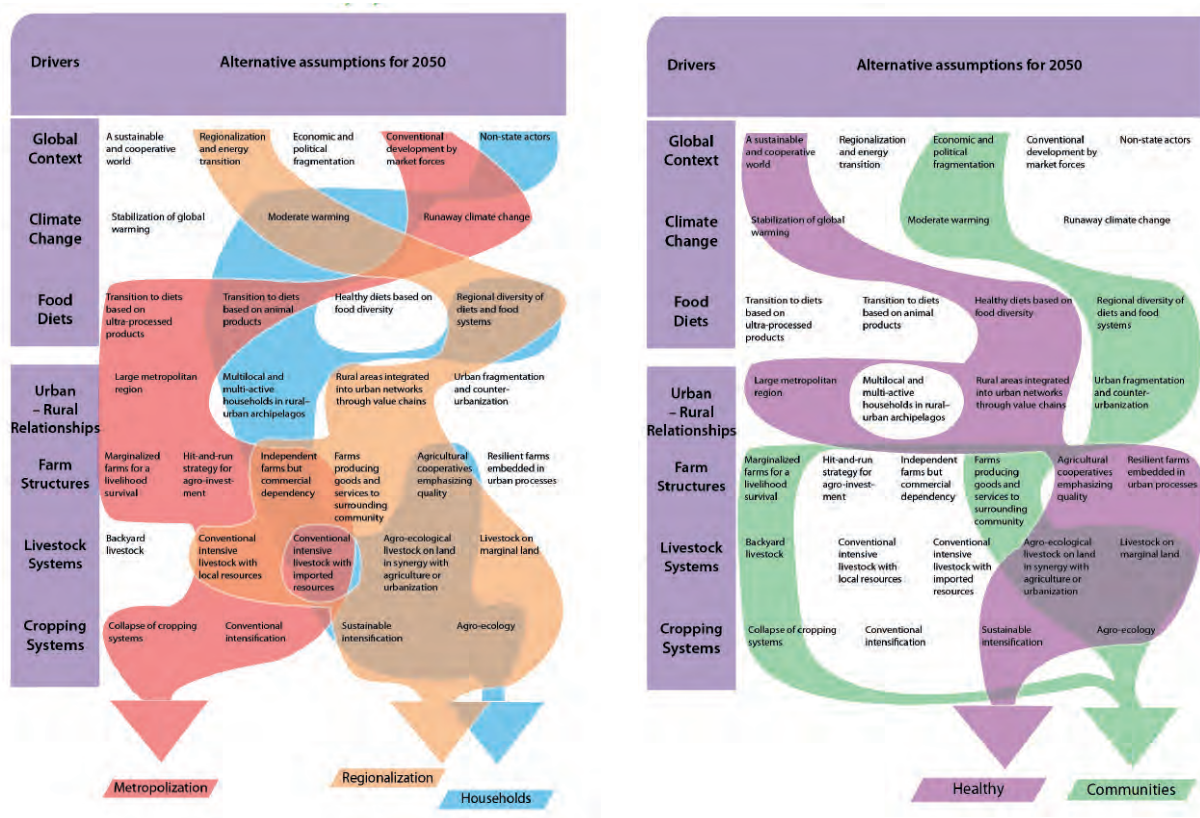


Figure 1. Alternative combinations of assumptions describing scenarios of land use and food security by 2050.

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