The food-energy-water nexus for small islands

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Background

Like microcosms of the Earth itself - a planet capable of hosting life, an oasis amid the vast, hostile emptiness of space - small islands are pockets of life with limited resources, surrounded by vast expanses of salt water. These territories, often small in relation to their growing populations, are particularly vulnerable to economic crises and natural disasters. They are also highly dependent upon imports, which undermines the sustainability of their social and environmental trajectories, hence the urgent need to develop their autonomy with regard to the fundamental resources of water, food and energy. The interconnectedness of and competition for access to these resources are exacerbated for small islands, and as such a systemic approach is needed to properly engage with the integrated dynamics of the FEW nexus (food/energy/water).

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Further reading

Direction de l'Alimentation, de l'Agriculture et de la Forêt (DAAF) – *La protection du foncier agricole à La Réunion.* https://www.reunion.gouv.fr/IMG/pdf/Protection-foncier-La-Reunion.pdf

Modelling the complexity of the food-energy-water nexus

One way of studying the food autonomy of small islands is to focus on the degree of security achieved for the interconnected essential resources of food, energy and water (FEW), bearing in mind the spatial restrictions engendered by geographical isolation. To do this, we need to find an effective method of modelling FEW dynamics, devoting special attention to the division of land resources among different activities. Each component of the FEW nexus can be quantified in terms of its impact on land usage dynamics (impact of agricultural development, energy production projects and water usage). The total surface area of available land on the island can thus be regarded as a limiting resource, inhibiting the development of the production systems associated with the three other interconnected resources. In the context of the FEW nexus, urbanisation is the principal spatio-temporal variable determining the equilibrium between water, energy and food, inducing changes in patterns of land usage. Much of the increase in urbanisation has been driven by residential expansion as a result of population growth; this leads to an expansion of urbanised areas, but also places greater demand on water, energy and food resources, thus fostering the development of local production systems which take up large amounts of land, with a view to securing the supply of these interconnected resources.

The preferred strategy for modelling the FEW nexus is to focus on the issue of food autonomy. The food system can be broken down into successive phases, from production to waste management via processing, distribution and consumption. The model is designed to analyse the interconnections between the different dimensions of the nexus, breaking down the food system into its component sectors (agriculture, residential/tertiary, transport and industry). Each sector can thus be evaluated in terms of its resource consumption, with demands which evolve dynamically in response to urban development. Food autonomy, as an objective, is about securing key resources within the food system, guaranteeing the reliability and viability of their supply and satisfying the demand for food, water and energy resources emanating from all of the sectors of activity which collectively constitute the food system. To this end, security indicators are constructed for each resource, with reference to two key criteria: availability and accessibility. The model delivers an analysis of the sustainability of the food system based on these security indicators for each component of the FEW nexus, incorporating their reciprocal influences on patterns of land usage.

Identifying thresholds and limits, obstacles on the path to food autonomy

Modelling the food system using the FEW nexus allows us to study the complex interactions between its component parts in multiple scenarios: for energy, some scenarios involve low-power energy production projects (solar panels etc.); agricultural development has various consequences for local people; projects

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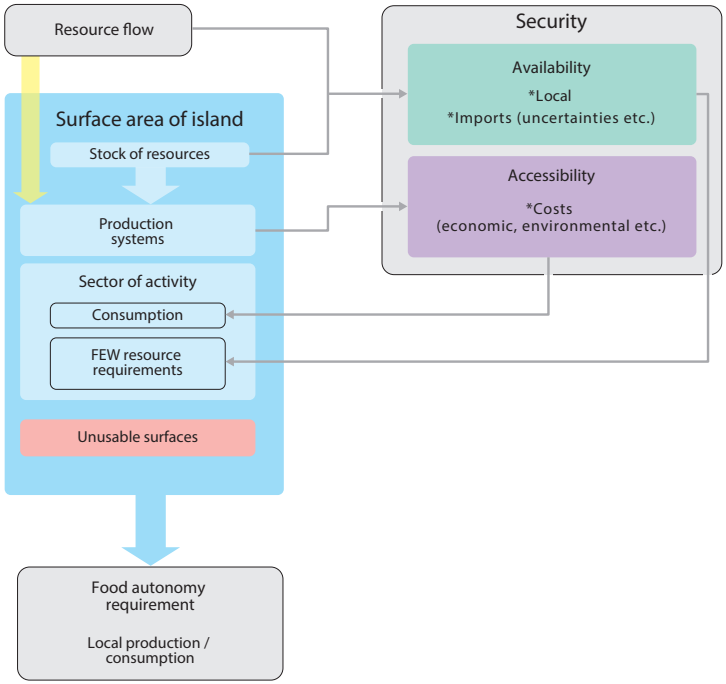

Applying the FEW nexus approach to food autonomy for small islands.

to increase the use of subterranean water resources also come at a price. This leads to increased competition for land usage. With regard to the choice of scenarios, it was not the purpose of our study to identify the most desirable solution. We believe that modelling, however detailed it may be, is never perfect. There are any number of constraints which we did not take into account, making these scenarios - which may seem achievable in the context of the model - operationally uncertain. Nonetheless, they do enable us to offer robust estimates of critical thresholds and hard maximum limits for FEW resource usage and land occupation across the island as a whole. In this respect, it is a useful decision-making tool. It succeeds in demonstrating the existence of a food autonomy threshold for a given population, a limit beyond which the security of food, energy and water resources and the availability of land can no longer be guaranteed.

Applying this approach to Reunion Island

We have used the FEW nexus to assess the food autonomy of Reunion Island. With a surface area of 2,512 km² and a population of

861,210 habitants (in 2019), Reunion is particularly vulnerable to natural disasters as well as land use pressures linked to urban sprawl. Available land is severely limited by the size of the island's national parks (42% of total territory), and Reunion remains highly dependent on imported foodstuffs (especially rice, a staple of Creole cuisine). As such, by virtue of its high population density and small usable surface area, Reunion can be regarded as a small island. This makes it a useful "laboratory" in which to study the stakes of the FEW nexus for small islands, with particular reference to food autonomy. In recent years, a section of the population has begun to express concern at the island's lack of autonomy. The isolation induced by the Covid-19 pandemic accelerated this phenomenon, and saw the emergence of initiatives to reintroduce rice plantations using local varieties. However, the results generated by our model suggest that it will be difficult to secure FEW resources and achieve full food autonomy for the island using these varieties, since their yields are too low (3.3 tonnes/hectare) and they require far too much irrigation (3,000 m^3 of water/hectare/cycle). The action with the potential to deliver the biggest impact would be to encourage people to change their diets to include more high value added foodstuffs such as fruits and vegetables (including legumes, leaf vegetables and tubers), a diet already adopted by part of the population.

KEY POINTS

Making life on small islands sustainable requires a systemic approach, integrating questions of FEW resources with land resource management. To this end, our modelling technique focuses on competition between different forms of land use, and the compromises required to achieve food autonomy while securing the supply and consumption of FEW resources.

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