Some challenges with farm-to-fork modelling

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Abstract: Policymakers and primary industries are increasing interested in creating explicit links along the full value chain from farm to fork. Modelling is a tool that can help with strategy development and planning.

McDowell et al. (2022) modelled the supply chain from farm to fork. They focused on the impacts of water quality and climate change policies and demonstrated the potential impacts of policies on the domestic food supply. Changing agricultural production could meet environmental targets and support healthier diets. Savings in the health system offset lost agriculture revenue, estimated at less than one percent of export returns.

The work passed outputs from one analysis to use as inputs in the next. An optimisation model of diet provided food quantities. Spreadsheet analysis converted food quantities into required production and land area. Environmental pressure and land suitability maps identified locations for production. Land use was optimised for profit, given constraints, using a land use optimisation model. In total, the analysis included two optimisation models, two types of spatial analysis, and several spreadsheets (see McDowell et al. (2022) for references to underlying models and spatial analysis).

Some key issues were:

- Data availability – data on food groups (in the diet) and commodities were either unavailable or available only from several different sources and needed to be assembled into a consistent data set, including using proxy products or commodities for food groups.
- Inconsistent product and crop mixes – each model or data source came from a specific set of concerns or issues that drove choices about which products or crops to include. A policy model might focus on primary industries with large carbon footprints, while a diet model might focus on the range of foods – imported and domestic – that people eat.
- Inconsistent spatial and temporal bases – daily food consumption, annual per-hectare economic performance, and spatial environmental data needed further calculation to make them consistent. Some of the apportionment and aggregation was straightforward but some required researcher judgment.
- Cross-model or interdisciplinary experience – because calculations converted data from food into agricultural commodities, and land area into environmental impacts, the team relied on individuals with expertise across models or disciplines. Overlapping expertise in the team was important for the process.

The research overcame these challenges sufficiently to produce some initial results, but the modelling could be better integrated and less ad hoc. The modelling did not include a dynamic value chain that could create productive or allocative efficiencies by promoting incentives regarding production or consumption choices. That is, there were no price or information effects. One challenge is to replace the fixed values passed from one step to the next with functions that incorporate supply and demand responses.

The research happened because researchers intentionally sought collaboration across institutions, and sought to understand the links across food consumption, production and the environment. This intentional effort – and associated funding – was essential for connecting the models and researchers into an integrated project.

REFERENCES

McDowell, R.W., Herzig, A., van der Weerden, T.J., Cleghorn, C., Kaye-Blake, W., 2022. Growing for good: producing a healthy, low greenhouse gas and water quality footprint diet in Aotearoa, New Zealand. Journal of the Royal Society of New Zealand, DOI: 10.1080/03036758.2022.2137532.

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