Information systems and computational methods for decision support in agricultural and food policies: A worst-case scenario in the wheat-to-bread chain

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Rallou Thomopoulos*[1], **Serafim Bakalis**[2]

1. *INRA UMR IATE / INRIA GraphIK, Montpellier, France;*

2. *University of Birmingham, United Kingdom*

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Abstract: Describing the complex links between food and environment is a relatively recent research field, starting from the so-called "ecology of food", a university discipline taught in Germany since 1987. In other European countries, this research domain is integrated in environmental science or in agricultural science. However the "grey" literature started in the 1970s (Moore-Lappé, 1971), and the very first scientific publications in the 1980s (e.g. Gussow et Clancy, 1986), encouraged by the Stockholm environment summit of the United Nations in 1972. Since then, environmental assessment methods have been refined and applied to various products, in order to help producers and industries to improve food production and processes from an environmental point of view.

From a systemic point of view, analyses from production to consumption have questioned the compatibility of environmental concerns and other aspects of food, such as nutrition or budget. According to American studies, a diet that would conform to nutritional recommendations in the USA would imply deep changes in the occupation of agricultural surfaces (Young et Kantor, 1999). In particular, a transfer of surfaces in favor of fruit, vegetable and legume production would be required. The question of the environmental benefit of a vegetable-based diet is tackled in Gussow (1995). Among several diets tested in Duchin (2005), the Mediterranean-type vegetable-based diet was shown to satisfy both nutritional and environmental requirements, while reducing the pressure of agri-food systems on the environment. Moreover, Goulet et al. (2008) confirmed its compatibility with price concerns. Recent advances (Perignon et al. 2016) analyzed the compatibility of nutritional, financial and acceptability aspects of food products with the reduction of greenhouse gases emissions. They constitute a step in the multicriteria approach of food products, although based on aggregated statistical data rather than on specific well-described products as in (Bourguet et al. 2013; Thomopoulos et al. 2015). In Seconda et al. (2017), the environmental issue is approached in relation with organic food consumption.

An increasing number of studies focus on the role of transportation in food systems. According to Pretty et al. (2005), national road transport for food distribution and shopping is an important part of food-related environmental costs in Great Britain. The scenarios they propose to reduce environmental costs could drastically reduce the environmental costs, up to 90%, e.g. by reducing the distance between production and consumption, and by opting for ecological means of transportation. This tendancy, confirmed by other works, is however balanced by Schlich et Fleissner (2005), who insist on the greater importance of the organization and size of the production-processing-distribution chain in energetic efficiency, studied on two food products in Germany.

In the case of the bread chain, a study led by Reinhardt (2005) shows that, concerning energy, the means of transportation chosen by consumers to go and buy a kilo of bread can annihilate the benefit of the most economic breadmaking process. Although home-made bread requires twice more energy than industrial bread,

and a quarter more than artisanal bread, home-made bread becomes the most ecological solution for consumers who drive to go shopping on more than 250 meters and 500 meters, respectively.

In the proposed paper, data and expertise were collected to provide information and arguments about several issues: about the main criteria of good bread in terms of environmental, nutritional, sensory and sanitary aspects; then, about ways to achieve them in the wheat-to-bread chain, while maintaining affordable prices. Computation for determining the best compromise between the various desired criteria is a challenge, since not all of them are compatible. Several scenarios are explored to highlight tensions between desired criteria, problem formulation and solution analysis such as best- and worst-case scenarios. Hence the approach demonstrates the interest of information systems and computational methods for decision support in agricultural and food policies.

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References

Bourguet, J.R., Thomopoulos, R., Mugnier, M.L., Abécassis, A., 2013. An artificial intelligence-based approach to deal with argumentation applied to food quality in a public health policy. Expert Syst. Appl. 40(11), 4539-4546.

Duchin, F., 2005. Sustainable consumption of food – a framework for analyzing scenarios about changes in diets. Journal of Industrial Ecology, 9(1-2), 99-114.

Goulet, J., Lamarche, B., Lemieux, S., 2008. A nutritional intervention promoting a Mediterranean food pattern does not affect total daily dietary cost in North American women in free-living conditions. J. Nutr., 138, 54-59.

Gussow, J.D., Clancy, K., 1986. Dietary guidelines for sustainability. Journal of Nutrition Education, 18(1), 1-5.

Gussow, J.D., 1995. Mediterranean diets: are they environmentally responsible? American Journal of Clinical Nutrition, 61(6), 1383-1389.

Moore-Lappé, F., 1971. Diet for a small planet. Ballantine Books, New York, 301 p.

Perignon, M., Masset, G., Ferrari, G., Barré, T., Vieux, F., Maillot, M., Amiot, M.J., Darmon, N., 2016. How low can dietary greenhouse gas emissions be reduced without impairing nutritional adequacy, affordability and acceptability of the diet? A modelling study to guide sustainable food choices. Public Health Nutr., 19(14), 2662-2674.

Pretty, J.N., Ball, A.S., Lang, T., Morison, J.I.L., 2005. Farm costs and food miles: an assessment of the full cost of the UK weekly food basket. Food Policy, 30, 1-19.

Schlich, E.H., Fleissner, U., 2005. The Ecology of scale: assessment of regional energy turnover and comparison with global food. International Journal of Life Cycle Assessment, 10(3), 219-223.

Seconda, L., Baudry, J., Allès, B., Hamza, O., Boizot-Szantai, C., Soler, L. G., Galan, P., Hercberg, S., Lairon, D., Kesse-Guyot, E., 2017. Assessment of the sustainability of the Mediterranean diet combined with organic food consumption: an individual behaviour approach. Nutrients, 9(1).

Thomopoulos, R., Croitoru, M., Tamani, N., 2015. Decision support for agri-food chains: A reverse engineering argumentation-based approach. Ecological Informatics 26(2), 182-191.

Young, C.E., Kantor, L.S., 1999. Moving toward the food guide pyramid: Implications for U.S. agriculture. U.S. Department of Agriculture, Economic Research Service (Agricultural Economics Report no. 779).