

GREENING PROTEIN PRODUCTION AND CONSUMPTION – THE *PROFETAS* RESEARCH PROGRAMME (PROTEIN FOODS, ENVIRONMENT, TECHNOLOGY AND SOCIETY)

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ABSTRACT

PROFETAS (Protein Foods, Environment, Technology And Society) is a transdisciplinary research programme exploring pathways towards more sustainable food systems, with a pivotal role for all stakeholders. By January 2000, it included 8 PhD students performing basic research on economic, ecological, political, consumer, sensory, chemical, agricultural and technological issues. By January 2001, an additional 7 transdisciplinary postdoc projects will have started to interactively address market and consumer behaviour, sociocultural lifestyle, legal, production and sustainability issues, while designing strategies to improve sustainability in (protein) food systems. Because the study area is quite dynamic, and predicting actual products a decade in advance is not feasible, the programme aims to deliver a toolkit to address future food problems, leading to a robust strategy, rather than to hardwired solutions. A second, strategic level of transdisciplinary aggregation will be performed by two programme co-ordinators, which should finally yield options for sustainable policy to political and industrial policymakers.

Key words: Industrial Transformation, Protein Foods, Environment, Technology, Society

1. INTRODUCTION

1.1 The issue

Food, our lives depend on it. Directly, by providing nutrients; indirectly, by generating income (Tansey and Worsley, 1995). Probably due to its essential role, food and food quality are in the floodlights of societal attention (Murdoch et al., 2000; Kloppenburg et al., 2000) to the point that food is often associated with esoteric properties of sometimes mythical proportions. The food issue may be approached from many perspectives, but there is no denying that a major proportion of global environmental pressure is generated by food-related human activities (Alexandratos, 1995; Brown, 1996). Crops are produced, transported, processed and turned into food products in ever larger volumes, with ever-increasing impacts on the environment. Within the realm of food, meat takes a unique place. Its production is responsible for a disproportionate share of environmental pressure.

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When striving for sustainable food production and consumption systems (Green et al., 1999), therefore, the protein chain is a good place to start for more than one reason.

1.2 Greening the protein chain

Due to continued growth of a) the world population and b) the proportion of meat in the global diet, the pressure of food production and consumption on the environment is rising steadily. A large proportion of this environmental pressure derives from meat production, due to the inherently inefficient conversion step from plant protein to animal protein. Already, we are feeding about 40% of harvested grain to livestock (Veerman, 2000). A significant amount of deforestation, loss of biodiversity, and pollution by harmful inputs - such as pesticides and fertilisers - might be avoided if protein-rich crops were destined for direct human consumption, rather than for cattle feed. Food vs. feed for meat, that's the question.

1.3 Industrial transformation

The *PROFETAS* programme aims to explore a (partial) transition from animal to plant protein as a means to decouple the increase in food demand from a concomitant increase in environmental pressure. At least four barriers to such a transition towards decoupling can be identified: 1) social forces opposing change are strong, because meat has a high status, 2) economic forces opposing change are strong, because established interests in the meat chain are powerful, 3) technological know-how on novel (plant) protein foods is lacking, and 4) for centuries the meat chain has been optimised for exhaustive use of all by-products, potentially offsetting a large part of the theoretical environmental gain. In order to study the feasibility of such a transition, therefore, a multidisciplinary approach is evidently required. Precisely for this reason, NWO – the Dutch equivalent of the American NSF and the British Research Council – put the question of developing a national research programme on more sustainable food production and consumption before a combination of two complementary research schools, SENSE (Socio-Economic and Natural Sciences of the Environment) and VLAG (Nutrition, Food Technology, Agrobiotechnology and Health Sciences), involving researchers from half a dozen universities in the Netherlands.

2. METHODS

2.1 Scoping

The team commissioned with the task of greening food production did not have to start from scratch, since the results of a strategic programme on sustainable technology development (STD) were available (Weaver et al., 2000). Though the latter had been a desk study exclusively, the STD programme had yielded clear conclusions on development of Novel Protein Foods (NPFs). STD's rather convincing rationale had been that predicting actual products 10-40 years in advance is not feasible, and that it is better, therefore, to now develop the methodologies and the tools to facilitate problem solving in the future, than to develop solutions for presently perceived future problems. The main conclusion of STD's NPF programme had been that trying to mimic whole meat chops (such as steaks or cutlets) with plant proteins is simply not feasible. Its main recommendation, therefore, was to

develop novel plant protein products, which may serve as protein-containing product “ingredients”.

Both the underlying “toolbox” philosophy and the “ingredients” focus were adopted. Therefore, the programme should compare opportunities for the NPF sector with options for the intensive livestock sector. Consumer preferences will be taken to be predominant in product development. Furthermore, environmental, industrial and social issues will be studied from the national and West-European perspectives in a global context, rather than *vice versa*. Although sustainability is a global issue, Europeans will experience difficulty enough trying to grasp what’s on the minds of European consumers (Verbeke, 1999), and could not possibly dream of modelling the non-European consumer with any degree of accuracy. Nevertheless, a trend setting Western diet change might have an impact world wide.

The challenges associated with even a partial transition from animal to plant protein foods require an approach addressing issues such as technological innovation, consumer demands, employment and food security. In short, the final result of the programme should be a practical toolbox containing methodologies and technologies providing policymakers from government and industry with potential strategies and options for policy. After a long and thorough scoping process, it was concluded that the common object of study should be the hypothesis that a substantial shift from animal to plant protein foods is:

- environmentally more sustainable than present trends
- technologically feasible
- socially desirable

2.2 Novel approach

The **novel approach** of the programme is reflected in:

- a) the predominant role given to consumer preferences when designing and evaluating alternative protein chains
- b) the study of the entire protein chain (from primary production via processing and consumption to waste), rather than concentrating on the primary production, as has been the focus of research in this area for decades
- c) the transdisciplinary (political, social, economic, technological, environmental, ecological, and chemical) design and evaluation of alternative protein production options and their impacts

3. RESULTS AND DISCUSSION

3.1 Analysis

Rather than a gradual optimisation, the issue at hand concerns a shift from the present societal trajectory to one with a significantly smaller pressure on the environment. Consequently, contributions from the social sciences will be indispensable to model societal structures and reactions to impending change, contributions from the technological sciences will be indispensable to develop and improve NPF alternatives, and bi-directional contributions from the consumer sciences are required at the interface. In addition,

strategies and scenarios should be built and compared for impacts and feasibility with contributions from the ecological, environmental and economic sciences.

In fact, the environmental perspective (the ecological basis of food systems) and the technological perspective (protein-related chains) are components contributing to the social perspectives (the key actors, and the societal context). These four perspectives have been detailed in table 1.

Table 1. A shift from animal to plant protein foods considered from a range of perspectives

	Perspective			
	Protein-related chains	Ecological basis of food systems	Key actors	Societal context
Main focus	Technological trajectories	Stocks and flows of natural capital	Political-economic networks	Sociocultural themes and linkages
Current issue	Competing sets of animal and plant derived ingredients	Competing sets of environmental demands	Competing sets of political-economic networks	Competing sets of food concepts and practices
Hypothesised intervention <i>(research questions)</i>	Design and selection of marketable products	Shift from animal to plant production systems	Design and selection of policy instruments	Anticipation and selective reinforcement of cultural forms
Envisaged outcome	Changes in the market	Changes in natural capital	Changes in networks	Sociocultural changes
Valued consequences	Patterns of environmental, technological, economic and social effects			

Phrased differently, the proposed transdisciplinary approach entails three intertwined types of research (Figure 1):

- (S) Applied analytical systems research, to evaluate the pressures exerted by different protein production options on society and the environment.
- (T) Fundamental food technology research, into innovative technological options for alternative protein foods production, their impacts and feasibility.
- (I) Interactive transdisciplinary design-oriented research, integrating (S) and (T), yielding:
 - (i) development and evaluation of options for a societal shift to alternative proteins,
 - (ii) channelling of information flows in both directions.

Whereas areas (S) and (T) are primarily analytical and directed towards development of tools, the integrative area (I) confronts environmental concern with social and technological reality, designing (more) sustainable (protein) food production and consumption systems by an iterative process of generation and evaluation.

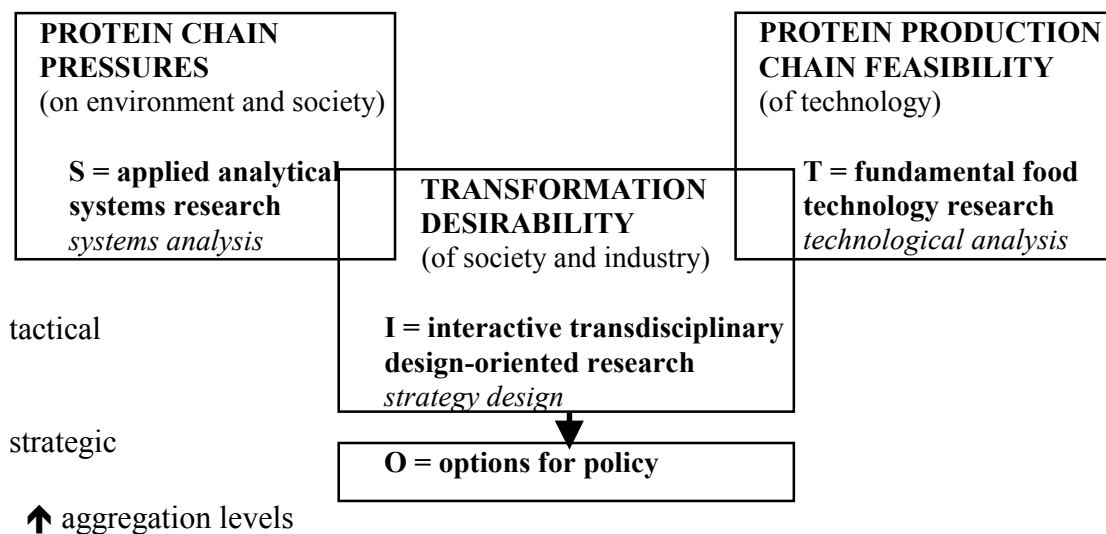


Figure 1. Three types of research, leading to policy options for government and industry.

(S) Applied analytical systems research is required to provide insight into the question which patterns of protein production and consumption (bounded by nutritional criteria) are desirable from socio-economic and environmental viewpoints. The main goal is to gain understanding of the present system, and to facilitate development of novel strategies (the appropriateness of the developed strategies will be assessed as a part of the interactive transdisciplinary research (I)). Five well-concerted disciplinary projects have been identified, addressing environmental, economic, behavioural and ecological issues, respectively (Figure 2):

- S1 Development of a methodology to assess the full cycle of environmental effects of present and future food production and consumption systems
- S2 Environmental economic assessment of the animal protein production and consumption chain and alternative options
- S3A Protein politics: Policy and socio-technical networks and their implications for protein production
- S3B The citizen-consumer: An exploration of citizens' strategies for influencing the supply side of food products and technology development
- S4 Development of ecological indicators for sustainable food production

(T) Fundamental food technology research is required to provide insight into the question which technological innovations are feasible to develop alternative protein production chains. Food products based on plant proteins and proteins from other non-meat sources do not meet consumer preferences and the technology to design these products is not well developed. To meet consumer preferences technological progress should be made along the whole production chain. This part of the programme has a strong experimental focus, and will entail basic research. Five disciplinary projects have been identified (Figure 2):

- T1 Translation of consumer sensory preferences into product characteristics

- T2 Protein-flavour interactions in relation to the development of novel protein foods
- T3 Protein-induced texture formation in novel protein foods
- T4 Modification of pea protein composition by genetic modification
- T5 Quantitative methodology for efficient chain design

(I) Interactive transdisciplinary research is the integrative, third type of research, thus lending a clear ‘added value’ to the overall objective of the programme. Here, in parallel with the basic PhD research in (S) and (T), the first (tactical) level of transdisciplinary aggregation will be achieved by postdocs. Evidently, systems-oriented research has to be supported by food technology expertise for development and evaluation of the feasibility aspects and vice versa. Clearly, important aspects from all contributing disciplines, such as consumer preferences, and other social, political and legal aspects will be taken into account. Five transdisciplinary projects have been identified (Figure 2):

- I1 Designing sustainable plant-protein production systems
- I2 A sociocultural analysis of the potential for a shift from animal to plant protein foods in the context of modern lifestyles
- I3 The introduction of meat substitutes from vegetal protein: consequences for EU agriculture
- I4 The role of property law in product development and marketing: Novel Protein Foods in Western Europe
- I5 Consumer and consumption behaviour with respect to meat and novel protein foods

3.2 Synthesis

(O) Options for policy (for policymakers from government and industry) constitute the final product and will be derived by development and evaluation of strategies for a shift towards more sustainable protein (food) production and consumption. This involves the second (strategic) level of transdisciplinary aggregation, which will be performed by two programme co-ordinators. A participatory approach including feedback from stakeholders and external expertise will be an asset to such aggregation processes.

Distilling options for policy, detailing a robust strategy regarding desirable and feasible options for more sustainable food production and consumption, will require extensive communication both within the PROFETAS programme, and externally, with all stakeholders (representatives from consumers, government, industry, scientists, etc.). The latter is envisaged to take place during meetings of a Strategy Group. These will be organised as annual forums on discrete topics.

The programme co-ordinators will act as internal as well as external facilitators between the (S), (T) and (I) parts of the programme, and the Strategy Group, channelling information in both directions. In this way they will take care of 1) transdisciplinary integration, 2) internal and external communication, and 3) coherence of the programme. The final results of the programme will be evaluated in an international workshop. The final options for policy – embodied in the proceedings – will be published as a monograph.

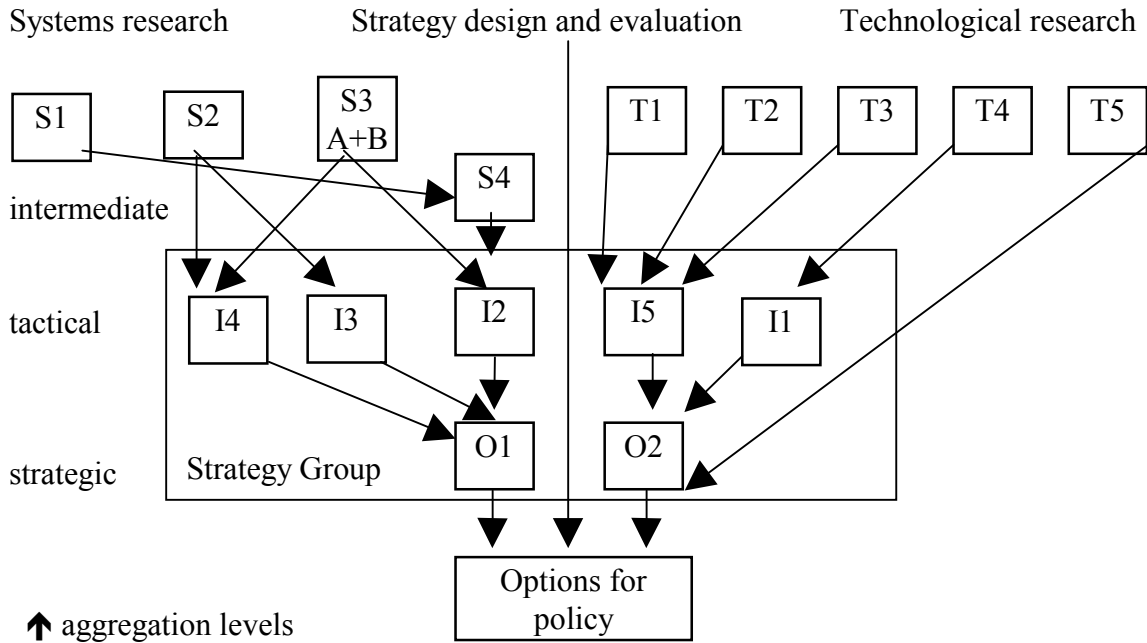
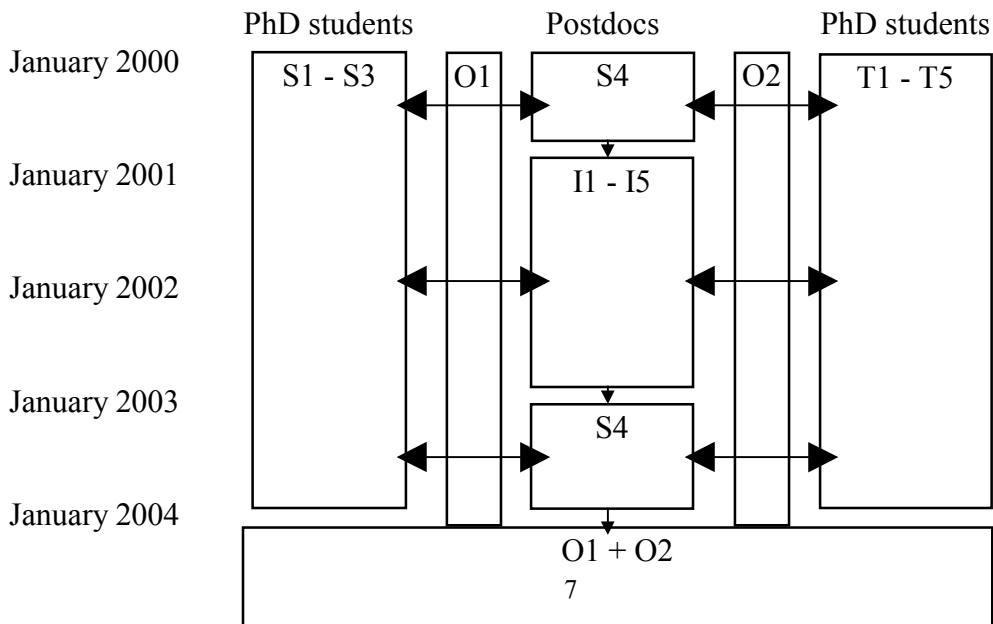


Figure 2. Detailed programme showing a two-step transdisciplinary aggregation.

3.3 Optimisation

The research tasks associated with the applied systems-oriented (S) and fundamental food technology research (T) will be performed by 8 PhD students and 2 post-doctoral fellows (S4 and S3B). The research tasks in the interactive transdisciplinary research area (I) will be performed by 5 post-doctoral fellows and by the two programme co-ordinators (O1 and O2). With regard to timing (Figure 3), (S) and (T) projects have started (on average, January 2000); (I) projects will begin one year later (approximately, January 2001).



January 2005

Figure 3. The PROFETAS time table.

3.4 Current state of the research programme

By January 2000, *PROFETAS* included 6 PhD students performing basic research on economic, ecological, political, consumer, sensory, technological, agricultural and chemical issues. By October 2000, 2 more PhD students and 2 postdocs had started. Cross-disciplinary discussions emerged on topics such as “reference chains” (see section 3.5) and GM foods. So far, extensive internal communication has been facilitated by 2 common meetings, lasting two days each. It has been an instructive experience for all concerned. The all-importance of communication is evident every day of the year.

By January 2001, 5 additional postdoc projects will have started to interactively integrate these inputs, addressing market and consumer behaviour, sociocultural lifestyle, legal, production and sustainability issues, designing strategies to improve sustainability in food systems. By then, forum discussions in the Strategy Group will start to yield stakeholder feedback, as well. Additional information can be found on <http://www.profetas.nl>.

3.5 Scenarios

The programme’s final results will include options for policymakers from government and industry. To this end, opportunities for the NPF sector will be compared with options for the intensive livestock sector. Many options (“strategies”) will be taken into consideration (such as extensified livestock breeding in combination with a decreased demand of animal proteins). Ultimately, however, two extreme scenarios can be identified: a) a considerable shift in the western diet towards more plant proteins and less animal proteins will be contrasted with b) business as usual. For reasons of efficiency, it was recently decided to devise a common basis of “reference chains” for these two extreme cases (Figure 4).

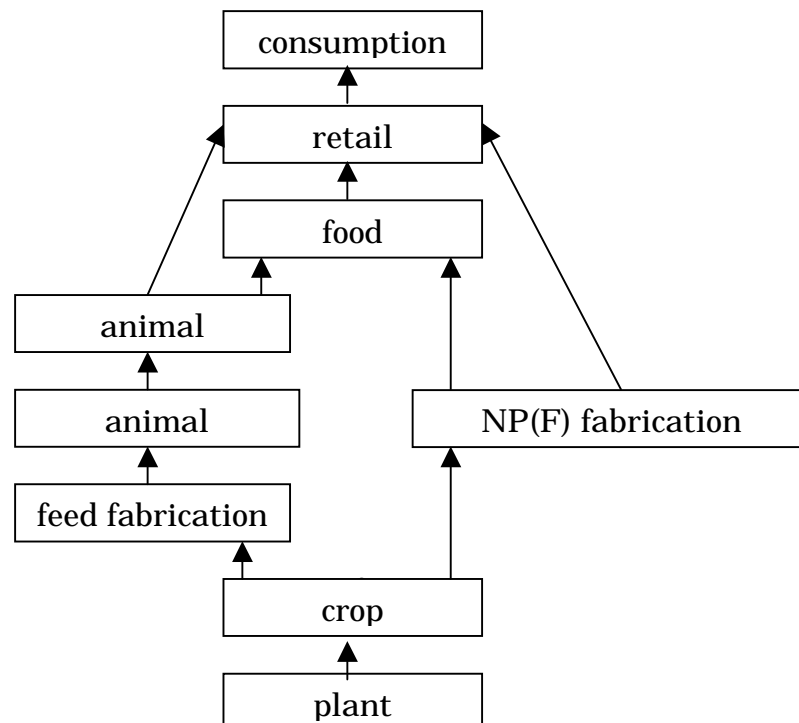


Figure 4. The reference chains (meat vs. Novel Protein Foods).

Deriving from the focus on “ingredients” (no steaks; see section 2.1) and due to the absence of secondary products such as milk or eggs, pigs were selected for the common reference meat chain. Criteria such as protein content, absence of unwanted substances and availability of expertise were used to select green peas for the representative reference chain of a NPF-yielding crop that could be cultivated in Europe, with soy beans as a global alternative. Within the reference chains, the functional unit can be imagined at three different levels: the ingredient level, the product level, and the diet level. To date, a final choice has been left open, though it must be said at this instance that the product level seems less appropriate, because for NPFs to be developed in the future little information will be available at that level during the next few years.

4. CONCLUSION

A study of issues as complex and all-encompassing as sustainable global food production and consumption requires an inherently transdisciplinary approach. If anything else, such a study will yield scores of researchers with extensive transdisciplinary experience as an additional advantage.

The *PROFETAS* programme is an experiment in social transformation itself, as well as a rapidly learning, adaptive organisation. At any rate, the two-step transdisciplinary aggregation design - which has been deeply embedded into its fabric - seems to work well.

Beforehand, extensive internal and external communication were considered a prerequisite, and rightly so. Preliminary experience with two-day common meetings of approximately 30 researchers, supervisors, and board members from an incredible range of different scientific backgrounds and nationalities is generally positive. Participatory forum discussions including feedback from stakeholders and external expertise will be held in the near future.

Meeting the high expectations is a real challenge to the research group and, therefore, we welcome all reactions on the desirability of novel protein foods.

ACKNOWLEDGEMENTS

PROFETAS is supported by grants from NWO (Netherlands Organisation for Scientific Research), LNV (Ministry of Agriculture, Nature Management and Fisheries), and the food industry. In addition, the authors would like to thank Ms Martine Helms MSc for constructive criticism on the manuscript, and all other colleagues within the *PROFETAS* programme for continued support and feedback.

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