Available online at www.centmapress.org

INTERNATIONAL JOURNAL ON FOOD SYSTEM DYNAMICS

Int. J. Food System Dynamics 13 (2), 2022, 192-204

DOI: https://dx.doi.org/10.18461/ijfsd.v13i2.B6

Bringing together Stakeholders' Interaction and Economic Modelling: Recent Experiences in Designing Research and Agricultural Policy

Ana Gonzalez-Martinez[1], Petra Salamon[2], Martin Banse[2], Roel Jongeneel[1]

[1] *Wageningen Economic Research, The Hague, The Netherlands*
[2] *Thünen Institute of Market Analysis, Braunschweig, Germany*
ana.gonzalezmartinez@wur.nl, martin.banse@thuenen.de, roel.jongeneel@wur.nl

Received April 2021, accepted February 2022, available online April 2022

ABSTRACT

Policies are becoming intensively interrelated while increasing numbers of societal groups and stakeholders are affected. At the same time, current and future challenges require improved capacity in terms of models, their linkages or redesigns to deliver forward-looking insights on policies. Different stakeholder workshops have recently been carried out in the context of two scenario studies to support these activities, including stocktaking, inputs for narratives, validation of the outcomes, acceptance of analysis and drafting future research agendas. This paper describes the approaches applied in both projects, shortly presents their results and findings to finally draw some general conclusions.

***Keywords**: Stakeholder; Modelling; Agricultural Policies; Climate Change.*

1 Introduction

In the recent past, policy assessments in the area of agri-food that are based on simulation results of applied quantitative models have become increasingly popular. This interest for evidence-based policy-making reflects the fact that policies are becoming intensively interrelated while at the same time a broader range of societal groups and stakeholders are being affected by public interventions. As one can imagine, the more complex (and cross-cuting) a policy becomes, the more difficult it is to assess its consequences since there is a larger number of interactions and trade-offs that need to be considered. These challenges are not different to those that happen in other fields such as resource management, in which participatory research and participatory modelling has been extensively applied (van Eeten, 2002; Hare et al., 2003; Mendoza and Prabhu, 2006). Contributions such as Basco-Carrera et al. (2017) even go one step further and propose to follow a collaborative modelling approach in which participation and cooperation are taken as conditioning factors.

Coming back to the policy-making process related to the agri-food field, understanding the implications of current and future agricultural challenges requires the improvement of existing capacities in terms of the coverage and (re)design of the available modelling tools and their linkages in order to deliver relevant forward-looking insights. When thinking about capturing the key interests and priorities of those that could be potentially affected by the implemented policies, as well as having a better overview of the existing trade-offs among the parties involved, participatory modelling aproaches appear to be as a crucial element in this task. As an illustration of the use of participatory stakeholder workshops, we refer to recent experiences that combined scenario simulations and stakeholder workshops in order to generate useful political solutions to a given set of policy questions related to agricultural policy.

More specifically, this article refers to the EU-funded project 'Support for Policy Relevant Modelling of Agriculture (SUPREMA)'.[1] In the context of this project aiming at identifying future directions for agricultural modelling, three stakeholder workshops were conducted. The first one defined the needs and challenges for model development and set the key priorities, the second one focused on the definition of detailed narratives for medium-term EU Common Agricultural Policy (CAP) instruments and long-term climate change mitigation policies to test the modelling tools that were improved or linked in the course of the project, while the third one captured the stakeholders' feedback on the outcomes of the narratives and took stock of future research requirements. The list of stakeholders invited to the mentioned workshops covered a broad range of societal actors: policy community, businesses in the value chain including farmers, the scientific community, civil society and Non-governmental Organisations (NGO) among others.

The second group of stakeholder workshops that are considered in this contribution were organised within the project 'Scenario study on future directions for the development of Dutch agriculture in 2050' which supported the discussion of the Dutch 'Climate Table for agriculture and land use'.[2] First of all, all the members of the Climate Table were involved in the definition of several packages of mitigation measures that were formulated in terms of reduction of greenhouse gas emission, ammonia emission, and nitrate- and phosphate-leaching and run-off. In a second stage of the project, they were confronted with the simulated economic, social and environmental outcomes regarding the consequences of the potential implementation of the mitigation packages previously defined. Several rounds of expert workshops were organised in order to identify and further refine the parameter values that were used to populate the simulation models applied in this study, as well as creating ownerships of the results.

In a nutshell, the aim of this article is to provide concrete evidence on how the different stages of the economic-modelling process in the area of agri-food, e.g. definition of the narratives, model design, validation of the outcomes, etc., can benefit from an active interaction with stakeholders. In doing so, it builds on recent sucessful experiences in designing research and agricultural policy at both national and EU level. Popularising this type of participatory modelling appraoch in the agricultural field is highly relevant in view of the current discussion about policy items such as the EU Farm to Fork and Biodiversity strategies which eventually will affect a variety of stakeholders (farmers, consumers, etc.) who might have conflicting interests and/or express their 'rejection' to the implemented legislation.

After this introduction, the layout of this article is a as follows. Section 2 relies on existing literature and provides general considerations regarding stakeholder workshops, focusing on the advantages and challenges identified so far. Section 3 elaborates on the different stakeholder workshops that were carried out in the context of the two mentioned projects.

[1] The reader is referred to Gonzalez-Martinez et al. (2021a) for an overview of the findings of the SUPREMA in terms of priorities for agricultural modelling, and further discussion on model linkages.

[2] The main outcomes of this project are presented in Gonzalez-Martinez et al. (2021b).

Further discussion of the findings of this article is provided in Section 4, while Section 5 provides some concluding remarks.

2 Stakeholder involvement as a tool to generate input in participatory processes

It has been more than two decades since Geurts and Joldersma (2001) pointed out that the use of traditional formal modelling approaches has limited impact on the policy-making process when searching for solutions to complex issues. As a possible way forward, Geurts and Joldersma (op. cit.) propose supplementing scientific insights with subjective information provided by the all those who are affected by the problem under consideration, as well as improving the communication among them. In other words, stakeholder participation can facilitate the learning process of the participants by providing them with a better understanding of the characteristics and interactions that are present in the system or related to a given policy problem. At the same time, stakeholder participation contributes to identifying the potential effects of policy measures or solutions to a specific problem under consideration (see, Voinov and Bousquet, 2010).

Focusing on the management of natural resources and risks, Hedelin at al. (2017) emphasise that sustainable development requires stakeholder participation. These authors suggest that the intended stakeholder participation can be operationalised by means of participatory modelling. In general terms, participatory modelling describes an iterative and interactive process in which the participation of the relevant stakeholders is supported by the outcomes of models and communication instruments. Moreover, Barreteau et al. (2010) also highlight the potential of participatory approaches to avoid encountering 'disappointed' stakeholders, researchers and policy-makers. In this sense, informing all of them what is expected from their participation at the very beginning of the decision or policy-making process is key.

Drawing attention to the different methods for participatory modelling, stakeholder workshops are special forms of stakeholder dialogues in participatory approaches intending to provide information or to consult affected population groups (Völker et al., 2018). They may differ according to their participation and overall aim (ibid), namely to provide information, to capture opinions, to gain information or to assess experiences of the stakeholders, so that, directly or indirectly stakeholders are involved. Plans and solutions can jointly be developed and implemented. Problem-oriented dialogues are usually held in cases of critics or loses of credibility (Leitschuh-Fecht and Bergius, 2007) while strategy-oriented ones are mostly ongoing processes in order to be able to plan actions (Leitschuh-Fecht and Bergius, 2007). Project-related dialogues often involve various stakeholders during the entire process (Leitschuh-Fecht and Bergius, 2007; Litschel and Schramm, 2010). Stakeholder workshops form involvements which also enable common learning through the thematic discussions and elaborations so that repeated meetings can be used in negotiations processes (Schramm, 2012). Often actors from politics and administration, non-governmental organisations and different types of companies, experts and scientists as well as consumers and citizens are included (Schramm, 2012). Thus, diverting perspectives and needs, as well as differentiated knowledge of the problem at hand come together as various stakeholders bring their specific expectations and their individual expertise along contributing in observational, advisory, and decision-supporting ways (Litschel and Schramm, 2010). Organisation and structure of the workshops often follow different routes depending on the questions considered and the groups involved.

In general, stakeholder involvement may promote acceptance and transparency (Völker, et al. 2018), while the exchange on information and results may increase credibility and minimize room for possible criticism (Litschel and Schramm, 2010). In addition, local knowledge and commitment are captured when using this participatory approach (Völker, et al. 2018). Thereby, potentially different interests and areas of tension may be addressed and empirically assessed in research (Schramm, 2012) and direct and real reactions of stakeholders can be observed and included in further project design. Simple transmission of decisions may act in a counterproductive manner (Litschel and Schramm, 2010), while stakeholder workshops can be converted into networks of stakeholder groups benefiting all by long-term future collaborations (Schramm, 2012) as well as from 'cross-actors' cooperation (ibid). Different groups, actors, economic sectors or scientific disciplines are all affected and, therefore, required to find joint solutions to deal with challenges and divers demands, expectations, and interests.

Moreover, formal normative processes may be supported by stakeholder-involvement workshops. In this regard, OECD (2012) advices that 'governments should co-operate with stakeholders on reviewing existing and developing new regulations' - whereas they should engage all relevant stakeholders in the process maximising effectiveness of information and making all relevant material available according to needs of those affected and cooperate with them in (re)designing regulations. OECD (op. cit.) also states that a 'public participation of stakeholders […] can help governments understand citizens' and other stakeholders' needs and improve trust in government'. Apart from that, stakeholder engagement in regulatory processes provides expertise, perspectives,

and ideas for alternative actions and helps to balance opposing interests, to identify unintended effects and practical problems, to provide a quality check on assessments, to identify and facilitate interactions between different regulations (OECD, 2017). Stakeholder engagement can increase compliance with the regulation as stakeholders may adjust to changes more easily if these are announced with sufficient time and input by stakeholders themselves to overcome challenges. Stakeholder involvement may render a kind of shared ownership of outcomes which may motivate compliance.

Nevertheless, stakeholder workshops as an active form of participation are not an approach exempt from challenges which arise in relation to their complexity and their required efforts. Compared to surveys, increased resources are often needed (Schramm, 2012), both in planning and in implementation to be balanced by worthwhile benefits (Völker et al., 2018). Certain stakeholder groups may assert their particular interests above other interests if only stakeholders with greater influence are given a voice while other interests are suppressed, and thus, exerting negative impacts. Public interests in the problems might be limited and, therefore, no useful output might be delivered (Völker et al., 2018). Another disadvantage may lie in the small number of people invited, their selection process, and in their accessibility, especially in repeated meetings. It may also happen that stakeholders are affected but have not expressed any interest or are wrongly excluded (Litschel and Schramm, 2010).

With respect to formal regulatory processes one has to ensure that stakeholder engagement is not perceived as a replacement for formal procedures in a representative democracy. Risks are relatively pronounced in the case of to stakeholder involvements which are captured by 'pressure groups' pursuing their interest in an unbalanced way. The difficulties in reaching certain stakeholder groups and the wider society are also a challenging aspect of this approach. Moreover, the engagement of stakeholders may be timed too late, namely when the actual decision has already been made and options for further changes are limited. Further risks cover frequent involvements, insufficient information, or very low reflection inputs in the final outcomes (OECD, 2017). More recently, Adams et al. (2021) also indicate that participatory modelling promotes stakeholder engagement for tailoring models better to the specific policy context and the decision-making process under consideration. In their view, participatory models create room for the redistribution of expertise among those who are engaged in the policy-making process.

The existence of specific challenges in case of controversies regarding the design of upcoming regulations prove the value of stakeholder involvement. Here the involvement of stakeholders may enable balancing trade-offs between different effects and interest groups. As pointed out by OECD (2020), initiatives may apply a random selection of participants to ensure representation of larger population groups to avoid disproportional influence of certain interests. The OECD (op. cit.) reflects in detail on possible approaches to solve such problems as for example, 'problem-solving (where policies are re-designed in an attempt to accommodate the different values at stake) and deliberation (where stakeholders discuss why certain values are important in an attempt to clarify and potentially resolve value conflicts). These concerns regarding the approapiate selection for a participatory approach are not a new issue in the literature and have already been discussed by Hare et al. (2003). More specifically, the level of involvement of the stakeholders and the scale at which the actions are supported constitute important elements to be taken into account when designing participatory process. Hare et al. (2003) also suggest other key factors that should be considered in the design such as the goals of the project, the democratic participatory goals, the power structures in place, the number of stakeholders, as well as the normative beliefs of the researchers involved. Along the same lines, a systematic review of the available methods at hand for modellers and stakeholders when pursuing participatory modelling is also provided by Voinov et al. (2018). These authors highlight that the type of method selected for participatory modelling is in practice quite often related to the experience and expertise of the modellers. Therefore, the authors encourage modellers to consider all potential participatory modelling approaches in order to select the most suitable one for their specific context.

3 Recent examples of stakeholders' interaction in economic modelling

3.1 SUPREMA workshops to capture input and feedback to model scenarios and define needs for future directions for agricultural modelling

The EU-funded project SUPREMA aimed at improving the capacity of current models, connecting or redesigning them to deliver empirical evidence on increasing varieties of policy objectives, and also to explore future directions for agricultural modelling in light of future needs.[3] Where possible SUPREMA sought to close the gaps

[3] Details can be found at the SUPREMA website: https://www.suprema-project.eu/. The specific project reports that focus on the outcomes of stakeholder workshops are D1.1, D1.2, D1.4 and D1.8.

between expectations and the actual capacity of models with current resources to deliver relevant policy analysis and to identify gaps for further research. The SUPREMA model family includes 'core models' already used in European impact assessments in agriculture, trade, climate and bioenergy policies.[4] In a number of scenarios, linkages between different models and limited model improvements were to test the current possibilities of the SUPREMA toolbox (see, also, Gonzalez-Martinez et al., 2021b).

3.1.1 Set-up of SUPREMA workshops

During the project, three stakeholder workshops were conducted in order to capture the views and input of the relevant stakeholders. They participated in identifying challenges and needs of anticipated future policy support and requirement for model-based policy analysis in a first workshop (see, for further details, Salamon et al. (2018a). In a second workshop, they were involved in defining the narratives for the scenarios to test the ability of the SUPREMA toolbox (see, also, van Leeuwen et al., 2019a). Finally, in the third workshop, they validated draft outcomes and improvements in order to help phrasing future research prospects beyond the scope of SUPREMA (see, Salamon et al. (2020a) for further details).

In the three workshops, similar stakeholder groups were addressed. The invited stakeholders covered a broad range of societal actors: policy community, businesses in the value chain including farmers, the scientific community, civil society and NGOs among others. Stakeholders were not involved in a regulatory process where they might be directly affected by the decisions or its implementation schemes although policies were discussed during the process. Instead, stakeholders were involved in the process of gaining additional insights into different subjects where the stakeholders may have broader knowledge, where they could be involved in preparing of decisions, where they could seek additional knowledge to support their own decisions or where they could be affected by decisions of others.

All workshops took place in Brussels between 2018 and 2020. The first workshop was organised back-to-back with an AGMEMOD workshop on 'Medium-term development of agri-food markets in EU Member States' a with a number of European market experts involved. For each stakeholder group under consideration a lists of likely participants was compiled and invitations were sent out. However, for the first workshop a focus was on Brussels-based stakeholders and experts from the back-to-back workshop. The invitations and two reminders were issued per mail. Invitations to participate were turned down giving reasons of timing or limited/unavailable experiences with models and their outcomes. Positive were personal relations and the back to back workshop minimizing travel time. When stakeholders declined participation the respective list was extended. At the second and third workshop additional efforts were invested in order to ensure a sound regional distribution of participants, including reimbursement of travel costs. Between 60 to 120 likely participants were invited while actually 30 and 35 participated.

The stakeholder workshops were organised in an interactive way and covered most part of a working day. In all workshops an introduction explained either the project or draft outcomes, and finally, a wrap-up provided first conclusions. The remaining time of the workshops consisted of interactive parts that were specific for each workshop.

For example, the first workshop included a session to define future challenges and needs for the agri-food systems by writing topics on cards on different flipcharts. Another session consisted of three stakeholder group discussions on challenges, needs, and shortcomings of the current model outcomes on: (i) a global perspective covering climate change, sustainable development goals (SDGs) and resource constraints; (ii) market and value chain perspective with international integration, supply chain, societal concerns and ethical issues; and (iii) a farming perspective with adaptation, mitigation and adoption of new technologies. Additional inputs were gathered in a running world café to identify challenges and needs, followed by another session to prioritise needs and challenges by limiting the selected points.

The interactive elements organised for the purpose of the second workshop included presentations with parallel discussions in separate groups and cards on flip charts to define the narratives on: (i) baselines including alignment of assumptions across models; (ii) a medium-term CAP related scenario; and (iii) a long-term climate change mitigation scenario.

In terms of the third workshop, presentations on selected draft results of the baseline and the two scenarios

[4] The SUPREMA suite of models includes the General Equilibrium Computable (GCE) MAGNET model (https://www.magnet-model.org/) and the following Partial-Equilibrium (PE) models: GLOBIOM (https://iiasa.ac.at/web/home/research/GLOBIOM/GLOBIOM.html); CAPRI (https://www.caprimodel.org/dokuwiki/doku.php); AGMEMOD (https://agmemod.eu/); MITERRA-Europe (http://content.alterra.wur.nl/Webdocs/PDFFiles/Alterrarapporten/AlterraRapport1663.1.pdf); IFM-CAP (https://op.europa.eu/en/publication-detail/-/publication/13480ce0-803e-4ec4-9f88-24d44d565eab/language-en).

followed by questions of attendees, interactive sessions in two parallel groups on flip charts addressing topics such as whether relevant questions are covered, what additional improvements would be required, which caveats would be seen and which future needs should be covered, etc. Subsequently, a presentation was organized to share first insights regarding the conducted model improvement and linkages accompanied by content related questions from the participants. The final interactive element included in this workshop was a world café seeking for responses to questions: 'What is the way ahead? Where are we, what do we need and what is missing?'. More spefically, this world café was organised around separate posters covering the following issues: (i) farmers' decisions and their reactions to a changing environment; (ii) is the demand side adequately reflected?; (iii) supply chain - what is missing?; (iv) are SDGs addressed efficiently?; and (v) testing on CAP and climate change policies - what are we missing?

In terms of the general organisation of these workshops, it is important to mention that they were conducted under the Chatham-House rule with no recording taking place. Alternatively, a moderator and several rapporteurs were allocated for each discussion. The moderators and rapporteurs were given detailed instructions, with rapporteurs taking notes of the different discussions and preparing overviews of the discussion. All written contributions were also photographed. Notes on oral contributions were compiled too.

Overall, the SUPREMA toolbox has shown by a number of medium-term and long-term scenario analyses a presentation was organised including linkages between different models and limited model improvements the current possibilities to analyse policy options and support policy decisions by quantitative analysis. In particular, the stakeholders participated in the whole process by identifying challenges and needs in future requirements of model-based policy analysis, by defining the narratives to test the modelling capacities of the SUPREMA toolbox and finally, by validating outcomes and improvements in order to help phrasing future research prospects with respect to the challenges going beyond the scope of SUPREMA.

3.1.2 Selected Outcomes

Content-wise, the outcomes of the different workshops are shortly presented in this section. To begin with, four general considerations with respect to the models were drawn. First of all, data requirements of models are, in general, high while scarcity of information and its quality is apparent. Therefore, modellers have to be flexible in their data use but model linkages require harmonisation and alignment. A joint data strategy is required reflecting new data sources, availabilities and data access. The second consideration is that continuous efforts will have to be put on maintenance of models to keep them up-to-date and ready to use in case of upcoming new policies. Thirdly, model linkages are perceived as a strong option to capture interactions between agriculture, trade, climate and related policies and to cover impacts in terms of economic, social and environmental dimensions. Increased complexity requires new linkages with additional types of approaches like biophysical models, mixed-method approaches as well as household models. Harmonisation of outcomes is a core requirement and considered as an area for further research. Due to limitations in harmonisation processes a better communication of differences is crucial. The fourth 'lesson learnt' is that an improved communication between modellers and stakeholders in an easy understandable way is strongly emphasised. Both, the definition and the implementation of scenarios as well as the treatment of their outcomes, need careful handling and communication which might required further efforts and resources.

In terms of the topics that require additional efforts in future research, the stakeholders pointed out several topics that according to their views were not sufficiently explored. Firstly, they indicated that policy measures and implementation schemes are a key for model-based policy assessment comprising a wide field of policies from SDGs over trade policies, CAP implementation schemes in the European 'Farm to Fork' strategy and the 'Green Deal', from the EU budget and rural policies to climate change policies (Paris Agreement). Nevertheless, these are not the only policies that affect the agri-food sector. Therefore, all policies should adapt to a changing environment which, in turn, induce required adjustments in the modelling tools. Monitoring likely changes for preparatory ex-ante impact assessments is also important so that models can be prepared and linked accordingly. Moreover, the participants indicated that in most models, individual behaviour of farmers and their adoption of policies together with the farmers' heterogeneity across the EU is not being fully considered. Therefore, understanding farmers' behaviour is important to adequately reflect the uptake of measures, risk management tools or technologies. Additionally, investment decisions, structural changes and diversification should be improved. Links between farming, biodiversity and performance indicators are needed. Bottom-up approaches like agent-based modelling or integration of decision-making units into models may lead to further insights.

The participants also pointed out that at present, consumers are represented mostly by homogenous behaviour and products. Differentiation of consumer groups may allow to depict health needs and diverting ethical beliefs while differentiation of food quality would enable a reflection of preferences for organic products, requests for higher animal welfare and different types of footprints. A link to health-related consequences may better reflect

impacts of dietary changes and the implementation of a food system approach would capture economic, social and environmental impacts simultaneously. Furthermore, according to the stakeholders, the representation of the value chain is another topic not sufficiently addressed. In particular, the coverage of the whole value chain would help to assess impacts across the whole agri-food system from primary production to the final use including residues or waste. In this sense, the representation of the complex relationships between involved agents and decision processes would connect consumers/citizens with producers. Currently, the value chains are only modelled in a stylized manner at aggregated levels. Price transmission, concentration, market power and specialisation in the value chain and the (bargaining) position of farmers are also elements that deserve further research.

Furthermore, other topics that should be better modelled are related to the expansion of the bioeconomy and the monitoring of the progress achieved in terms of sustainability objectives. In terms of the former, the need for assessing the transition of the fossil resource-based economy into a sustainable bio-based economy. Since this process is partly unknown and expected interactions are manifold, research is needed for modelling this transition. For a proper representation, data and parameters of material flows for bio-material and bio-energy, waste, and residues as well as fossil-based substitutions are needed to better reflect circularity. Regarding sustainability, there is a pressing need for indicators that reflect outcomes in terms of economic, environmental and social dimensions. The study of climate change also requires a good biophysical representation of agriculture, including its interaction with the biosphere. Currently, most efforts to reduce CO_2-equivalent emissions are on primary production; but the coverage of CO_2 or methane footprints along the whole supply chain show room for improvements. Therefore, a 'circular' approach should model nutrient cycles with reduced fertiliser use, lower feed imports and decreased nutrient losses to the environment. Coverage of footprints may be strengthened by a combination with LCA approaches.

Finally, new technologies and innovation processes, as well as their adoption play an important role in agriculture GHG mitigation and are another priority for future modelling according to the participating stakeholders. Improved technology may reduce emissions but it is mostly exogenously treated in models. In particular, stakeholders requested model adjustments to capture innovations in input use and climate change mitigation and also put an emphasis on new technologies concerning digitalisation and automated processes on farms and in supply chains. For further details on the outcomes of this series of workshops the reader is referred to Salamon et al. (2018b), Havlik et al. (2019) and Salamon et al. (2020b)

3.2 Stakeholder and expert involvement in the context of a scenario study on perspectives for Dutch agriculture in 2050

The Dutch example of stakeholder and expert involvement took place in the context of a scenario study on perspectives for Dutch agriculture in 2050 . This study was launched by the Dutch Ministry of Agriculture, Nature and Food Quality based on the idea of allowing private stakeholder organizations to come up with their own proposals and solutions to address the longer term GHG reduction commitments the Dutch government had made, i.e. in the Paris Agreement. The rationale for this study was the need to get more insight into the consequences of possible future developments for Dutch agriculture when pursuing those future climate and environmental targets.

3.2.1 Set-up of the Stakeholder Involvement

The stakeholders invited were selected from a set of societal organisations with broad interests, ranging from directly involved actors in the sector such as farmers, food processors and agribusiness to the non-governmental organisations with interest on environment, animal welfare and biodiversity among others. The organisations could change during the process. In general, they were represented by one person and a replacement but also the involved persons could change during this participatory process. In general, about 25 groups were present. Originally, the government indicated the groups that should be invited but others groups could be added as well. An emphasis was put on the dialogue and the exchange between those groups with diverging interests. Discussions were conducted mostly as round table discussions supported by presentations, notes on white boards and flip charts.

The meetings were chaired by an independent and well-known former politician appointed by the government with a clear given mandate. This person had the incentive to come with proposals shared by a wide stakeholder group and fit the challenging policy objectives. Government representatives were not regarded as stakeholders in the process. Although they were joining the meetings, government officials were only involved as observers and supported the process by secretariat-services.

Additionally, experts in the field were invited at different stages of the process. The NGO initiating the process together with the chair and a small executive committee were taking and executing the final decisions. Hence,

stakeholders themselves could also invite additional researchers or present studies to support their positions. Experts and researchers did not take final decisions on values or parameters unknown, but indicated related uncertainties. If experts had to provide scores these were mostly done by rankings.

Basic ideas on different scenarios were derived from the stakeholder participating process. Nevertheless, this process also depicted that very opposing and conflicting interests of the stakeholders involved limited the possibilities of finding applicable solutions. During the process, researchers took on a mediator role and the final scenarios were the outcomes of an interactive process involving stakeholders and researchers, where researchers contributed additional knowledge in areas with high complexity, added insights in trade-offs and 'slacks'. The mentioned slacks comprise possibilities to make adjustments to scenarios aiming to keep their original orientation but satisfying stakeholders' interests as much as possible - utilising all the Pareto-improving options that the group was able to agree on.

Designing the scenarios was a challenging task since the stakeholders had conflicting interests, e.g. should the livestock reductions affect all the sectors in a proportional way or should those sectors that pollute more face stronger reductions or should the reductions consider contributions of the sector to the value added, etc. Therefore, the participating stakeholders found it difficult to commit themselves to certain story lines. This conflict was solved by relying on model outcomes that transparently showed which could be the most suitable ('the optimum') livestock reductions which could be implemented complying with the environmental regulation of the Netherlands. Stakeholders were confronted with those outcomes so that they could react to them, validate or reject them if they were not plausible. The uncertainty in the process was perceived as severe and made participants careful in expressing clear opinions.

Despite the problems mentioned above the experience was perceived as highly positive. In the context of the Dutch policy agenda the topic of the study was considered as a highly sensitive one and therefore all interactions helped to engage the stakeholders in the study and the modelling exercise. The process was also very useful from the point of view of gathering expert information and creating a joint commitment and engagement with the final results.

3.2.2 Selected outcomes

Four different scenarios have been developed in close cooperation with stakeholders and with additional input from experts. An overview of the scenarios is provided in Figure 1, positioning them along two dimensions: (i) the environmental operating space; and (ii) the farm strategy for development or agricultural orientation.

The execution of the modelling exercise related to this study (see, Gonzalez-Martinez et al., 2021b) raised several issues, one of them being related to the determination of future environmental emission coefficients. The selected 2050 horizon imposed difficulties in the sense that one has to form a good judgement about the available emission reduction and abatement technologies during the period 2020-2050. Part of these are already known, but for several others the existing knowledge at the time was very limited. This is the case as certain technical measures that farmers can take are still at an embryonal stage of development. There were also futuristic technologies, directions that could offer potential, but which were not really developed yet. The uncertainty was not only coming from the availability of emission reducing technologies, but also about the potential degree and speed of farmers adopting such measures. An important issue here was that the changed policy context (more strict future emission standards) could affect the implicit incentives to adopt new measures), whereas side policies (e.g. subsidies from the future CAP) could also influence the economic incentives associated with farmers' adoption of technoogy.

The economic dimension was not only of interest because of the impacts it could have on farmer technology adoption, and for that reason on the reduction of environmental emissions by the adoption of technical measures. There was also a direct interest regarding the implications in terms of farm income . On the one hand, the Ministry of Agriculture and stakeholder groups, e.g. farmer unions, wanted to have insight into the consequences on the income for farmers. But on the other hand, it was also felt that financially viable farms would be needed in order to have them make the required future investments.

In terms of the modelling exercise, it is important to clarify that market impacts regarding product revenues and agricultural inputs of which feed is the most important one could be assessed, but neither the cost of measures nor the associated investments were considered. In order to estimate the costs and benefits, a group of farming and sector experts was consulted. This consultation took place in two rounds. In the first round, experts were introduced to the setting and types of measures under discussion. This action delivered insights into the different aspects of the potential new, but still largely unknown, measures. The interaction between researchers and experts helped to get a better view on potential costs and revenues. In the first, a round table discussion possible analogies between potential 'new measures' and already existing ones were discussed. It became clear that it would be impossible to make reliable quantitative estimates. In the second round, experts were provided

with score sheets and requested to score a set of potential new measures in a qualitative way. Based on this information 'average scores' for each of the selected measures were calculated. Additionally, experts were given the opportunity to react and comment on the outcomes.

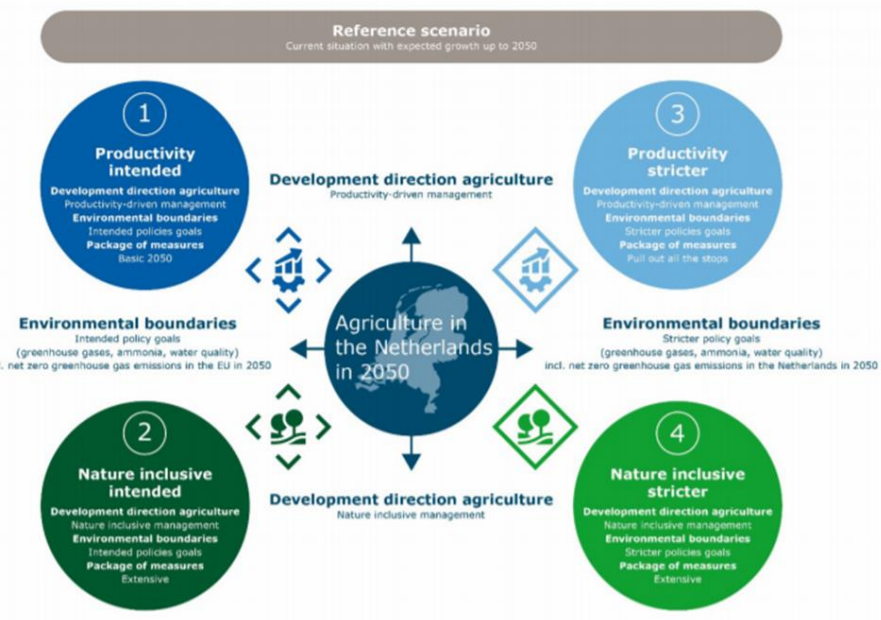

Figure 1. Four scenarios, characterizing potential pathways for the development of Dutch agriculture (Source: Lesschen et al., 2020)

As an illustration, the outcomes for the dairy and arable sector are presented in Tables 1 and 2. The qualitative scores indicate expected cost and revenue changes relative to the reference scenario at primary production level of two farm types, i.e. dairy and arable. Several cost entries were considered: land prices, costs associated with manure disposal, direct costs, costs associated with buildings, labour and contractor costs. With respect to the farmers' revenues, the experts were asked about market impacts (price changes), the potential to sell products at a premium (green label), and the revenues that farmers could obtain from providing other services, e.g. green services, biodiversity outputs, etc. among others.

The estimates were 'composite estimates' in which experts tried to make estimates for the different scenarios, where farmers were assumed to adopt scenario-specific sets of measures (see details in Lesschen et al., 2020). In Tables 1 and 2, A + indicates an increase relative to the reference scenario. In case of a stronger effect the experts could use ++, or even +++. The reader should note that a cost a + indicated a higher cost, which will then have a negative impact on farm income.

Table 1.
Qualitative evaluation of different mitigation scenarios in costs and returns for dairy farms (relative to the reference scenario)

Sector: dairy	**Expected differences in costs item:**					**Expected differences in development of farmer revenues because of:**		
Mitigation scenario:	Land	Manure disposal	Direct costs*	Buildings	Labour, contractors, machines	Price changes (supply/demand)	Premium value from markets	Other services
Business as usual	0	+	+	++	+	0	+	0
Nature inclusive – EU challenge	++	-	+	+	+	0	+	+
Productivity driven – NL challenge	+	++	++	+++	+	0	+	0
Nature inclusive – NL challenge	++	-	+	+	+	0	+	+

*) Costs for resources (energy, feed, seed, plant protection, fertilizers) and animal-related costs (e.g. veterinary services) .
Source: Lesschen et al. (2020); Gonzalez-Martinez et al. (2021b)

Table 2.
Qualitative evaluation of different mitigation scenarios in costs and returns for arable farms (relative to the reference scenario)

Sector: arable	**Expected differences in costs item:**					**Expected differences in development of farmer revenues because of:**		
Mitigation scenario:	Land	Manure disposal	Direct costs*	Buildings	Labour, contractors, machines	Price changes (supply/demand)	Premium value from markets	Other services
Business as usual	+	0	0	0	0	0	0	0
Nature inclusive – EU challenge	0	+	+	0	+	0	+	+
Productivity driven – NL challenge	--	++	+	+	+	+	0	0
Nature inclusive – NL challenge	--	+++	++	+	+	+	+	+

*) Costs for resources (energy, feed, seed, plant protection, fertilizers) and animal-related costs (e.g. veterinary services).
Source: Lesschen et al. (2020); Gonzalez-Martinez et al. (2021b)

4 Findings with respect to the processes

In principle, the mentioned stakeholder workshops have worked well to generate contributions to the two projects which dealt with model-based work. The stakeholder workshops depicted a number of similarities but also several distinctions in their function and consequently in their structure and their course of actions. The remainder of this section is devoted to further compare the two experiences, to extract commonalities and differences and to point out difficulties which should be avoided.

Both stakeholder involvement processes took place during a similar time span. Nevertheless, the first one, although Brussels-based, was intended to capture input across the whole EU and was conducted in English. In contrast, the geographical scope of the second one was the Netherlands and the discussion was held in Dutch. This had consequences for the participation of stakeholders who were required to speak English in the first case, this being the 'mother tongue' for only a few. Previously to the workshop, a number of invitees raised concerns whether they would be able to properly express themselves in English and turned down the invitation to participate in the stakeholder workshops. Additionally, their required travel effort was significantly higher if they were not based in Brussels and especially representatives from businesses on the outskirts of the EU claimed high expenditures for the travels involved as a reason to cancel their participation although travel expenses were reimbursed. In this respect, organizing the first SUPREMA workshop back-to-back to another workshop partly helped to overcome the problem.

Financial resources reuqired for both stakeholder processes were relatively high compared to other instruments. First of all, they included significant costs like travel expenses, catering, materials and such.An even higher impact had the personal costs of the involved researchers and other personal in the workshops for the organisation, concept development, preparation of inputs, conduction of concepts, registration and analysis of outcomes. Secondly, the required effort may vary if recording is possible (keeping in mind that the Chatham-House rule applies) and is especially high if external personnel is hired and provided with incentives like in the case of the 'Climate Table' workshop. Those costs are often good investments but increase the pressure to come up with results in the process although there are no guarantees. That way including stakeholder workshops in projects could constitute a significant burden on the overall budget as the actual incurred costs are often underestimated and only partly covered by foreseen resources.

The number of stakeholder groups and the diversity across those groups in knowledge and involvement in the respective processes increases the required efforts for preparing the workshops. This is strongly influenced by the topic of stakeholder workshops which was quite challenging in both workshops as a number of stakeholders did not feel knowledgeable enough and inadequately prepared to deal with models and model results. In this context the personal involvement or interests play a major role in their voiced interventions. In most cases the involvement was much higher in the 'Climate Table' workshop as it was indicated that an achieved solution based on a workable consensus could find entry into the Dutch implementation schemes. On the one hand, that increased the commitment towards active participation in the process, while on the other hand, the complex interactions of measures to be validated and the option to influence the outcomes directly increased the risk not to voice opinions in order to avoid 'wrong' decisions. Additional efforts by the researchers were required to

overcome the problem which aimed to close knowledge gaps. In case of the SUPREMA workshops, personal involvement was in most cases limited to 'only' future challenges and needs in modelling and requirements for future research prospects were to be compiled together with narratives for testing the toolbox. Here, in contrast, the low level of personal involvement also led to a certain reluctance to voice opinions because some participants did not feel as well equipped to contribute to topics in the realm of modelling as others so that not all were engaged with the same intensity. Hence, it was an explicit objective of the workshops to engage all relevant societal groups not only academics or district groups that could be addressed easier.

Although the workshops included respectively between 25 and 35 participants each, not all elements gained the same attention and active contributions. In general, contributions in smaller groups (group discussions) were easier to gain. Therefore, discussions in sub-groups were given preference, where applicable; hence, discussions in sub-groups require significant additional efforts and staff in the cases where recording in not an option. As a positive trade-off they provide useful insights into stakeholders' perceptions, interests, and values from their individual perspective but it is difficult to apply them to balance diverting interests and values.

'Running world cafés' were organized to gain additional contributions and insights into already compiled results. Those elements require sufficient room for participants to move from one 'action point', e.g. flipcharts, posters, etc., to another. As the available space was limited participants, at least partly, were reluctant to move between groups and had to be motivated to do so. That may have led to the fact of even additional comments and contributions.

Round table discussions or open discussions worked quite well for defining the scenario narratives and resulted in active contributions as long as no different options of diverting interest groups had to be balanced against each other. In contrast, validating scenario results in open discussions or round-table discussions strongly depended on ex-ante knowledge of participants, interests and values as well as on the participants' personalities. Therefore, providing contributions and comments on cards combined with discussions at flipcharts often resulted in better responses as stakeholders had more time to reflect about their possible contributions as well as more time to reflect on expressing them in English. It was helpful to then motivate stakeholders to explain their interventions. In the analysis, the written cards proved valuable in itself especially for further analysis. Provision of scores by ranks or points to items at the flipcharts also received quite positive active stakeholder participation. In the latter, they were given a limited number of points which they were asked to distribute according to their perceived importance. Participants were not required to justify their choices.

The willingness to contribute was lower when it was necessary to balances different interests and values during the Climate Table workshops which could be regarded as semi-regulatory processes. Designing choices for the scenarios included numerous conflicting interests, e.g. should the livestock reductions affect all the sectors in a proportional way, should those sectors that pollute more face stronger reductions, should the reductions be made account the contribution of the sector to the value added of agriculture, etc. The taken choices had to be defended and there was a feeling that choices had to be justified to the outside world as well. These conflicts required efforts to be solved by outcomes of an optimisation model indicating in a transparent way which could be most suitable ('the optimum') livestock reduction that could be implemented complying with the environmental regulation of the Netherlands. This process was helped by researchers who added additional knowledge as well as by a respected and well-know chair person.

5 Conclusions

Stakeholder engagement involves actors in a learning process, where these actors may also be affected by the decisions or may influence the implementation of decisions. In this respect, the 'SUPREMA' stakeholder approach follows the lines of the classical approach of this learning process with stakeholders being involved to gain additional insights into different subjects That they may already have knowledge about. These actors may be, in turn, involved in preparing decisions, they may seek additional knowledge to support their own decision making or they may be affected by decision of others in future. They supported in defining a research agenda to prepare models so that they will be enabled to support future decision making. In contrast, the 'Climate Table' stakeholder workshop resembles a stakeholder involvement in the regulatory process as it is aimed at making choices to address the longer term GHG reduction commitments made by the Dutch government (Paris Agreement). In the case of this second approach, stakeholders' involvement and concerns were much deeper. This can be considered as an advantage and disadvantage at the same time, since participants had to justify and defend choices. In both projects the stakeholder workshops generally worked well to generate expected outcomes.

Nevertheless, the stakeholder involvement depicts several limitations. Perception of participants can vary over time and are influenced by the respective circumstances when the workshops are being conducted. The

composition of the participants and their personalities may also have an influence on the outcomes as well as discussed topics and decisions. Stakeholders' participation depends on the topic at hand. For example, if a topic or decision affect a stakeholder in a strong manner the person is more willing to participate. Morevoer, it requires considerable efforts to achieve a balanced participation across groups, to conduct structured discussion as well as to motivate an active participation. The broader the regional scope is which should be reflected the outcomes the more difficult it is to achieve it. It is easier to conduct stakeholder workshops in one country, e.g. The Netherlands, than for the whole EU.

More specifically, a way out when considering a pan-European case could be to organize several workshops in different EU Member States but this dramatically increases the cost. Often there is a compromise to conduct the workshops in Brussels especially if policy and administration should be represented mostly requiring travel of other participants. A combination of different events may also ease the required efforts. Another challenge that can emanate in this type of 'international' setting is the language barrier. This is difficult to overcome as the lowest common denominator is to use English and not all stakeholders feel well equipped enough to actively contribute to the discussion when it is held in this language. A solution might be to have small regional online workshops in several countries although they significantly limit bilateral interactions and often reduce discussions on most topics.

Experiences also depict that stakeholder involvement requires higher input if controversial topics are discussed. A broad involvement of researchers and also of experienced moderators or mediators help in the process. The application of different tools to provide insights into the consequences also proved useful. How this can be achieved is case-dependent but in total requires significant efforts. The mentioned elements indicate that stakeholder workshops are useful approaches but one should not underestimate the necessary efforts, the required personal and financial resources as well as other temporal expenditures.

References

Adams, S., Rhodes,T., and Lancaster, K. (2021). New directions for participatory modelling in health: Redistributing expertise in relation to localised matters of concern. Global Public Health. https://doi.org/10.1080/17441692.2021.1998575.

Basco-Carrera, L., Warren, A., van Beek, E., Jonoski, A., and Giardino, A. (2017). Collaborative modelling or participatory modelling? A framework for water resources management. *Environmental Modelling & Software*, **91**: 95-110.

Barreteau, O., Bots, PWG., and Daniel, KA. (2010). A Framework for Clarifying "Participation" in Participatory Research to Prevent its Rejection for the Wrong Reasons. *Ecology and Society*, **15**.

Gonzalez-Martinez, A., Jongeneel, R., and Salamon, P. (2021a). Lighting on the Road to Explore Future Directions for Agricultural Modelling in the EU – some Considerations on what Needs to be Done. *Int. J. Food System Dynamics*, **12**(3): 287-300.

Gonzalez-Martinez, A., Jongeneel, R., Kros, H., Lesschen, JP., de Vries, M ., Reijs, J., and Verhoog, D. (2021b). Aligning Agricultural Production and Environmental Regulation in the Netherlands: An Exercise for Bringing together Economic and Biophysical Models., Land Use Policy, **105:** 105388, https://doi.org/10.1016/j.landusepol.2021.105388.

Geurts, JLA., Joldersma, C. (2001). Methodology for participatory policy analysis. *European Journal of Operational Research*, **128**: 300–310.

Havlik, P., Jongeneel, R., Salamon, P., Barreiro-Hurle, J ., Rau, ML ., Witzke, P., Brouwer, F., Frank, S., Banse,M., and Zirngibl, M. (2019). Deliverable 1.3: Narratives for implementation in impact assessments. Project Support for Policy Relevant Modelling of Agriculture (SUPREMA).

Hare, M., Letcher, RA., and Jakeman, AJ. (2003). Participatory Modelling in Natural Resource Management: A Comparison of Four Case Studies. *Integrated Assessment*, **4**: 62–72.

Hedelin, B., Evers, M., Alkan-Olsson, J., and Jonsson, A. (2017). Participatory modelling for sustainable development: Key issues derived from five cases of natural resource and disaster risk management. *Environmental Science & Policy*, **76**: 185-196.

Leitschuh-Fecht, H., Bergius, S. (2007). Stakeholder Dialoge können besser werden. In: *UmweltwirtschaftsForum*, **15**:3– 6.

Lesschen, JP., Reijs, JW., Vellinga, ThV ., Verhagen, J., Kros, H., de Vries, M., Jongeneel, R., Slier, T., Gonzalez Martinez, A., Vermeij, I., and Daatselaar, CHG. (2020). Landbouw in Nederland in 2050: Effecten van ontwikkelrichtingen. Wageningen. The Netherlands.

Litschel, J., Schramm, E. (2010). Konzeption und Durchführung eines Stakeholder-Involvements in BiKF (am Beispiel der ersten Phase von „Wald- und Forstsysteme der Zukunft“). In: Knowledge Flow Paper Nr. 9, LOEWE Biodiversität und Klima Forschungszentrum (BiKF), Frankfurt am Main 2010.

Mendoza, GA., Prabhu, R. (2006). Participatory modeling and analysis for sustainable forest management: Overview of soft system dynamics models and applications. *Forest Policy and Economics*, **9**(2): 179–196.

OECD (2020). Food Systems and the Challenge of Coherent Policies Chapter 3 – Achieving Better Policies, TAD/CA/APM/WP(2020)29. Manuscript Paris, France.

OECD (2017). OECD Best Practice principles on stakeholder engagement in regulatory policy - Draft for public consultations. Manuscript Paris. France.

OECD (2012). Recommendation of the Council on regulatory policies and governance. OECD Publishing, Paris 2012. France.

Salamon, P., Banse, M., Angulo, L., Brouwer, F., Gocht, A., Haß, M., Havlik, P., Hurle-Barreiro, J., Laquai, V., Runge, T., van Leeuwen, M., van Meijl,H., and Witzke, H.-P. (2018). Deliverable 1.1: The needs – scope to address new challenges in modelling. Project: Support for Policy Relevant Modelling of Agriculture (SUPREMA).

Salamon, P., Banse, M., Angulo, L., Brouwer, F., Gocht, A., Haß,M., Havlik, P., Hurle-Barreiro, J., Laquai, V., Runge, T., van Leeuwen, M., van Meijl, H., and Witzke, H.-P. (2018a). Deliverable 1.2: Minutes of the workshop and other relevant documents. Project : Support for Policy Relevant Modelling of Agriculture (SUPREMA).

Salamon, P., Banse,M., Angulo, L., Zirngibl, M., Blanco, M., Brouwer, F., Havlik, P., Jongeneel, R., Gonzalez-Martinez, A., van Meijl, H., and Witzke, H.-P. (2020). Deliverable 1.9: Stakeholders’ Workshop Strategic Prospects. Project: Support for Policy Relevant Modelling of Agriculture (SUPREMA).

Salamon, P., Banse, M., Angulo, L., Zirngibl, M., Blanco, M., Brouwer, F., Havlik, P., Jongeneel, R., Gonzalez-Martinez, A., van Meijl, H., and Witzke, H.-P. (2020). Deliverable 1.8: Report on the prospects for research. Project: Support for Policy Relevant Modelling of Agriculture (SUPREMA).

Schramm, E. (2012). Stakeholder-Involvement zur Bewältigung von Biodiversitätskonflikten. Ein Leitfaden. In: Knowledge Flow Paper Nr. 15, LOEWE Biodiversität und Klima Forschungszentrum (BiKF), Frankfurt am Main. Germany.

van Eeten, MJG., Loucks, DP., and Roe, E. (2002). Bringing actors together around large-scale water systems: Participatory modeling and other innovations. *Knowledge, Technology & Policy*, **14**(4): 94–108.

van Leeuwen, M., Rau, ML., Salamon, P., Barreiro-Hurle, J., Havlik, P., Jongeneel,R., Witzke, H.-P., Banse, M., and Brouwer, f. (2019). Deliverable 1.4: Stakeholders’ Workshop Narratives. Project Support for Policy Relevant Modelling of Agriculture (SUPREMA).

Völker, C., Schulz, O., and Kerber, H. (2018). Planungshilfe für die Gestaltung von Beteiligungs-prozessen im Flussgebietsmanagement - Empfehlungen aus dem Projekt NiddaMan. In: ISOE-Materialien Soziale Ökologie (51), ISOE - Institut für sozial-ökologische Forschung, Frankfurt am Main 2018.

Voinov, A., Bousquet, F. (2010). Modelling with stakeholders. *Environmental Modelling & Software*, **25**: 1268–1281.

Voinov, A., Jenni, K., Gray, S., Kolagani, N., Glynn, PD., Bommel, P., Prell, C., Zellner, M., Paolisso, M., Jordan, R., Sterling, E., Schmitt Olabisi, L., Giabbanelli, PJ., Sun, Z., Le Page, C., Elsawah, S., BenDor, TK., Hubacek,K., Laursen, BK., Jetter, A., Basco-Carrera, L., Singer, A., Young, L., Brunacini, J., and Smajg, A. (2018). Tools and methods in participatory modeling: selecting the right tool for the job. IIASA, Laxenburg.