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How to make Participatory Technology Assessment in agriculture more "participatory": The case of genetically modified plants

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ABSTRACT

This paper suggests a framework, based on Critical Systems Heuristics (CSH), to guide the organisation and management of expert-facilitated and participatory processes that allow for stakeholders' different interests, concerns, and values to be included in the assessment and policy making of GM plants. The framework is particularly useful for stakeholders, such as governments, foundations, and researchers, who attempt to facilitate inclusive and democratic processes to assess GM plants. The use of the framework is illustrated by evaluating the report from a citizen jury carried out to assess the cultivation of new GM plants in Denmark. Furthermore, through this illustration, the term Participatory Technology Assessment (PTA) is redefined, thereby suggesting two additional aspects to assessing new technologies – *following* and *evaluating* policy making – to be considered in the conduct of PTA.

1. Introduction

Participatory Technology Assessment (PTA) was developed to integrate a wide range of knowledge and values in the assessment and policy making of new technologies that involve complex and uncertain decision contexts. Complexity and uncertainty arise because the assessment and policy making of new technologies often deal with "wicked" social problems associated with the introduction of the technology. Those are problems in which problem structure and the goals of addressing and the means to solve the problems are not well defined (Rittel and Webber, 1973; Pellizzoni, 2003; Burgess and Chilvers, 2006). Different stakeholders, ranging from the expert to the lay citizen, engage in conversational and participatory processes to discuss and debate the issues associated with a particular technology. After reaching consensus on options, alternatives, and consequences of introducing a new technology, the stakeholders involved aim at informing policy making (Coates, 1976; Burgess and Chilvers, 2006). In practice, however, different stakeholders often have different (also conflicting) perspectives concerning the risks and benefits of introducing a technology, emphasise different (often overlapping) knowledge and values, and pursue different interests and goals (e.g. economic, social, and environmental) (Pellizzoni, 2003; Burgess and Chilvers, 2006). Stakeholders speak different languages and draw on different bodies of expertise to assess technologies, thus experience difficulties in communicating with each other. Moreover, stakeholders', especially citizens', interests, concerns, and values are often not fully integrated in PTA, causing citizens' mistrust in institutions, authorities, and policy makers (Pellizzoni, 2001; Cook et al., 2004; Borch and Rasmussen, 2005; Vergragt and Brown, 2008; Cronin et al., 2014). Researchers have therefore questioned the effectiveness of PTA in generating inclusive and democratic participation by different stakeholders (Rowe and Frewer, 2000; Abelson et al., 2003; Burgess and Chilvers, 2006; Hagendijk and Irwin, 2006). There is little understanding about how to ensure the inclusion of a wide range of stakeholders that have different concerns, interests, and values, in particular, the lay public in technology assessment and policy making (White, 2000, 2002; Burgess and Chilvers, 2006; White and Bourne, 2007).

This paper focuses on PTA in agriculture, in particular, the assessment and policy making of genetically modified (GM) plants. The introduction of GM plants is one of the most publicly contested new technologies (Levidow, 1998; Durant, 1999; Pellizzoni, 2001; Burgess and Chilvers, 2006; Vergragt and Brown, 2008), characterised by a debate about environmental, human health, ethical, and socio-economic risks and benefits (Cook et al., 2004; Borch and Rasmussen, 2005; Deisingh and Badrie, 2005). This paper addresses the question about which stakeholders should be involved, which expertise is necessary, and which issues should be discussed within PTA of GM plants, in order to include stakeholders' different interests, concerns and values. In addressing this question, I refer to "Critical Systems Heuristics" (CSH) (Ulrich, 1983), an approach which aims at getting the widest representation of problem situations in the same room at the same time and creating democratic participation (*ibid*). CSH is concerned with planning and critical reflection on its practical limitations (Midgley, 1997). Specifically, CSH deals with "the need to counter possible unfairness in organisations and society at large. This unfairness is manifested through the exclusion of certain stakeholder parties from having an input into the decision making processes about issues that

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affect their lives" (Gregory, 2008, p. 608). CSH allows both those involved in and those affected by planning processes to be involved in conversations that matter.

This paper contributes to the literature and practice of PTA with a framework to guide the organisation and management of expert-facilitated and participatory processes. These processes allow for stakeholders' different interests, concerns, and values to be included in the assessment and policy making of GM plants. Through the evaluation of the report from a citizen jury carried out to assess the cultivation of new GM plants in Denmark, I illustrate the use of CSH. Through this illustration, I redefine the term PTA, thereby suggesting two additional aspects to assessing new technologies – *following* and *evaluating* policy making – to be considered in the conduct of PTA. Thus a further contribution to PTA literature and practice is achieved.

2. Theory

2.1. Participatory Technology Assessment in agriculture

Participatory Technology Assessment (PTA) belongs to the family of approaches used to assess new technologies. Technology assessment (TA) originates in studies carried out, especially in the United States during the 1950s and 1960s, to forecast technological trends. These studies initially aimed at supporting corporations and the government in making decisions concerning technology investments. At the same time, society became more alert to the negative, often unintended and unforeseen implications of using technology. As a consequence, the Office of Technology Assessment was established in 1969–1972 with the aim to assess, for instance, the ethical, societal, economic, political, and legal implications of developing and using new technologies (van den Ende et al., 1998; Tran and Daim, 2008; Banta, 2009).

TA has been used within agriculture to address the interests of individual farmers, as well as consumers and society. Through a literature review, I identified four major areas in which TA has been applied within agriculture in order to assess (i) the economic consequences of introducing new technologies (e.g. no-till technologies, precision farming technologies, and GMOs) at farm, as well as national/societal level (e.g. Pinstrup-Andersen, 1979; Bowman et al., 1989; Bonnieux et al., 1993; Gotsch et al., 1993; Griffith et al., 1995; Borch and Rasmussen, 2005; Lankoski et al., 2006; Self and Grabowski, 2007; Jensen et al., 2012; Nolan and Santos, 2012); (ii) the effect of using new technologies on agricultural outputs at farm level in developing countries (e.g. Mann et al., 1968; Loehman et al., 1995; Hijmans et al., 2003; Jagtap and Abamu, 2003; Sheikh et al., 2003; Torkamani, 2005; White et al., 2005); (iii) consumers' acceptance of, for example, GMOs and biotechnology (e.g. Bonnieux et al., 1993; Burton et al., 2001; Lusk et al., 2004; Vergragt and Brown, 2008); and (iv) most recently, the impact of innovative agricultural technologies (e.g. precision farming technologies, GMOs, and irrigation technologies) on climate change and environmental sustainability (e.g. Barrett and Abergel, 2000; Cederberg and Mattsson, 2000; Pringle et al., 2003; Furtan, 2007; Pampolino et al., 2007; Vergragt and Brown, 2008; Ahlgren et al., 2009; Gnansounou et al., 2009; Fleischer et al., 2011; Smyth et al., 2011; Mushtaq et al., 2013; Zaher et al., 2013). To carry out these assessments, scholars have applied different TA approaches, such as economic and simulation models, surveys and participatory approaches (*ibid*).

Participatory approaches, used within PTA, include, for instance, interviews, group discussions, consensus conferences, and facilitated workshops (Joss, 1998; Durant, 1999; Hennen, 1999; Irwin, 2001; Burgess and Chilvers, 2006; Stirling, 2008). These approaches involve different stakeholders in participatory and open conversations about the development and introduction of new technologies. Stakeholders contribute with, share, and discuss different facts, interests, and values with the aim to provide advice to policy makers (*ibid*). A similar, but different, approach called Delphi technique, developed in numerous versions, has also gained popularity for assessing human judgement concerning the application of new technologies (Rowe and Wright, 2011). Using the Delphi technique enables a systematic gathering of expert opinions through anonymous questionnaires—iterated over a series of rounds, and controlled opinion feedback (statistically summarised) after each round allowing experts to reconsider their opinion (Rikkonen and Tapio, 2009; Linstone and Turoff, 2011).

Participatory approaches vary depending on stakeholder selection and their degree of participation. Depending on the technology of concern, stakeholder selection includes different stakeholders such as the government, scientists, interest groups, NGOs, the industry, and citizens. Their participation ranges from information provision to education, consideration of proposals or evaluations made by policy makers, to the active development and contribution to proposals or evaluations (Burgess and Chilvers, 2006).

Within agriculture, for example, Harris et al. (2001) conducted participatory on-farm trials with farmers in Zimbabwe and India in order to develop and test seed priming techniques, and enhance their adoption. The trials included farm walks during which farmers individually evaluated the techniques at different stages of crop growth, conversations amongst farmers about the advantages and disadvantages of the techniques, discussions in semi-structured focus groups, and formal matrix ranking exercises. Within the latter, farmers ranked the techniques in accordance to mutually agreed categories regarding agronomy, crop development, and yield. The authors found that on-farm seed priming, particularly if developed and tested in collaboration with farmers, enhanced crop development and yields.

Hu et al. (2007) present a participatory project aimed at testing standard and modified technologies for site-specific nitrogen management for irrigated rice within four provinces in China. The project comprised four phases: (i) site selection, (ii) consultation between farmers and researchers to design the modified technologies, (iii) farmers' evaluation of standard and modified technologies, and (iv) a farmer participatory experiment. Importantly, the design of modified technologies (ii) comprised dialogue between farmers and researchers, surveys of farmers aimed at exploring the features of rice production within the selected provinces, and a workshop with agronomists, economists, technicians, and farmers, during which technology for site-specific nitrogen management was discussed. Subsequently, suggestions for modifying the existing technology were formulated, followed by a workshop to finalise the design of the modified technologies. Within the evaluation of standard and modified technologies (iii) the famers, firstly, reflected on and, secondly, considered the opportunities and incentives for adopting the different technologies. Finally, (iv) farmers were selected for experiments to evaluate the technologies. The project identified that 95% of 514 farmers were willing to adopt standard and modified technologies, and 76% to conduct experiments. Besides, more than two-thirds of the farmers opted for the adoption of modified technologies, especially due to lower requirements for nitrogen input compared with the standard technologies.

Borch and Rasmussen (2005) carried out iterative questionnaires and workshops to assess a Danish company's aim to develop a transgenic ryegrass plant used to enhance the nutritional value of fodder. Through questionnaires, selected experts formulated arguments for and against GM plants and indicated further stakeholders to be involved in the assessment. Stakeholders were then selected according to their expertise for participating in workshops and Delphi questionnaires, within which they formulated, assessed, and discussed value-laden statements. Importantly, the discussion focused on the statement "knowledge of long-term consequences (of GM plants) cannot be obtained," which was considered by the stakeholders to determine the future GMO (genetically modified organisms) debate in Denmark. Overall, the authors found that the iterative questionnaires and workshops facilitated open dialogue amongst stakeholders supporting them in addressing and sharing different interests and perceptions.