Assessing societal and environmental impacts of science, technology and innovation

A (brief) position paper for the Thinkers' Program Sustainable Innovation of the Royal Flemish Academy of Belgium for Science and the Arts (KVAB)

Johan Schot, Utrecht University Centre for Global Challenges, and Petra Verhoef, Rathenau Institute

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Preface

This is a brief position paper written by the two thinkers appointed by the KVAB. The paper aims to introduce three sets of questions to be discussed at round table discussions on October 4 and October 11 organized by the KVAB. During the first session we will focus on general Science, Technology and Innovation Policy (STI) developments, while during the second session we will zoom in on the STI policies for the agriculture and food system. The session aims at gathering information about the situation in Flanders and a first discussion with various stakeholders. A follow-up discussion will happen at a one day symposium on November 23, 2021.

The three questions are:

1. How did STI (agriculture & food) policy develop over time in Flanders (and Belgium)? How did it integrate considerations about negative STI impacts?
2. How to account for and integrate societal impacts into STI (agriculture & food) policy?
3. How to design, implement and evaluate STI (agriculture and food) policy?

Introduction

Science, technology and innovation (STI) has played a central role in the development of the world as we know it today. Especially after WWII, STI policy became a concern for governments as a driver of growth, development and wellbeing. Yet, as we know today, technology and innovation have also become a part of the problem. They are implicated in many of the challenges the current world is facing, including the climate and biodiversity crises and growing inequality. These challenges are expressed in the United Nations Sustainable Development Goals. To understand how STI policy can contribute to addressing these challenges and lead to sustainable innovation, we need to understand the frames or logics behind STI policy.

Three STI policy frames

We distinguish three frames of STI policy [1, 2]. Frame 1 or "Innovation for Growth" emerged in the post-war period, stressing the benefits of science and technological change to the economy. Policy makers became concerned about the role of the public sector in supporting science and technology because in the language of economists they constitute a public good, suffering from market failures. The inadequacy of the market to support their development at the level desired, required state intervention, and investment in R&D up to a level of 3% of GDP (according to the OECD and EU). This idea was supported by the linear model of innovation which focuses on building an excellent knowledge basis (including higher education institutions) that will then – presumably – almost automatically lead to innovation, and rapid economic growth. The role of the state is to secure the presence of excellent science. Within this frame there is a recognition that innovation may lead to unintended consequences such as pollution, inequality and climate change, but these impacts can and should be dealt with by means of more science and technological development and if necessary regulation. This to generate a level playing field for companies stimulating them to address these undesired consequences (impacts) through innovation. Since these innovations would only be developed after the impacts have become visible, they often led to cleaning-up (waste management) and add-on technologies (such as the catalytic convertor for a car, or higher chimneys and use of filters for the chemical industry). The conviction was that economic growth is necessary in order to pay for the costs of environmental and for social measures too, for example loss of jobs due to technical change, and social benefits necessary to provide people with a decent life (at a minimum level).

Frame 2, or "National Systems of Innovation", emerged in a context of growing international competition, marked by economic shocks such as the 1970s oil crisis. Analysts started to recognize that producing knowledge and investing in R&D is not sufficient. Actors need to be able to absorb the knowledge and use it for productive purposes. Following the emergence of Japan and Korea into knowledge economies, this new frame brought attention to the different paths that these countries and regions followed in the constitution of their innovation systems, characterized by systems and institutions that support learning, skill and capacity building and entrepreneurship. These type of elements evidently enhance the absorptive capacity of an economy. This frame led a move away from a linear view of innovation to a more systemic one in which innovation is the result of interactions across many actors: universities, firms and entrepreneurs, governments, workers (they need to have skills), and even civil society. In this frame societal impacts should be integrated in this interaction process, and thus be addressed because some actors (workers, civil society, firms) articulate a demand for it. The role of STI policy is not only to provide for knowledge production, but also for learning by interacting, including the building up of skills to participate in the learning process. Within this frame, there is a recognition of the importance of technology assessment. In other words the need to assess the potential negative consequences of innovation, in order to be able to address them early on, and provide remedies. These assessments should be inserted into the learning by interacting process, and this could be done by dedicated technology assessment actors, or other institutions. Reference 3 gives historic examples for the Netherlands.

Frame 3 is what we call “Transformative Innovation Policy”. This frame takes addressing environmental and social challenges as the central aim of STI policy, questioning assumptions about the neutrality of technological innovation. It starts from the conviction that the current socio-technical systems that fulfill basic needs, such as energy, mobility, food, water, security and communications, need to have a fundamental shift (transition) in order to become truly sustainable. This is different from what constitutes a mere system optimization, e.g., improvements in agricultural yields. It calls for a transition policy focused on bringing about system change in order to address the climate and biodiversity crisis as well as rising inequalities. Changes that are needed involve infrastructures, such as food supply systems, and cultural norms and practices, such as what we consider a healthy diet. Sustainable innovation includes social innovation. This frame brings the attention to the direction of innovation, namely the different social and political choices embedded in technological choices made. This frame is close to a mission-oriented innovation policy called for by many governments and the EU, if a mission is not interpreted as a top-down policy but a bottom-up process enabling system change. It is also close to Responsible Research and Innovation practices aiming for articulating political choices and impacts of science and technology early on in the process [7]. In this third frame technology assessment is not just an additional instrument called upon to insert attention for impacts, but a starting point for any STI policy since it focuses on addressing societal and environmental challenges head-on. It also calls for a whole of government approach since energy, food, transport et cetera are issues addressed by various government departments. STI policy needs to leave its own comfort zone and become coordinated across government.

Concluding remarks on design and implementation

Currently, these three frames co-exist in STI policies, and each of them fulfills an important role. Yet, more emphasis on frame 3 is required for innovation to play a prominent role in finding solutions to complex global challenges such as the ones expressed in the SDGs. How to implement frame 3 policies then? A starting point is the acknowledgement that there are no best and optimal approaches to complex problems. Therefore, it is important to allow for societal experimentation, a structured learning process informed by evidence and experience to explore potential transformation paths and their consequences. An experiment can also be seen as a series of practices, methods and objectives used to inform and facilitate system change. It allows to test ideas at small scale and in real contexts (for example in a living lab) before full implementation, without the compromises of large-scale policy intervention. The subsequent large scale implementation will require a process of niche construction, as well as de-stabilization of the dominant system. A niche in an environment in which the new solutions are nurtured through shielding, networking, learning and visioning and then scaled in a process of replication, circulation, wider adoption and institutionalization. Eventually the niche may become a new system. For this to happen, actors supporting the dominant system need to open up for change, and become promotors of the niche [4]. An example is the development of renewable energy socio-technical system replacing an energy system build around fossil fuels. This is not just a technological process, but requires new regulations, business models, user preferences, industry strategies and cultural norms. Investing in this process of experimentation and niche construction requires new forms of evaluation which engage with the process itself, inducing second order learning, and reflexivity. This type of formative evaluations differs from traditional evaluations of public policies, since they are participatory, and seek to assess and stretch the level of transformation in the experiment [5]. Impact assessment becomes impact construction. Technology assessment becomes Constructive Technology Assessment [6], and innovation turns into sustainable innovation because impacts are integrated into the design and implementation of innovation practices in a participatory manner.

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