

Quadruple and Quintuple Helix as a way to socially inclusive growth in the development of bioeconomies in Europe?

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Introduction and background

We live in a rapidly changing world where we need to handle challenges such as climate change, food crisis, migration, and fuel- and energy crises. Several initiatives towards sustainable development have been initiated at the global arena by the UN, starting with the Brundtland report in the 1980s. However, this first initiative towards sustainability coincided with a neoliberal political agenda, implemented mainly in the western world from the 1980s and forward. The neoliberal political agenda is often highlighted for its implications on the global economy such as deregulation, privatization and off-shore production also leading to increased consumption patterns at the individual level. Thus, rather than building a more sustainable world, this development and the current economic system have had negative effects on the environment (Murray, Skene, and Haynes 2015, 1-12). Additionally, the current economic systems build on a linear economic system where natural resources are put in to the production system and after their use turned into waste in a non-circular system. Thereby, it contributes to the deterioration of the environment by pollution throughout the whole production cycle and it is necessary to propose new economic models to be able to meet future challenges. In Europe, a turn towards a 'sustainable bioeconomy' and a 'circular economy' has been proposed. However, these two concepts do not always imply a path towards sustainability. A transformation towards sustainability calls for a change to all of society and not only within economic activities, but for example changed consumption and production patterns, a transition from fossil materials to renewable materials, new innovations in technology for the use of waste streams into a circular economy, changed regulations, values and norms within the society as a whole (Geels 2005, 681-696; Geels and Kemp 2007, 441-455).

Today the European governments are redirecting their innovation policies towards larger societal challenges including as well environmental and social challenges as social inclusiveness. Since the 1990's European innovation policy has been directed towards regional innovation systems (RIS) i.e. an institutional infrastructure supporting innovation in specific firms at the regional level. The existing model mainly builds on a triple helix model building on close collaboration between universities, government and industry (Leydesdorff and Etzkowitz 1996, 279-286; Leydesdorff 2000, 243-255). However, a critique has been directed towards current innovation systems in Europe as being too narrow-minded and undemocratic due to its exclusion of civil society (Campbell, Carayannis, and Rehman 2015). As a result of the linking and clustering of heavy industry mainly dominated by men, several studies highlight the gap between gender equality, innovation and entrepreneurship in triple helix systems (Pettersson 2007). For

example Lindberg and others (2012, 36-52; 2014, 94-113) shows that innovation policies can maintain elitist and masculine norms and values about innovation and entrepreneurship affecting the transformation to a more sustainable society by the exclusion of specific groups based on gender, ethnicity and social class. One way of addressing both environmental issues and democratic aspects in innovation systems could be to develop current regional innovation systems further into a quadruple and/or a quintuple helix system (see for example Carayannis and Rakhmatullin 2014, 212-239). Within research the quadruple helix model addresses the importance of including civil society groups in regional innovation systems and innovation processes. A further development of the innovation system is a quintuple helix model including a fifth helix, representing the natural environment, thereby taking environmental challenges into concern (Carayannis and Campbell 2009, 201-233; Carayannis and Campbell 2010, 41-69; Carayannis and Campbell 2012; Campbell, Carayannis, and Rehman 2015). Further, research shows that the everyday practices of ordinary people are overlooked in innovation processes, thus creating a lack of knowledge about civil society (Yang and Holgaard Egelund 2012, 132-148). Additionally, the inclusion of civil society in innovation processes can contribute to a wider understanding of environmental problems and changing attitudes towards environmental issues, lifestyles and consumption patterns. This can also lead to a change in the work of public authorities, and within industry and business practices such as the production system (Rennings 2000, 319-332). Thereby, the engagement from civil society i.e. Non-Governmental Organizations (NGO's), labor unions, consumers, users and so on, can lead to a balance between the common good and market driven growth. It can also initiate a change in production patterns leading to new innovations and technological development (Etzkowitz and Zhou 2006, 77-83); required if a transformation towards sustainability will be possible.

Aim and research question

The aim of this paper is to highlight the processes of a further development of regional innovation systems to include as well civil society groups as environmental challenges in the innovation process by posing the following research question: *How can we create and strive for more inclusive and sustainable innovation policy?* In this paper I have been inspired by the perspective of political ecology aiming to emphasize the role of civil society in environmental politics. Within political ecology the concept of green governance takes the departure from a bottom up perspective where civil society groups are given greater influence over environmental development processes (Peet, Robbins, and J. Watts 2011). Therefore, I am using the implementation of policies regarding the bioeconomy and civil society groups in European regions as a lens for studying how political economies and political ecologies are formed and shaped (Widengård 2015) in innovation policy in three different regions in Europe.

Research methodology

The empirical material for this paper builds on discourse analysis, with the aim to search for the ways that bioeconomy and civil society is being implemented into regional policies in a European context. In this context the term bioeconomy includes ideas and arguments having performative power, affecting the views, behavior, beliefs and interests of different actors. Thereby, the discourses surrounding as well bioeconomy and the inclusion of civil society in the transformation process are an expression of new ideas, values and norms shaping investments, policy orientations and policymaking which could be seen as an expression of green governmentality.

Questions asked to the texts analysed have been; *how is the bioeconomy framed? What narratives are being used to define and motivate a transformation to bioeconomy and the inclusion of civil society in the regional innovation systems? How can these frames and narratives about the bioeconomy and civil society be related to current innovation models within the innovation literature?*

Case studies and empirical material

The texts analysed are regional strategy documents used by the regional authorities in three cases: Värmland in Sweden, Noord-Holland in the Netherlands and Flanders in Belgium. The three regions have been chosen due to their participation in the so called Vanguard initiative. The Vanguard initiative is a network of industrial regions in Europe. The aim with the network is to create joint platforms to further develop new technologies in different industrial sectors to promote reindustrialization in Europe. Within the initiative there are currently five pilot projects; Bioeconomy, advanced manufacturing for energy applications in harsh environments, efficient and sustainable manufacturing, high production through 3D-printing and new nano-enabled products. In this paper the focus is on the bioeconomy pilot project. Currently there are 22 participating and interested regions involved in the pilot project regarding the implementation of bio-based value chains within regions specializing on bioeconomy in their smart specialization strategies (Vanguard Initiative 2016).

Political ecology and the bioeconomy in Europe

Within the field of political ecology there is a critique towards current economic models towards sustainability seen as forms of neoliberal governmentality processes. One way of addressing this issue is by using the concept of environmental justice related to social inequalities and social justice often based on class, gender and ethnicity (Smith and Pangsapa 2008). This perspective is also related to political ecology addressing the importance of social, economic and political vulnerability within specific groups in society often connected to environmental problems. In particular, political ecology emphasizes governance from below where civil society groups are seen as important drivers and managers of environmental concerns (Peet, Robbins, and J. Watts 2011).

Political ecology mainly takes its departure within the governmentality literature building on the writings of Michel Foucault and his concept of biopower. By biopower Foucault (2010) pointed towards new kinds of sovereignty implemented in society for the identification, classification and organization of knowledge and subjects. In the context of the sustainability debate new forms of green global governance to face for example climate change and food and energy insecurity is an example of how biopower works (Peet, Robbins, and J. Watts 2011). In this case the concept of bioeconomy can be seen as an expression of green biopower or green governmentality reproducing particular subjectivities through expert knowledge and different practices of sustainable governance in European regions (Peet, Robbins, and J. Watts 2011). However, and as according to Foucault, power is not necessarily a top-down process; rather power is executed in relations to other persons, institutions, and places around us (Foucault 2008). This means that different and overlapping power relations exist at the same time, representing different discourses in society. Some of these discourses represent resistance and a bottom-up perspective. Just as Widengård (2015) argues there are important connections between using the theories of Foucaults governmentality and assemblage theory, which originates from the writings of Gilles Deleuze and Félix Guattari. In accordance with Widengård (2015) assemblages are produced over and in between different geographical scales, institutions and relations. Assembling in this

context means the ways that different actors relate to, form, and shape an assemblage, which unless it is firmly established needs constant confirmation. In this paper the bioeconomy can be seen as an assemblage or an expression of green governmentality framing innovation policy in Europe.

The use of the term bioeconomy has become more and more commonly used and there are several related definitions such as a biobased economy and biotechnology (Pülzl, Kleinschmit, and Arts 2014, 386-393). In the European context the EU has defined the bioeconomy as a larger economic transformation away from the use of fossil fuels and fossil resources into a more resource efficient bio based economy, where the bioeconomy is seen as:

...the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products and bioenergy (European Commission 2012:3).

The European definition of the bioeconomy differs from the use of the concept in other contexts such as in the Organization for Cooperation and Economic Development (OECD) and the USA. In the USA the bioeconomy is mainly connected to biotechnology referring to the use of living organisms and systems in the production system in trade and industry (McCormick and Kautto 2013, 2589-2608). There is no outspoken sustainability approach in this context, rather biotechnology links to the genetic modification of cells, crops and other raw materials (Birch 2012, 183-201). In the definition made by the European Commission (2012) biomass is seen as a resource regardless if it comes from waste or other renewable materials or energy sources (Kleinschmit et al. 2014, 402-410). Thereby, the bioeconomy refers to the use of bio-resources (Kleinschmit et al. 2014, 402-410) in a circular cycle. Circular refers to the word cycle where the production system affects the environment as little as possible by reusing and reproducing waste or renewable materials in a closed production system (Murray, Skene, and Haynes 2015, 1-12). However, the bioeconomy in Europe is dominated by the relation to the European smart growth agenda linked to innovation, resource efficiency and competition (Pülzl, Kleinschmit, and Arts 2014, 386-393), and it is mainly driven by a competitiveness agenda to strengthen the European market and economic growth by technological innovations and new products (Staffas, Gustavsson, and McCormick 2013, 2751-2769). Thus, it could be argued that the use of the term bioeconomy is just another buzzword for sustainable development and a continuous greening of the economy and green governmentality (Birch et.al. 2010; Birch 2012). The relation between bioeconomy and market oriented growth thereby risks superseding social and democratic aspects related to environmental justice (Birch, Lewidow, and Papaioannou 2010, 2898-2919). It is also important to add that there is a lack of research about the bioeconomy within the social sciences risking that the project of a sustainable bioeconomy only becomes represented within science and technology studies not addressing political and social issues thereby contributing to the legitimation of the bioeconomy as a political project without further objections (Goven and Pavone 2014, 1-36). However, it could also be used as a tool to force firms and industries into producing more environmental friendly and sustainable products. As argued by Grundel and Dahlström (2016) the use of the term sustainable bioeconomy or a sustainable bio based economy, if built on a circular economy, could be a way of transforming society into becoming more sustainable. Thus, several of the European regions use the bioeconomy as a way of strengthening their regional economies and as a way of

enhancing growth and competitiveness by a specific focus in their regional research and innovation strategies.

From triple helix to quadruple and quintuple helix innovation systems in Europe

Former innovation policies in Europe have mainly been dominated by a traditional view of innovation processes and regional innovation systems such as triple helix building on close collaboration between academy, government and industry (Leydesdorff and Etzkowitz 1996, 279-286; Leydesdorff 2000, 243-255). The origin of regional innovation systems (RIS) started to gain attention in policy making in the 1990s and is closely linked to the rise of regional clusters and regional innovation policy (Lundvall 1992). Due to the regional context and institutional settings the regional level was seen as the appropriate geographical level for innovation processes to occur (Doloreux and Parto 2005, 133-153). In this context an innovation can be seen as the outcome of social processes where the actual innovation occurs in interaction between different actors. Thus, an RIS can be defined as an institutional infrastructure supporting innovations in firms in specific regions (Asheim 2007, 223-241). Today, the concept of smart specialization strategies is a directive developed by the European Commission (EC) (2012) for European regions to develop so-called *Research and Innovation Strategies for Smart Specialisation* (RIS3) where a RIS3 can be seen as a further development of earlier Regional Innovation Systems. A RIS3 has an enhanced focus on European regions to draw on their unique resources to strengthen pre-existing specializations on the regional level (Aranguren and Wilson 2013, 127-145; Carayannis and Rakhmatullin 2014, 212-239).

However, a transformation of society into becoming more sustainable calls for a variety of knowledges in current innovation systems. Several scholars have addressed this transformation to sustainability by a further development of current regional innovation systems into quadruple or quintuple helix innovation systems (see for example Carayannis and Campbell 2009, 201-233; 2010, 41-69; 2012; Carayannis and Rakhmatullin 2014, 212-239; Campbell, Carayannis, and Rehman 2015). A quadruple helix innovation system builds on collaboration between four helices i.e. universities, authorities, firms and industry *and the civil society*. However, the role of civil society in innovation systems is not clearly defined. There is still skepticism towards citizen based knowledge in decision making processes (Isenhour 2011, 117-134), thus citizen involvement have become highlighted as important in relation to environmental justice (Reed 2008, 2417-2431) and democracy (Campbell, Carayannis, and Rehman 2015). Civil participation in policy making processes has also become more complex due to the involvement of other actors than earlier where firms, supranational organizations, lobby organizations and expertise have been given more influence (Swyngedouw 2005, 1991-2006; Miller and Rose 2008). A critique is pointed towards a “post-political” condition where there is no or little antagonism in policy making processes (Mouffe 2008) thereby undermining democracy. Political processes have become a question of consensus building between different parties making alternative discourses of environmental politics excluded. Therefore, it is important to maintain and allow different discourses, ideas and knowledges in policy making processes to meet future societal challenges.

Within innovation policy civil society is mainly seen as users and consumers, but can also be defined as citizens, NGO's, labor unions, workers and so on. Thus, there are two important differences within the definitions of civil society. On the one hand there is a more growth oriented definition defining civil society as clients and consumers. On the other hand there is a more democracy oriented perspective focusing on end users, the

role of NGO's, labor unions and other associations (Grundel and Dahlström 2016). Under a long time the role of consumers, users and citizens has been underestimated or ignored in innovation processes, even though they are the main users of goods and services (Ivanova 2014, 369). Additionally, NGO's and other kinds of association's e.g. environmental organizations, could also represent other interests than purely economic (Hock Heng et al. 2012, 530-536) important in transformation processes to sustainability. Environmental organizations often represent economic models opposed to our current economic models (Kenis and Lievens 2014, 531-548). Due to a more democratic view on innovation policy within research, a widening of the earlier triple helix model could be a possible way of acknowledging knowledge from other sectors, such as the civil society (Lindberg, Danilda, and Torstensson 2012, 36-52) in innovation processes.

A further development of current innovation systems into a quintuple helix system could also be proposed (see for example Carayannis and Campbell 2010, 41-69; Carayannis, Barth, and Campbell 2012, 1-12; Campbell, Carayannis, and Rehman 2015). In a quintuple helix innovation system a fifth helix does not represent a real actor, but the natural environment. By this, it comprise of; the education system; the economic system; the natural environment; the media-based and culture-based public and the political system. Each helix works as a system giving input of knowledge in a circular manner creating a base for knowledge creation by new inputs and new knowledge necessary for a transformation to sustainability.

The three different innovation systems presented here can be seen as a representation of the view and development of knowledge in society by time. A triple helix system relates to the development of the knowledge economy, a quadruple helix system to the knowledge society and knowledge democracy, whereas the quintuple helix system refers to a broader perspective of socioecological transformations and natural environments (Campbell, Carayannis, and Rehman 2015). A quintuple helix model thereby represents a system where innovation goals and strategies should be able to integrate public opinion in processes of knowledge creation, creative industries, politics, lifestyles, culture, values and norms, based on close dialogue with citizens (MacGregor, Marques-Gou, and Simon-Villar 2010, 173-190). In transformation processes knowledge is a fundamental resource where the quintuple helix model establishes nature as a central component for innovation and knowledge production necessary in the transformation to a biobased society (Carayannis, Barth, and Campbell 2012, 1-12).

Bioeconomy and regional innovation systems in Europe

In a European context the transformation into a bioeconomy mainly occur at the regional level as a result of the intensification of innovation and economic policies aiming to transform the European market into becoming more competitive and sustainable. One part of this development is the European strategy Europe 2020 structuring guidelines and withholding a vision for the European market until 2020 (European Commission 2010). A further development of the goals in Europe 2020 is also put forward in the strategy: *Innovating for Sustainable Growth: A Bioeconomy for Europe* (2012), where the bioeconomy was singled out as one of the main conditions for a transformation to sustainability.

In the three case studies presented here the focus was on seeing how the bioeconomy was framed, related to, formed an shaped as an assemblage or an expression of green governmentality in a European context through the lens of the regional authorities in three specific regions. Important here is that the bioeconomy as such comprises of

different sectors, thereby making it possible to speak of a green (agriculture), red (healthcare and medical) blue (marine and aquatic) and white (enzymes and microorganisms) bioeconomy (Kleinschmit et al. 2014, 402-410). Within the three regions compared in this study they were not referring to the same sectors within the bioeconomy. In Värmland the bioeconomy relates to a forest based bioeconomy where the forest is the main asset or natural resource used in the production system. Within Flanders it is mainly biotechnology, agriculture and food, chemistry and energy that are promoted as the main parts of the bioeconomy (Government of Flanders 2014). In Northern Netherlands the focus of the smart specialisation strategy and the development of a common bioeconomy were mainly directed towards already strong industries in the region such as the food and energy sector together with the chemical industries (SNN - Northern Netherlands Provinces 2013).

Framing the bioeconomy - sustainability or growth discourses?

The strategies and or policies pointing to the path of the development of a bioeconomy in the three regions is mainly used as a way of increasing research developing new technologies, products or other innovations thereby promoting economic growth and regional competitiveness. It is also seen as a way of opening new markets, leading to new business opportunities and new employment whereas aspects of sustainability and resource availability is often limited in policy (Staffas, Gustavsson, and McCormick 2013, 2751-2769).

The bioeconomy is perceived as a key to be able to meet future challenges such as population growth, climate change, and a lack of natural resources, food scarcity and increased pressure on our ecosystems. A transformation to a bioeconomy is also seen as a necessity due to the high dependency and use of fossil raw materials and its impacts on greenhouse gas emissions and climate change. Thereby, the major societal challenges are being used to frame the necessity of the transformation into a bioeconomy in Europe. In Flanders the bioeconomy is seen as a necessary transformation of society due to major societal challenges, using the bioeconomy as a tool for addressing upcoming crises in a sustainable manner requiring a larger transition of society as a whole away from the use of fossil materials to biomass. However, biomass in for example the use of resources for food, animal feed and biological raw materials are already under pressure. In Flanders the ecological perspective is especially strong due to a strong focus on a more sustainable economy also including ecological and social sustainability. The government of Flanders also points towards a circular economy necessary for conserving the ecological and social capacity of the earth (Government of Flanders 2014).

In Northern Netherlands one aim is to transform the agricultural industry into becoming more sustainable, contributing to bio-diversity, improving the development of rural areas but in the same time increasing production, however the greening of the economy requires a more progressive government policy (SNN - Northern Netherlands Provinces 2013).

In Värmland the discussion of societal challenges are not lifted out as a driver for the transformation to a sustainable future. However, sustainability is seen as important for the transformation to a forestry based bioeconomy, but the growth agenda is dominating the strategy as a whole.

Growth discourses and the bioeconomy as green governmentality

The framing of the bioeconomies in the three regions is dominated by a growth discourse especially due to the branding of the regions as forerunners and examples of best-practice oriented businesses. In Flanders this is lifted in their vision by promoting their own regions as a forerunner within new innovations in the bioeconomy:

“By 2030 Flanders will be one of the most competitive bioeconomy regions in Europe”.

Värmland is promoting the region as:

...a large scale demonstrator, to which people from all over Europe and the rest of the world come to learn about and witness the achievements possible when society, business, academia and the citizenry, women, men, girls and boys, come together for a common vision (Region Värmland 2015, 24).

It could be argued that the bioeconomy is not implemented as such to build sustainability in the regions. Rather, it is a tool for the development of new technologies and innovations in new sectors or to enhance growth in already existing industries. In this way the bioeconomy becomes a tool for green governmentality aiming to create policies for growth and competitiveness. The environmental aspects of the actual process of implementation are lacking. There are the already strong industrial clusters in each region that are prioritized, which according to the critique towards regional innovation systems as narrow minded and undemocratic risks continuing already existing patterns, norms and values.

Knowledge, innovations and civil society

The smart specialization strategies are pointed out as a tool for European regions to include other groups than earlier in the regional innovation system, whereas innovation is lifted out as the main tool for the development of a working bioeconomy:

“Innovation is key: a bioeconomy can only exist through innovation, and also contributes itself to a region’s strength of innovation. Such an economy offers huge opportunities for, among other things, the further development of a circular economy, the optimal use of raw materials and economic growth (Government of Flanders 2014 ,5)”.

However, there is a lack of involvement of civil society in all three regions. The role of civil society is unclear and undefined with a large focus on civil society as users, clients and consumers. The forms of cooperation and collaboration are unclear and there is still a lack of understanding of the role of civil society. However, studies within environmental studies points to the importance of engaging participants as early as possible in the development of a project or as in this case an innovation process or rather a larger transformation of society. It is also important to engage participants in as many of the phases as possible which improves the usefulness for decision makers, the educational potential for the public and the credibility within the community (Smith Korfmacher 2001, 161-176; Beierle and Cayford 2002; Reed 2008, 2417-2431).

The Government in Flanders sees civil society as having an important role if a transition to a bioeconomy will be possible. A sustainable society demands a change of both consumer and production patterns and a strategy will be developed together with stakeholders including business federations, civil society organizations and research institutions pointing to a quadruple helix system as well a quintuple helix system focusing

on environmental aspects in the region. A large amount of stakeholders are asked for whereas all stakeholders are seen as actors with their own interests that must be taken into concern:

“Transition management requires networks in which forward-thinking players from government, business, civil society and science are involved (Government of Flanders 2014,11)”.

In the Northern Netherlands the civil society is also lifted out as important in the development of a bioeconomy where “inclusive growth” includes residents, businesses, institutes of higher knowledge and public authorities in a quadruple helix spectrum. The innovation process here requires different kinds of knowledge from different kinds of people expressed by the use of living-labs for pilots and research. However, in this context the role of civil society is the role of end-users measuring their consumption patterns or as a testing ground for new innovations not actually involving civil society in the actual innovation process. The idea of the innovation system in the region thereby is directed towards a quintuple helix innovation system. However, the role of the civil society is mainly focusing on the citizen as an entrepreneur or as a user, whereas the civil society is not given much influence over the actual innovation process.

In Värmland the vision for the region is to be a tool for sustainable and inclusive development, making it a concern to all actors working with innovation in the region. However, a market oriented perspective is dominating rather than an actual focus on sustainability. This is shown by using the transformation to a forestry based bioeconomy as a tool to build a brand name and create greater visibility for the industries in the region. The research and innovation strategy in Värmland VRIS3 is inclusive to the extent that it embraces different actors in society in the written document. However, the transformation towards bioeconomy is a top-down process. The triple helix system in the region is strong and civil society does not play any actual role in the system so far. Therefore the base for developing a quadruple helix architecture is weak, however the fifth helix is taken into concern due to the transition into a sustainable forestry based bioeconomy also relating to the assets and natural resources in the region. Thus, this implies a responsible and sustainable use of the forest as a resource in the region where different kinds of uses of the forest must be taken into concern together with production such as cultural and recreational values of the public.

Concluding discussion

The aim with this paper was to highlight the processes of a further development of regional innovation systems to include as well civil society groups as environmental challenges in the innovation process by posing the following research question: *How can we create and strive for more inclusive and sustainable innovation policy?* The paper used the bioeconomy as a lens for studying how new innovation policies are being framed within three regions in a European context.

There is a great focus on growth and competitiveness in all of the regions, which can also be seen as a direct result of the smart specialisation strategies aiming to strengthen regional growth and competitiveness in Europe. However, if the focus will be on a sustainable circular bioeconomy within the regions based on regional assets and natural resources there is a possibility that the transformation to a bioeconomy could be a possible way towards sustainability. The innovation literature could play an important role while focusing on the further development of earlier innovation systems into a

quadruple and quintuple helix system highlighting democratic deficits and the importance of the inclusion of civil society and a concern for environmental aspects. There are several challenges with the bioeconomy depending on whether it is only a way to create growth and competitiveness or whether it could be a turn away from the dependency of fossil raw materials.

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