Agroecology and Social Sciences – Regulation of agroecosystems

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Introduction

In his article form January 2013 Massimo Monteduro argues that there is a need for better interaction and transdisciplinary between law and agroecology. We are very much welcoming this invitation to contribute with our social science perspective on agroecology in the global setting of this conference.

In our presentation we will focus on agroecology and the problems of sustainable agroecosystems regulation, by including a multiperspectival approach (Alrøe and Noe 2011) and a social systems theoretical perspective, based primarily on theories of Niklas Luhmann, Bruno Latour, and Charles Peirce. We will address two main challenges raised by our view on agroecology, the epistemological challenge of how to observe agroecosystems as a whole, and the ontological challenge of how to understand the existence of agroecosystems independently of perspectives.

Agroecology as a multiperspectival platform and implications for regulation

Agroecosystems are heterogeneous systems (Noe and Alrøe 2006), hybrids between technical, economical, biological and social systems, and agroecology is widely described as the study of the interactions between soils, plants, animals, machines, actors, stakeholders, etc. in agroecosystems. However, agroecology as a study does not have its own perspective that is able to observe an agroecosystem as a whole, it has to rely on range of disciplines. No single scientific perspective can observe the "agroecosystem" as such; the observations will always be defined by the "scientific eyes" observing: A biological perspective on an agroecosystem will focus on the biological processes and things that influence the biological processes; an economic perspective will define the system as a flow of money and transformation of assets; and a sociological perspective will focus on communication or human interaction and how humans are interacting with nature, technology and economy.

Agroecology has the position to serve as a common multidisciplinary platform for studying and developing sustainable agroecological systems. However it also faces the challenge of coping with the complexity of contributions from multiple perspectives involved in the study of agroecosystems. Here our point is that agroecology has to be understood as second order observations of disciplinary observations (Noe et al. 2008). This means that agroecosystems must be understood as second order construction of the objects for second order observation of agroecology.

The multiperspectival understanding of agroecology also has consequences for the law system's interaction with agroecology. The law system does not have its own perspective either, from where it can observe an agroecosystem as such. In any kind of regulation the law perspective has to build on other perspectives on the systems. If the agroecosystems is understood as a technical system, law and regulation will be targeting technical matters such as the handling of liquid manure or the requested space for the animal. If it is seen as an economical system, law and regulation will be targeting taxes and subsidies. The choice of scientific perspective has consequences not only for the measures that are applied by the law systems, but also for how the effects are measured, and, more importantly, for what effects are not measured.

Seen from a multiperspectival understanding of agroecosystems, the challenge for the law system is to deal with the complexity of multiple perspectival observations. Agroecology may constitute a useful platform that enables regulation to build on second order observation of perspectival observations of agroecosystems.

Agroecosystems as self-organising systems and implications for regulation

The fact that an agroecosystem can be viewed as a biological system, a technical system, a social system, or an economic system, means that the unity of an agroecosystem cannot be viewed from any of these perspectives. Our viewpoint is that Luhmann's theory of social systems as autopoietic systems, developed from the ideas of Humberto Maturana, Francisco Varela, and Gregory Bateson, may provide a useful theoretical understanding of the ontological unity of agroecosystems. We will here elaborate on that and discuss its implications for regulation.

Maturana and Varela define all living organisms as autopoietic systems, which means that they are self-creating and self-organising systems. Living organisms are operationally closed but open to material flows. Luhmann has adapted this understanding to encompass social systems, which he claims operate in communication. We have further developed this theory to comprehend hybrids like agroecosystems (Noe and Alrøe 2006)

An agroecosystem can be seen as a flow of operations and interactions between natural, technical and social elements, including animals, seeds, tractors, buildings, knowledge, labour, extensionists, etc., and organisation can be seen as coordination of this flow of operations. How these processes of coordination are organised varies from agroecosystem to agroecosystem. In a classic family farm, the epicentre of coordination is the farm couple discussing and deciding. In larger enterprises there might be internal differentiation of organising processes in relation to the individual branches of production such as animal and crop production. Or external actors may be directly involved in terms of extensionists, enterprise board, etc.

However, these processes of negotiations of coordination are not only going on between human actors. How a cow or a computer is involved in this flow of operations can also be seen as a continuous negotiation (or communication). If we look at the milk yield of a cow, it can be seen as a negotiation between the potentiality of the cow and potentialities of other elements like the fodder, labour, and technical equipment, and how the interactions between these potentialities are coordinated, e.g. is there sufficient time to take care of the individual cow, how are the cows fed, etc.

So, from this perspective an agroecosystem cannot be understood only by describing the elements involved, each element constitutes a huge surplus of potentiality that can in no way be actualised in the same system. The agroecosystem has to deal with this huge complexity and has to focus on what is most important in relation to its coordination of flows of operations. To make this coordination possible in a coherent way, each agroecosystem needs to produce and reproduce operational closure. It is the agroecosystem itself that defines what is possible and not possible, and what is important not important, and the system develops its own schema of causality and logic. This continuous process of closure has to be negotiated in every interaction in the agroecological system, both in term of which elements and actors are included, e.g. what breed, which tractor, etc., and in terms of how these elements are enrolled in the flow of operations. E.g. how is the tractor used and to what extent does it fit into that function?

This means that how an agroecosystem is organised and how it reacts on changes in the surrounding environment and perturbations of the system cannot be understood from a universal logic of the social, technical, economic or biologic systems, but needs to be understood from the internal logic of the agroecosystem as an autopoietic self-organising system. Studies show that values and meanings play a very strong role in this organisational closure; it may be the proudness of high yielding cows, the fascination with technology, or the taste and quality of the products.

The autopoietic understanding of agroecosystems has strong implications for our understanding of the conditions for regulation. Firstly, the operational closure means that there isn't any direct access to the autopoiesis. Regulative measures can only perturb, disturb or irritate the autopoiesis of the agroecosystems, no matter whether it is prescriptive, economic or normative measures that are applied. All regulation of autopoietic systems depend on self-regulation. Secondly, there is no one to one causal relationship between the intended logic behind the measures and the reactions in the agroecosystems. It is the ability of the agroecosystem to observe the disturbance and its internal schema of logic that will define the reaction. To illustrate this we use a biological example: The ability of a body to feel pain when it is pricked by a needle is an attribute of the body, without the function of the nerve system the body will feel no pain. How a person reacts to the prick of a needle is not an attribute of the needle but is determined by how the prick is interpreted. If it is understood as a vaccination the person will probably not react to the pain at all, if it is understood as the sting of a wasp the person may react very dramatically on the pain. There is no simple causal effect between the needle prick and the reaction of the person.

An agroecosystem continually needs to react on changes in the encompassing world, and any form of regulation can be seen as changes in the environmental setting of the agroecosystem. But the reactions depend on the system's logic and related values, and thereby on how the agroecosystem has reduced the complexity of its environment. If it is a very market orientated agroecosystem, it will likely react on even very small price fluctuations, e.g. by changing crop rotation or changing input factors. If it is a very production orientated agroecosystem, it may adopt new breeds, seeds or technologies even with an expectation of small increases in yield.

The challenges of legal regulation (discussion)

The multiperspectival and social systems theoretical framework presented in this paper provides both analytical and normative points for the further discussion of regulation and agroecosystems.

In Table 1, we have used the understanding of agroecosystems as autopoietic systems as a framework to analyse the system reactions and pros and cons for three different forms of regulation. None of these forms of regulation target the agroecosystem as a whole. They work through technical, biological or behavioural regulation (perturbation) of the systems based on an underlying understanding of how the systems are functioning. Different types of regulative measures have different pros and cons, and as indicated in the table the reaction of the systems and the effects of the measures in the individual agroecosystems will depend on the system's logic and values. Even small changes in taxes on e.g. pesticides may have an effect on market orientated agroecosystems, while even very high taxes will have no effect on the internal organisation of agroecosystems orientated towards high productivity, although they may affect the economy of the systems.

Table 1. System reactions and advantages and disadvantages of three different forms of regulation

Forms of regulation	**Examples of regulative measures**	**System reactions**		**Pros**	**Cons**
		System logic	**System values**		
Legal injunction / prohibition	Green catch crops	The effect of the catch crop is very dependent on how the system is organised. If the rationale is not shared, the reaction can be contrary	Systems values plays only an indirect role	Possible to control	The real effect is unknown, and the side effects in the system are unpredictable
Incitements: Taxes/ subsidies	Pesticides tax	The sensitivity to taxes is dependent on both the values and logic of the system		It regulates directly on the target, less disturbance of the autopoiesis of the agroecosystems	High taxes to make all agroecosystems react. Leads to permanent dependence on taxes
Normative: Campaigns / information	Voluntary agreement on pesticide reduction	Will only be a part of the systems logic if it becomes incorporated in the systems values	Sensitivity is very dependent on values, some react very strongly in the intended direction while other react against	Cheap and little control. Co-constructive with the autopoiesis of the systems	Save the saved, agroecosystems that do not share the intention behind the campaign may react contrary

This analysis leads to a more normative point that can be made from the autopoietic understanding of an agroecosystem, namely that in order to obtain the perceived goals of the regulation, one should strive as much as possible to use measures that support the autopoiesis, rather than measures that try to destroy or restrict the autopoiesis of the systems by enforcing specific behaviour that is expected to lead to the intended results. The more the measures focus on the outcome goals, the more the autopoietic systems are allowed to choose the means in accordance with their internal systems logic, and the more likely is it that the regulation will have a more permanent influence on the systems. For example, nitrogen regulation could focus on the nitrogen balance (surplus) of the agroecosystems instead of detailed prescriptions of catch crops, injection of manure etc.

Concluding remarks

The social systems perspective is, like all other perspectives, just one way to observe the agroecosystem, and needs the other perspectives to say anything about the biology, technology or economy of the system. However, our conclusion is that on the one hand the social systems perspective can help us to understand why a specific regulation does not have the expected effect, and on the other hand it will move the focus of law and regulation towards mobilising the system's own logic to pursue sustainable development. This can be done by focusing on the regulation of output instead of input, results instead of actions, goals and intensions instead of prescriptions. This, if successfully employed, could lead to a much more effective regulation, and improve the possibility for the system to combine the multifunctional requests in a more sensible way. We know that this is a big challenge for law and regulation because it may often be easier to regulate on input and behaviour, and we therefore welcome this opportunity to take up this challenge on the platform of agroecology.

Further readings

Noe, Egon and Hugo F. Alrøe (2012) Observing farming systems: Insights from social systems theory. In: *Farming systems research into the 21st century: The new dynamic* (eds. Ika Darnhofer, David Gibbon and Benoit Dedieu). Springer, Chapter 17, pp. 387–403. [http://dx.doi.org/10.1007/978-94-007-4503-2_17]

Alrøe, Hugo F. and Egon Noe (2011) The paradox of scientific expertise: A perspectivist approach to knowledge asymmetries. *Fachsprache - International Journal of Specialized Communication* Vol. XXXIV, 3–4/2011: 152–167. [http://tinyurl.com/q3kq3k2]

Noe, Egon, Hugo F. Alrøe and Anne Mette S. Langvad (2008) A polyocular framework for research on multifunctional farming and rural development. *Sociologia Ruralis* 48(1): 1–15. [http://tinyurl.com/nfdccts]

Noe, Egon and Alrøe, H.F. (2006) Combining Luhmann and Actor-Network Theory to see farm enterprises as self-organizing systems. *Cybernetics and Human Knowing* 13(1): 34–48. [http://tinyurl.com/pn9ogdm]