The ecologization of agricultural sciences and technology and the role of social studies about it

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THE ECOLOGIZATION OF AGRICULTURAL SCIENCES AND TECHNOLOGY AND THE ROLE OF SOCIAL STUDIES ABOUT IT

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Abstract
This communication tries to shape and to ground the idea that Rural Studies and Rural Sociology have a particularly promising job to do in re-assembling the Social, the Natural and the Technical within the treadmill of sustainable development. It is argued that the cross-fertilising of ecological modernization movement and Social Studies of Science and Technology (particularly Actor-Network-Theory) is giving the opportunity to establish a perspective that might enlighten and accompanied the effective ecologization processes of agricultural sciences and technology. But this requests specific conditions and ways of doing social studies in situation, which are including those processes.

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Introduction

Following the important account of the ecologization of agricultural policy in Europe developed recently by Deverre and de Sainte Marie (2008)[1], we would like to develop some ideas about the parallel life of Science and Technological Studies (STS) and Rural Studies (RS) during the 90's. Doing so, we would like to underline the fact that they are some already existing or promising relationships about the multiple senses and narratives about ecological modernization, either in its early alternative agri-food system foundations, or in the booming eco-governmentalization of agriculture and rural space.

This communication would like thus to phrase the idea that Rural Studies and Rural Sociology might have a particularly promising job to do in re-assembling the Social, the Natural and the Technical within something that critical thinking could call today "the treadmill of sustainable development".

More specifically, it is argued that the cross-fertilising of ecological modernization movement and Actor-Network-Theory is giving the opportunity to establish a perspective that might enlighten and accompanied the effective ecologization processes of modernized agricultures under certain requisite of deliberative conditions.

1. The trend towards an ecological modernity

1.1. The ToP

The theory of the "Treadmill of Production" developed in the late 1970's by the Schnaiberg's group has represented the pillar of a critique of the effects of capitalism on the environment that had been opened by Catton and Dunlap (1978). The capitalism was compared to a treadmill in which accumulation processes generate the appropriate demand of consumption while at the same time industrial production is leading to a consumption of natural resources and an addition of wastes to the environment; until the last ton of coal would have argued Max Weber. This vision assumed the existence of equivalence between the exploitation and rejection of labour forces on one side and the addition and subtraction of natural resources on the other.

As Buttel (2004) had shown it: the relative decline of this theory during the turn of century does not necessarily mean that there is a complete deny of its potentiality. Nevertheless, the debate that took place during 2004 in *Organization Environment* indicates that many issues are still heavy to integrate. Wright (2004) notably pointed two questions to be addressed to the "Treadmill of Production"; they seems perhaps even more relevant today than yesterday:

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[1] We want to thank Christian Deverre for some - and too short- moments of discussion about some ideas developed here. Our thanks also go to the members of the team of INRA Sciences in Societies, who help me through permanent debates to frame some of the ideas that are developed in this communication (special thank to M.Cerf; P.B.Joly O.Thiery and T.Tari).

- in the light of the raise of direct consumption practices or green consumerism involvement, the predominance of entering in the treadmill through the temporality of production and not consumption is an important bias;

- in the light of eco-service economy and deployment of eco-government settings and apparatus, the idea that the environment is only to be mined for natural resources or to be uses as a trash, do not account for the economy of recycling or industrial ecology.

It would be certainly possible to justify the critique and the idea of a new treadmill of sustainable development. The sustainable development framework is born with international convention on natural resources use and protection, and it has promoted conceptual framework and grounded legitimacy for a new kind of individual or collective rights in relation to environmental justice. All these new rights are closely related to the material or immaterial realities of sciences and technology either depredating or healing environment. But, the expression of S&T in a sustainable perspective requests new political spaces (Latour, 1993) and a re-engagement of their social consequences (Redclift, 2005) to consider the fact that a market governance of sustainability would mean addition and subtraction of environmental justice according to a non deliberated distribution of risk (Beck, 1992).

But let's go back in the 90's. While delivering a review of the sociology of environment Buttel (1996) had already established at that time a continuity between the quite pessimistic environmental sociology movement and the forthcoming positive considerations of the « *ecological modernization school of environmental sociological thought in Northern Europe* », as he named it. Quoting the early work of Spaargaren and Mol (1992), he was pointing that « *the development of environmental knowledge and social pressures were creating a basis for deflecting the course of modernity in the direction of ecological modernization* ». Quite at the same time, Schmidt (1993) was also using the notion of "ecologization" to point the fact that environmental policies should pay attention to the social conditions that "*may be favourable or impedimental to an ecologization of 'the economy'*", such an economization being considered as a new phase of the "*civilizing process*".
The quiet conflagration of those two contrasted positions about ecologization, reflects particularly well how the Rio Conference in 1992 might have shaped, at that time, the agenda of the new political-economic regime of post-industrialised countries while internalizing, in purpose, what environmental and neo-Marxist critique were starting to consider as a new frontier for intellectual fights and social movements.

Concomitantly to the treadmill of production framework, the premises of the ecological modernisation were thus about to be shaped in Berlin, Netherlands and the UK during the end of the 1980's (Mol and Sonnenfeld, 2000), and this inspiration also sprang within rural sociology as a theory of non centralised and not planned change of social order because of environmental damages (Mol, 1992; Mol and Spaargaren, 1992). Many others also contributed to this theoretical emergence in Wageningen and Cardif (namely J.D. Van der Ploeg, H. Renting J. Murdoch, P. Milbourne and T. Marsden). Those

colleagues took the establishment of environmental issues as a turning point and a set of matters of concerns to frame a research program. It did so in relation to the definition of alternative solutions to the post-industrial agri-food system described by Allaire (1996) and the decline of national food system linked to a national agriculture (Friedmann and Mc Michel, 1989).

The ineluctability of the ecological modernisation process was then leading to a comprehensive and propositional agenda of social research with the explicit aim to develop a quest for ecological modernisation, which certainly did not mean, at that time, to take part to the greening of agro-chain strategies or agricultural policies (see notably Marsden, 2004).

Nevertheless, the early foundation of this research has possibly underpinned the role of farming techniques, of farmers' reflexive account of ecological modernisation and what all the organisation of production means in relation to agro-chain management (see Deverre and de Sainte Marie, forthcoming). The reduction of ecological modernization to a type of alternative, which was assembling organic farming and short circuit or direct consumption, might have represented, for a while, an efficient framework but perhaps a counterintuitive position as far as what we called the treadmill of sustainable development was starting to improve its efficiency. But, it is also to be noticed that the general orientation of the ecological modernization model was also containing a pragmatic promise: a constructive resistance to industrial agri-food system was also an alternative and a positive model associating very directly farm and rural development with innovative modes of food consumption, a "*new rural development paradigm in Western Europe* » as labelled by Goodman (2004). This is certainly why the « ecological modernization » theorizing has somehow to be considered in a certain continuity with the foundations of the critic of capitalism opened by the environmental sociology with the Treadmill of production.
This "*new rural development paradigm"* had thus much to say and propose about how to socially engineer new paths of development with claims for more organic farming; claims for new social practices and institutional reframing involving more largely NGOs in governance structure and claims for the empowerment of local political élites (Mol, 2000). More recently, mobilizing the idea of metabolic relation, some works brought evidence that alternative systems linking producers and consumers on a local scale not only represent a, so to say, political alternative but also an alternative that solve problems issued by the modernity of food system either because of food scares (Stassart and Whatmore, 2003) or because of market uncertainty related to globalization of agro-chain (Lamine, 2008). The potential of exploration of the multiple benefits of ecologized agrifood system has certainly not come to an end.

1.2. The competing narratives of ecological modernization

If, during the 90's, the ecological modernization theory of rural sociologist has proposed a consistent theoretical framework, one could also say that it did not enhance a comprehensive account of the ecological modernisation that was starting to take place within the so-called conventional agriculture under local agri-environmental

experiments and under the resources coming from the greening of agricultural policy. The ecological modernization started also to mean a variety of possibilities in terms of institutional arrangement of sustainable development (conventional, standards, labelling) and space (regions and nations). One has also to look at ecological modernisation as a manifestation of this profusion, and following York (2004) to note that: "*what appears to be improving environmental performance as part of the modernization process may not be due to a general trend toward sustainability associated with modernization but rather, due to a trend toward increased variability of environmental performance in institutions in late modernity*". In such a perspective the variability would not allow to grasp what is really happening but the profusion would represent "*extreme cases that appear to be ecologically modernizing*". This argument has to be seriously challenge, firstly because it considers ecology of knowledge and practices, which might echoes our sensibility.
They are recent proposals to indicate a broad approach of the diverse rural worlds and a systematic account of pathway towards sustainability through agriculture while paying attention to the distributional consequences of dynamic changes in agriculture (Thompson and Scoones, 2009). This kind of platform certainly takes the issue of ecologization in a less alternative food system orientation, since it explores the various master frames and narratives that shape the political agenda of sustainability. One might understand that ecological modernization could mean also, among other things, a rationalization process until the last acre to be turned into "biofuel cropping". The proliferation of narratives and public concerns about agriculture and rural life is certainly something to bear in mind as a compensation of the existence of those narratives in public debates. Lockie (2006) has acknowledged in corpuses of newspapers the central role of narratives about organic food playing the double role of concrete answer and testimony of all types of controversial food-related issues.

Moreover, it is to be noticed in this short genealogy that over the past decade the achievement of sustainable agriculture has been a central narrative in the work of many organisations (governmental and intermediary bodies, NGOs, professional organisations and research institutions). Various political, technological or research programmes defines future targets and objectives to improve sustainability in various subsectors of agriculture (animal production, arable farming, glasshouse horticulture, etc.). Either to develop organic farming or Integrated Production scheme the relations between agronomic sciences, agricultural technologies and public or private expectations are at stake. This has led to claims for "slow innovation" concerning the purposes and ways of designing new technologies or new relations to old techniques. In fact, these claims indicate a need for a shift in the governance of research and innovation to achieve a sustainable future with agrosystem for the 4 F: food, feed, fuel and fibres.

The competition of narratives is thus not concerning only food production and system of provision, but narratives concern more and more agriculture as a multifunctional and technological sector, and objectives addressed to agronomic sciences in order to develop the regime of evidences that could ground the measurement of sustainable agriculture according to multifunctional objectives and globalized governance of carbon emission and storage. There is a promise which is arising, showing the paths for an ecologically

intensive agriculture, which presents itself as very technical and modernist project similar to what the green revolution had been also justified (Griffon, 2006). Brooks (2005) has coined a stimulating comparison between the green revolution and the agri-biotechnology regime that will certainly have to be enlarged to this new narrative of ecologically intensive agriculture, possibly with GM organisms. The idea of a third Green Revolution is also proposed to promote an ecosystemic engineering based on ecological principles (Hastings et al., 2008) and it is thus challenging agricultural research practices and objectives. This is not necessarily the type of challenge addressed by agroecology (Altieri, 1989), nevertheless there are more paradigmatic and common approaches of farming practices there than with the type of Science and technology policy that has been promoted under the European Knowledge Based Bio-Economy (KBBE) for the last 5 years at least. But there also, there are divergent meanings KBBE (Coombs, 2007).

There is certainly an asymmetric competition between different paradigms as Vanloqueren and Baret (2009) have recently claimed, and certainly a biotech paradigm that has comfortably flourished under the CAP and consequently has locked-out agroecological innovation. One could easily feel that it could get even stronger under the new KBBE, based on innovation in molecular biology, in the use of biocatalysts and in crop breeding and management systems within sustainable objectives. It is to be noticed that agroecology certainly not relays on the same type of scientific practices, regime of evidences making and on the same type or sociotechnical arrangement to develop innovative system, even if fibres or agrofuel would be concerned. Thus as Vanloqueren and Baret (2009) have announced, " *This means not only a more balanced allocation of resources in agricultural research, but attention to the larger Framework that influences S&T choices*". Advances Sciences studies and Science Policy Studies about regime of knowledge and transition in agricultural research is announced here.

With the development of a new green technology the notion of ecologization also addresses technico-industrial progress and innovation as well as political message for governance and economic incentives for innovation in agriculture (Higgins, 2006). Looking forward, it seems then that there are different views and theoretical foundations of the ecological modernization promise, and the debates about this notion and the competing knowledge regime that are exploring what sustainable development is certainly opening new roads to redefine agriculture and rural development. Debates about what science and what technology are clearly crossing many boundaries.

2. Sciences Studies, Actor-Network-Theory and Rural & Agricultural Studies

2.1. ANT in the Rural

The purpose of the previous section was not to establish a full genealogy and academic review of ecological modernization but simply to establish that the debates about the

dichotomy between Nature and Society that explicitly grounds the "treadmill of production" framework, and that the "ecological modernisation" perspective had proposed to heal with alternative means, contains a too limited account of technological and knowledge regime and not much about how farmers, advisors, technical knowledge and even life sciences scientists are locking-in or even deconstructing the "treadmill" and rebuilding alternative farming practices. The opposition between the Natural and the Societal, which ground the modernist agricultural project, appears to be criticized. But this critic seems to leave aside many Knowledge and Technical aspects, despites it has brought back human agency in the matters of concerns of environment and sustainability of agriculture.

The critic of the Nature/Society divide within the ecological modernization project has been straightforward addressed to rural sociologists by Goodman (1999) and also by Human geographers (Murdoch, 1997). After some works had started to introduce ANT methodological considerations (Arce and Marsden, 1993; Bush and Juska, 1997; Whatmore and Thorne, 1997) Goodman (1999) introduced radically the ANT points of views: "*agrofood studies are weakened by their methodological foundations staying in the modernist ontology*". To frame this critic, the notion of corporeality is developped and is to be understood as a metabolic relation, which is networking in practices, settings and intermediary-objects, the "on the land" production of food and the "in the plate" consumption of food. It is also metaphoric in the sense it covers what is performed in between. Thus, corporeality also signifies "*organic, eco-social processes that are intrinsic to agriculture, to food, to agro food network and the hybrid constitution of the practices in the social worlds*". But, in order to make the concept adequate to the study of agro-foods networks, the notion of "second nature" is also introduced to reify agriculture and agrosystem and to define agricultural nature, as being *"produced in interaction with social labour, and the corporeal metabolism that describes the nexus of food and human bodies of production and reproduction*".

As Higgins (2006) has also claimed more recently more place has to be devoted to the centrality of non-human in agri-food studies. Also is present the idea that they are modes of ordering (Law, 1994) that enable to depict strategy and to move between actors and contexts, this framework has been mobilised by Lockie and Kitto (2000) to introduce ANT methodology in agro-food studies. Following the idea that we should go beyond the open-up and closing-down of controversies about the nodes of power relations within agro-chain, we should enter a more systematic programme of identifying and analysing the resources and contingencies of modes of ordering that are building agrofood networks in relation to sciences and to environmental management.

2.2. Issue of the agency of non-human objects

This defence for the reintroducing the agency of non-human object and the issues of the politics of networks corresponds to an internal evolution of debates in the STS. We would like, at this point, to make a quick jump within the debates that have surged in the STS community about the methodological problems that contains or raised ANT perspective.

Laboratory studies (Latour and Woolgar, 1978; Knorr-Ketina, 1982) and David Bloor's strong programme are well known for having setting the place of sociology of science and technology with a symmetry principle (that could even applied to sociology itself for D.Bloor). The SCOT model of Bijker, Hughes and Pinch (1987) has then developed a very clear methodological foundation to study the expressed, voiced an vested interest of social group in problem definition and problem solving processes that take place along innovation processes. The perspective opened by this attempt contrasts with the emphasis put by the localism and integrationist studies of scientific work and laboratory life represented by Star (1995). ANT was born in the attempt made by social studies of science to bridge the human and technical agency of laboratory life and the human and technical agency of technological innovation process in society. The concepts of translation, intermediary object, obligatory point of passage, immutable mobiles have been used by many to give an account of the co-construction of technique and society in the script of simple technical objects or complex technical systems.

ANT scholars had received strong critic about the consequence of the equivalence principle between human and non-human in the alignment of actor-networks. To accept that non-humans could have agency and master human action (and merely been designed in the purpose of that effect) was signifying that social interests, morale issues, and all democratic discussions about science and technology would be denied or pushed outside the alignments of actants in networks if not translated into it. For many STS scholars this "tour de force" was reinforcing the modernist forces of technoscience, did not Bruno Latour paint the scientist as a capitalist entrepreneur of efficient theory. But Law (1992) had early responded to the possibility of this critic. Nevertheless it is certainly true that translations that are punctualized after a long process of negotiation with multiple sophisticated arrangements are more easy to study because simply more "visible" and sometimes more "noisy" when socio-technical controversies had to be closed.

Anyway, thinking that ANT is meaning the biopolitics of the "lone some innovator" is miss leading. The semiotic of agrochain is, first of all, a methodological framework for the de-construction and understanding of the power-relation, heterogeneous human and non-human agency, functional materiality and knowledge that are punctualised in networks. For example, Law and Mol (2008) have described the collapse of the technique of boiling pigswill with the FMD epidemic in the UK. Because it failed in a single farm recycling feedstuff coming from place in the world where FMD is possibly endemic; it has triggered a large epidemic and while the debates was taking place about the origin and the management of the outset, the metabolic economy of recycling did not count for much and as in the BSE case "*the boundaries was taken to be far more important than sharing food a bit more equally*". What we mean here with this case study is that ANT is enabling more than flat description of innovation and allows discussion about human affairs.

Following actants along translations relation and agentic intermediary objects is not enough, since the reason of a successful translation or even a deny of being translated always exists in a specific area of practices. When one leaves the inscription of technoscientific networks, there is a need to explain how networks fit or not, under what

kind of local historical determination or contingencies to the area of practices or organisational setting that the actor-network is relating. Akera (2009) made recently a very stimulating methodological proposals based on a metaphoric extension of ecological view of knowledge in order to uphold the distinction between different scales of analysis while following actants of networks at "*different representational scales, corresponding to historical events, social institutions, occupations and disciplines, organizations technical knowledge, skilled practices, material artefacts, and human actors*", Akera, 2009: 418.

2.3. Biopolitics of actor-networks in the Bios

After this short attempt to justify – if needed- the felicity of ANT perspective, what is more important to notice about recent debates and works in STS is that many of the intellectual discussions are taking place about innovation that supposed practices affecting directly or indirectly the human bios itself, either scientific practices (biomedical innovation, stem cells, cloning techniques) or human practices affecting and self-transforming bodies (or ideas of natural bodies) and reinventing the idea of what is natural and what is not (the Cyborg of Harraway, 1991). When STS scholars take biomedicine and biotechnology as a matter of inquiry (either into resistance to biopower or into the pathways of innovation process), what life sciences researchers or clinicians do to the human *bios* is frequently questioned in terms of social control, surveillance, knowledge and ethics. This also questions the status of gender in half ontological, half political debates in STS[2]. Moreover, and it is a particularly important point, the question arose with of how STS work and knowledge could be or should mobilized in those circumstances public and political debate about governing societies with technoscience affecting the bios (the Paris 4S/EASST was clearly very much concerned by this issue).

The scientific and public issues of food scares, of GMO controversies, of animal welfare in husbandry, and lately about biosecurity and climate change indicate that the Science-Technique/ Society divide was hiding the fact that the politics of Nature was also at stake within the technoscientific project. We could even say a "second nature" to go back to Goodman (1999) "second agriculture": a first Nature, for example, with peasant locally selected seeds and with GMO as techno-scientific artefacts extended from the laboratory place to the farm place; and a second Nature of organic products or GMO as being metabolised in the environment or in human corporeity. This second nature has been at stake and a matter of controversies and regulation in the EU, whereby the US regulation had consecrated the non existence of it because of the principle of substantive equivalence.

[2] The ontological debate about the naturality of the human being is clearly addressed. Gender issues have also been flourishing in STS, with a charge of feminist STS against mainstream STS ignoring their work although the sciences war had presented STS as an unified front, but also with a claim that the insights of feminist scholarship can help to improve the understanding of the nature of scientific knowledge, culture, and practice (Whelan, 2001).

Within an ANT framework we could says that domesticated animals or plants for food supply have at least three political voices: one as they encapsulate the human work who have breed them and put them into the metabolic relation (from farm to plate); another as they also encapsulate the human work who have selected or transformed their genetic characteristic and the human agency about the fact that they have been engineered by technoscientific and/or breeding practices; and finally the fact that their ways of being in rural spaces is more and more a matter of monitoring for sanitary and environmental reasons and, why not soon, according to their efficient contribution to global warming and CO2 storage.

What we see here is the arising of three political layers to discuss and/or contest the type of performation of politics of natures: farming, technoscientific and monitoring practices and expertise of the Rural.

3. The junction of the Divides and after

3.1. Parallel lives of 2 Divides

At this point of my reasoning I would like to sketch the idea that Rural Studies and Rural sociology on one side, and Science and Technological Studies on the other have been evolving quite separately according to the consecration of two divides respectively: The divide between Science or Technique and Society confronting rather lately to the issues of the politics of Nature[3] for STS; and the divide between Nature and Society hiding the politics of Technology in the ecological modernisation project as I tried to explore it in the first section for Rural Studies. The existence of those parallel divides is, I guess, why "*ANT has been slow to find its way into agrofood studies*" (Goodman, 1999). As Murdoch (1997) had already proposed a non-dualistic and symmetrical perspective on nature and society has to be grounded with the ANT early prospection. As far as those divides are recognised and also identified as sources of questions, problems and new scientific issues, we think that there are two directions for social studies involved in the matters of cultivating, engineering, transforming, managing, governing "Nature".

One direction is to consider that there are disciplinary ontologies to be maintained despite the divide. For instance, after a review of the literature of the Nature/Society debate, Goldman and Schurman (2000) confess that they do recognise the usefulness of considering nature-culture hybrids in order to understand the new political identities, tools and strategies of new biotechnologies; but they conclude that « *sociology remains at its best when it tries to understand how new and enduring structures, institutions, and practices exploit and dominate people and nature, as well as reveal new strategies for emancipatory politics. We believe that once scholars begin to rethink the framework of the society-nature divide, other cherished but flawed ideas will also reveal their weaknesses. We hope that from this process, a new sociological imagination will spring* ». ANT would

[3] This is not the case of Latour (1993) and certainly many other Works about environmental controversies in STS, my views might looks like a caricature, but I find that the "bio political turn" is recent and perhaps also very European. This should be clarified and challenged.

thus be only an exotic trip or something like the night diary of Bronislaw Malinowski, and then B.Latour would be happy to say that the Moderns have definitely a snake's tongue.

Another direction is to consider that they will always be enough scholars to take care of the disciplinary pillars of academic knowledge, and because – anyway- some elements of traditions are necessary to shape meaningful points of view. There is thus no intention to fight with academic knowledge. More urgent in this second direction is to take risk with the recognition of the divides that grounds our modernity (Latour, 1993), and thus our position towards the people that are not supposed to be modernized enough and our responsibility towards the tremendous effects of modernity on the climate and biodiversity, as the ToP might have explained it in its own way.
The primitives of our modernity are not defined anymore by colonial and post-colonial science. Who has to take the blame? The peasant as the technocentric and modern narrative is always doing when technology are not adopted (Handy, 2009). Who is the patient when environmental and sanitary damages are advocated as public problem that directly question the type of technological package engineered by agronomists: The farmer or the agronomist engineer? There is here a possible turn in defining what is normal and pathological for society (Mol, 1998), and they are scientific claims made by STS colleague that agricultural science and technology is locked-in a technological paradigm that tends to exclude other alternative approaches: the ecological modernization has also become a matter of the ecologization of agriculture science and technology.

But it would be too much at ease to trigger a science-war-game with Sokal-like hoaxes, playing a good sustainable science against another. It seems that the dynamic of S&T in agriculture could quickly find different pathways promoting the need of ecosystem engineering (Hastings et al., 2008), conservation techniques (Goulet, 2008) and financial assets based on biodiversity conservation, while at the same time supporting organic food and slow innovation. Clearly we do not know what is going to happen though we know the many skills of entrepreneurs that lead them to follow the potentiality of situation of scarcity.

At least, we are sure that the ecological modernisation is having its "second nature" since the accelerating proliferation of eco-govermentality and ecosystem services during the past 5 years calls for many more works about the treadmill of sustainable production. Moreover, the concrete sustainable schemes are frequently associated with the need of participatory mechanisms in order to design more robust technology. The contestability of technoscience promises as well as the contestability of technological artefact deployed in society are both calling for new ways of governing innovation process in societies, specially according to existence or allegation of collective risk. The development of studies about participation and participatory design in the field of STS clearly indicate this trend (Lengwiler, 2008), either in the macro biopolitics of expertises (climate change, biodiversity notably) either in the micro biopolitics of innovative design. For social or biotechnical research in and on the rural and agriculture, participation is of course an issue or a matter of fact to get into the biopolitics with the treadmill of sustainable development, but it is also a matter of professional attachment

to the situation, place and social worlds where - through participatory programmes, scheme, project, etc.- scientists are going to get close to the materialisation of biopolitics in *dispositif* (Barbier, 2008).

3.2. Conditions for a junction of the Divides

So what to do with the two divides we have presented in the conclusive section? I guess two things.

1. First of all to recognise the idea that there is a co-production of technology, nature and society; and that a ANT-like methodological approach of this co-production provides a unique flat vision of socio-technical hybrid constructs, which are ordering society in particular ways, and thus are grounding this order on separate 'natural' characteristics (Jasanoff, 2004: 21). Pestre (2003) suggests that during the past thirty years this coproduction has corresponded to changes in the forms of regulation of knowledge production, particularly with the decline of national states regulation system, with the intensification of infra or supra state regulation in the form of standards that operates at the international level based and with the existence of international civic epistemologies.

New regimes of power-relations are then appearing within the legitimacy that the protection and value of environments had gained in discourses. It comes to the point that the notion of biopower itself has to be re-problematized (Lazzarato, 2000) since the co-production of science, nature, technologies and social order seems to have reached new frontiers with issues of global change and sustainability. Not only the integration of biological life into politics matters; beyond that, the contestation and moreover the contestability (either legitimized or in civil disobedience) of this integration has become a public problem to design policies and to be in politics with bio-risks, threats, diseases, etc. This integration may define governmentality in a much more performative conception of biopolitics, where practitioners, regulators, stakeholders and activists do not conceal the fact that they are making history in a state of vulnerability and that irreversibility follows from decisions or non-decisions. Governmentality is certainly also starting to be driven as much by pastoral power as by what could have been labelled pastoral surrenders during the 70's.

2. Bearing in mind this type of current post-foucaldian and govermentality studies (Lemke, 2001; Dean, 2006), a pragmatic approach of the "use of our knowledge" in this turn is an obligation that we cannot escape. We shall not only produce ontology and methodology to get the Social Sciences right, we also have to perform the re-assembling of the social, the technical and the natural. This is perhaps the condition that we have to address to disciplinary point of views such as Goldman and Schurman (2000) had delivered. And this, we cannot do from our desk.
But, there are conditions of possibility for this re-assembling in the light of our exploration of STS and RS. I mean that it seems difficult not to be present, as social scientists on the "field", whatever the intensity of this attachment. It seems also difficult not to "invite" those who create knowledge and technologies on one hand and not to pay

attention in pulling-in those who have concerns, ideas or oppositions on the other. Thus, the systematic treatment of the dynamics of coproduction and the re-assembling of the social, the technical and the natural is something that can take place in specific condition and *kairos*.

This means a pragmatic and pluridisciplinary oriented programme, which many scholars of rural studies, rural sociology but also certainly many STS scholar have in mind, which consists in taking part into participatory research or project with interdisciplinary challenges and scientific objectives, as well as political surface and stake-holders (see an example of mobilizing Interactive Technology Assessment in Marris et al., 2008).

It means also that the re-assembling of the Social, the Technical, the Natural can only happened in defined circumstances of entering collective experiments where matters of concern and matters of facts (Latour, 2004) are simultaneously at work in specific *dispositif* or promising organizational arrangement, which might have certain properties (see Barbier et al. 2004):

- to involve situations and practices of cooperative design between scientists, engineers and practitioners;

- to involve a certain level of worrying without tolerance about the re-framing of occupations and identities in systems of practices (farmers, land managers, R&D engineers, scientists, etc.)

- to involve a certain level of hybridity and openness in order for claims and concerns about producing "Natural" goods (first of second agriculture) to be translated.

What we mean here is that the re-assembling of the social, the technical and the natural is requesting a dense milieu of heterogeneous practices, a collective exploration of the potentiality of innovative design and of course to cross many of the organisational and institutional layers that new arising networks will cross.

In this perspective, Grin (2007) brought back the notion of reflexive modernisation from Beck (1992) and the structuration theory of Giddens to consider the re-structuration as the interrelated transformation of structure and action through structuration processes guided by the deliberated re-orientation of modernization. A reflexive modernisation in this way is not to be considered as "re-modernisation". Bos and Grin (2008) applied this framework to a pig husbandry research project dealing with side effects of first modernisation and trying to get out of a narrative about a successful project, to establish the idea that participatory research is possible crossing reflexive design methodology to supply the instrumental and describes the necessary institutional conditions to facilitate re-orientation of modernization. I guess we could easily replace this kind of pig husbandry by any ecological experiential setting in organic farming or integrated production.

Indeed, a variety of new sociotechnical "system innovations" are coming to match - and even create- the sustainability challenges in various agrofood systems; and we know that the promotion of narrative about green technical change will not be enough to answer the challenges of civic epistemologies or sustainable consumerism. But, one has also not to forget the willingness to change towards sustainable solution that is growing in agricultural R&D organizations and technical centres (Barbier et al., 2005).

The enormous challenges of sustainability (and precisely because it is an oxymoron) will also require new regulations, changes and transition management, and necessarily institutional "hybridity" (Allaire et Wolf, 2004) and reflexive governance (Voss et al., 2006; Elzen et al., 2004). Such changes and transitions are taking place at the level of systems of production, distribution and consumption and are related to societal tensions, political purposes, economic expectations that can take place within a given sector or in the interplay between different sectors. There is an enormous amount of work in the treadmill of sustainable development.

References

Akera A., 2007. Constructing a Representation for an Ecology of Knowledge: methodological advances in the integration of knowledge and its various contexts, *Social Studies of Sciences*, 37: 413-441.

Allaire G., 1996. Émergence d'un nouveau système productif en agriculture, *Canadian Journal of Agricultural Economics*, 44-4, 1996, p. 461- 479.

Allaire G., Wolf S.A., Cognitive Representations and Institutional Hybridity in Agrofood Innovation, *Science and Technology & Human Values*, 29: 431-458.

Altieri, M.A., 1989. Agroecology: a new research and development paradigm for world agriculture. *Agriculture, Ecosystems & Environment*, 27, 37–46.

Barbier M., 2008. Water in bottles, farmers in green. The sociotechnical and managerial construction of a 'dispositif" for underground water quality protection. *International Journal of Agricultural Resources, Governance and Ecology*, 7(1/2): 174-197.

Barbier M., Cerf M., Barrier J., 2005. Projects as Learning agency at organization borders: a resource for organizational learning ?, In S.Gherardi et al. Eds. *Proceedings of the International Conference on Organizational Learning and Knowledge*, University of Trento, 9-11 June 2005.

Barbier, M., Maxime F., Cerf M., Lemery B., 2004. The transformation of practices of rationalisation in agriculture and rural development. New Issues, New Direction, *Communication to the XI World Congres of Rural Sociology*, Trondheim, Norway.

Bijker W.T., Hughes T., and Pinch T. (eds). 1987. *The social construction of technological systems: new directions in the sociology and history of technology*, Cambridge, MA: MIT Press.

Bos B. and Grin J., 2008. Doing" Reflexive Modernization in Pig Husbandry: The Hard Work of Changing the Course of a River, *Science Technology Human Values,* 33(4) : 480-507.

Brooks, S., 2005. Biotechnology and the Politics of Truth: From the Green Revolution to an Evergreen Revolution, *Sociologia Ruralis*, 45(4): 360-379.

Buttel, F., 1996. Environmental and Resource Sociology: Theoretical Issues and Opportunities for Synthesis, *Rural Sociology*, 61, 1, 56-75.

Buttel, F.H. 2004. The Treadmill of Production: An Appreciation, Assessment, and Agenda for Research, *Organization & Environment*, 17; 323-335.

Buttel,F.H., 2003. Environmental sociology and the explanation of environmental reform, *Organization & Environment*, 16(3), 306-344.

Coombs J., 2007. *Building the European Knowledge Based Bio-Economy. The impact of "non-food" research (1988 to 2008). Outputs from the EPOBIO project*. CPL Press.

Deverre C. et de Sainte-Marie C. 2008. L'écologisation de la politique agricole européenne. Verdissement ou refondation des systèmes agro-alimentaires ?, *Revue d'Etudes en Agriculture et Environnement*, 89 (4), 83-104,

Elzen B., Geels F.W., Green K., (eds.) 2004. *System Innovation and the Transition to Sustainability: Theory,Evidence and Policy*, Edward Elgar Publ.

Friedmann H., and Mc Michel P. 1989, « Agriculture and the state system: the rise and decline of national agricultures, 1870 to the present *», Sociologia ruralis*, (2): 93-117 ;

Goldman M., and Schurman R.A., 2000. Closing the "Great Divide": New Social Theory on Society and Nature, *Annual Review of Sociology*, (26):563-584.

Goodman D., 1999. AgroFood Studies in the age of ecology: nature, corporeality, biopolitics, Sociologia Ruralis, 39(1): 17-38.

Goodman D., 2004. Rural Europe redux? Reflections on alternative agro-food networks and paradigm change, *Sociologia Ruralis*,

Griffon M., 2006. *Nourrir la planète*, Paris : Seuil.

Handy J. (2009). "'Almost idiotic wretchedness': a long history of blaming peasants", *Journal of Peasant Studies*, 36 (2): 325-344.

Haraway D., (eds.) 1991. Simia*ns, Cyborgs and Women: the reinvention of Nature*, London: Free Association Books.

Hastings A., Byers J.E., Crooks J.A., Cuddington K. Jones C.G., Lambrinos J.G., 2008. Ecosystem engineering in space and time, *Ecology Letters*, vol. 10 Iss.2, 153-164

Higgins V., 2006. Re-figuring the problem of farmer agency in agri-food studies: A translation approach, *Agriculture and Human Values*, 23: 51–62.

Jasanoff, S., 2004. *States of Knowledge. The co-production of science and social order*. London, Routledge

Jones M.P. (1996). Posthuman Agency: Between Theoretical Traditions, *Sociological Theor*y, 14(3): 290-309.

Knorr-Cetina, K. D. (1982). Scientific Communities or Transepistemic Arenas of Research? A Critique of Quasi-Economic Models of Science, *Social Studies of Science* 12: 101-130.

Lamine, C. 2008, Settling Shared Uncertainties: Local Partnerships Between Producers and Consumers, *Sociologia Ruralis*, 45(4): 324 - 345

Latour B. (1993). *We have never been modern*, Harrow: Pearson Education.

Latour, B. and Woolgar, S., 1979. *Laboratory Life: The Social Construction of Scientific Facts*. Beverly Hills, CA: Sage.

Latour, B., 1995. Moderniser ou écologiser ? À la recherche de la septième cité, *Écologie politique: science, culture, société*, 3, 5-27.

Latour, B., 2004. Why Has Critique Run out of Steam? From Matters of Fact to Matters of Concern, *Critical Inquiry,* 30(2): 248.259.

Law J., Mol A., 2001. Situating technoscience: an inquiry into spatialities, *Environment and Planning D. Society and Space*, 19 (5) 609-621.

Law J., Mol A., 2008. Globalisation in practice: On the politics of boiling pigswill, *Geoforum* 39: 133–143

Law L. and Hassard J. (eds) 1999. *Actor Network and After*, Oxford: Blackwell and the Sociological

Lemke T., 2000. Foucault, Governmentality, and Critique, *Paper presented at the Rethinking Marxism Conference*, University of Amherst (MA), September 21-24, 2000.

Lengwiler M. 2008. Participatory Approaches in Science and Technology. Historical Origins and Current Practices in Critical Perspective , *Science,Technology, & Human Values Volume*, 33(2): 186-200.

Lockie S., 2006. Capturing the sustainability agenda: Organic foods and media discourses on food scares, environment, genetic engineering, and health, *Agriculture and Human Value*s (2006) 23:313–323.

Lockie S., 2006. Networks of Agri-Environmental Action: Temporality, Spatiality and Identity in Agricultural Environments, *Sociologia Ruralis*, 46 (1): 22-39.

Lockie S., 2009. Responsibility and agency within alternative food networks: assembling the ‘‘citizen consumer’’, *Agriculture and Human Values*, 26:193–201

Lynch, M., 1985. *Art and Artifact in Laboratory Science: A Study of Shop Work and Shop Talk in a Research Laboratory*. London: Routledge & Kegan

Marris, C., Joly, P.B., Rip A., 2008. "Interactive Technology Assessment in the Real World: dual dynamics in an iTA exercise on genetically modified vines." *Science, Technology and Human Values*, 33(1): 77-100.

Marsden T., 2004. “The quest for ecological modernisation: re-spacing rural development and agri-food studies”, *Sociologia Ruralis*, 44 (2): 129-146.

Mol A., 1998. Lived reality and the multiplicity of norms: a critical tribute to George Canguilhem, *Economy and Society*, 27 (2-3): 274-284

Mol, A.P.J,1992. Sociology, environment, and modernity: ecological modernization as a theory of social change, *Society and Natural Resources*, 5 (4): 323-344.

Mol A.P.J., 2000. The environmental movement in an era of ecological modernisation, *Geoforum*, 31: 45-56

Mol, A.P.J,, and Sonnenfeld A., 2000. Ecological Modernization Around the World: An Introduction, *Environmental Politics*, 9(1):3-16, Spring 2000,

Murdoch J., 1997. Inhuman/nonhuman/human: actor-network-theory and the prospect for a non dualistic and symmetrical perspective on nature and society, *Environmental Planning D: Society and Space*, 15: 731-756.

Pestre D., 2003. Regimes of knowledge production in society: towards a more political and social reading, *Minerva* , 41: 245–261.

Redclift M., 2005). Sustainable development (1987-2005): An oxymoron comes of age, *Sustainable Development*, 13(4): 212-227.

Schmidt C., 1993. On economization and ecologization as civilizing processes, Environmental Values, 2 (1): 33-46

Star S.L. (ed.), 1995. *Ecologies of Knowledge: Work and Politics in Science and Technology*. Albany, NY: State University of New York Press):

Stassart, P. and Whatmore, S. (2003). Metabolizing risk : food scares and the un/re-making of Belgian beef. *Environment and Planning* . 35(3), 449-462.

Thompson J. and Scoones I., 2004. Addressing the dynamics of agri-food systems: an emerging agenda for social science research, *Organization & Environment*, 17(3): 355-362.

Vanloqueren, G., Baret, P.V., 2009. How agricultural research systems shape a technological regime that develops genetic engineering but locks out agroecological innovations. *Research Policy*, in press.

Voss De J-V., Bauknecht D., Kemp R., 2006. *Reflexive governance for sustainable development*, Edward Elgar Publishing.

Whatmore, S. et L. Thorne, 1997, Nourrishing Networks : Alternative Geographies of Food, pp. 287-304, in Goodman, D. et M.J. Watts (dir), *Globalising Food. Agrarian Questions and Global Restructurin*g, Routledge, London/New York.

Whelan E., 2001. Politics by Other Means: Feminism and Mainstream Science Studies, *Canadian Journal of Sociology / Cahiers canadiens de sociologie*, 26(4): 535-581.

Whrigth E.O., 2004. Interrogating the Treadmill of Production: Some Questions I Still Want to Know about and Am Not Afraid to Ask, *Organization & Environment*, Vol. 17, No. 3, 317-322 (2004)

York R., 2004. The Treadmill of (Diversifying) Production, *Organization & Environment*, 17(3): 355-362.