WP1 - Review of relevant conceptual frameworks and theoretical underpinnings

Towards a conceptual framework for agricultural and rural innovation policies


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1. Innovation systems in agriculture and rural development

Several years ago, sponsored by official organisations such as OECD and FAO, the concept of ‘agricultural knowledge systems’ (AKIS) was introduced in the policy discourse. As Leeuwis and van den Ban (2004) assert, the concept was originated by an interventionist policy in agriculture based on the idea that, in order to accelerate agricultural modernization, innovation transfer should be strongly coordinated. This concept was implemented in many countries through a strong integration, generally at national level, of public research, education and extension bodies, in many cases under the control of the ministry of agriculture.

In one of its most recent versions (Rivera et al. 2002), the concept is broadened to include rural development and named AKIS/RD. The model takes into consideration four main actors whose mission is related to agricultural/RD innovation:

- Research
- Extension services
- Education and training
- Support systems (that is all organisations related to credit, inputs, producers’ associations)\(^1\).

All of these domains, according to this model, act upon farmers’ and rural actors’ knowledge and, by this way, generate innovation (see Figure 1). The two-ways arrows from and to agricultural producers show that this model does not necessarily imply a top-down approach. However, this is very much true when we look at support systems. For many farmers the greatest part of their relevant knowledge is carried through marketing networks of seeds, fertilisers, machinery, pesticides. In this case, innovation is produced outside the farm and of the farmer’s network, that is at the agribusiness level, and farmers’ learning capacities can be only linked to their speed of adaptation to change and to their capacity of making strategic alliances with the right input providers.

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\(^1\) A previous model identifies an ‘innovation agricultural system’ composed by all these domains and an ‘agricultural knowledge system’ centred upon the first three domains.
The recent debate has shown that the coherence of AKIS/RD has been endangered even in the countries where it was fully implemented. On one hand, research, extension and education (the so-called ‘knowledge triangle’) – the state-owned or state-funded components of the system – have been criticised for being inefficient and bureaucratised, and for not responding to farmers’ needs. Consequently, they have incurred in a deep restructuring. The trend to liberalisation has radically changed the system, leading to privatization of delivery, multiplication of extension organisations, farmers’ participation to the costs, competitive bids to assign research and extension tasks (Garforth et al. 2003, Kidd et al. 2000), tight evaluation procedures.

On the other hand, the increasing concern with the environmental impact of industrial agriculture, with the quality of life of rural population and rural employment, with the production of positive externalities linked to agricultural production, has modified the political discourse, that now puts emphasis on rebalancing and integrating agricultural policies with rural development. This implies awareness that a) not automatically innovation in agriculture have a positive effect on rural areas; b) there may be a potential conflict of interests between ‘demand driven’ innovation and public goals; c) pursuing rural development objectives needs broadening the scope and the targets of intervention, shifting focus from farmers to rural groups (of which farmers may be an important subgroup), from sector-based measures to territory-based measures, from private goals to public goals.

All these changes have an effect on the concept of rural innovation and on the principles for innovation policies. First of all, innovation involves much more than only technology: more and more it regards strategy, marketing, organization, management, design. Farmers looking for alternatives to industrial agriculture don’t necessarily apply ‘new’ technologies: their novelties emerge as the outcome of ‘different ways of thinking and different ways of doing things’, as in the cases illustrated by Ploeg et al. (2004).

Secondly, innovations are not only carried out by firms within the farm, but they may involve a plurality of actors and reconfigure outside relational patterns. Supermarkets that introduce self-service and self-weighting tools for fruit and vegetables reconfigure the roles between consumers and retailers’ personnel, and imply learning processes of all the involved actors. Retailers also play a key role in shaping production systems, as they are able to impose their standards to many national production systems (Campbell, 2005). Regulation bodies, opinion makers, experts, have a dramatic impact on the evolution of production processes (Dixon, 1997). Consumers’ beliefs, attitudes and behaviour affect in a decisive proportion the success or the failure of product innovation, and firms are increasingly organised around the anticipation or prompt adaptation to consumers’ needs. Consumers and citizens increasingly try to affect the way production or financial systems are shaped and governed by acting in an organized way on markets and regulation.

Increasingly, innovation can assume the shape of new social patterns aimed at improving service provision or at responding to emerging social needs. Much of the urban waste management has to do with changing routines at family level, such as purchasing recyclable packages, separating different materials, putting them in the right containers at the right moment etc. ‘Tandem operation’ projects (Moseley 2000), providing separate and distinct services jointly (ex. Village halls-cum-post offices, milk-delivery/cheque cashing service, delivery service/passenger transport) are other examples. This kind of innovations emerges as one of the most promising aspects of innovation in rural areas (Moseley 2000). It can be called ‘social innovation’², as it responds to social needs by organising goods and services provision in innovative ways.

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² Social Innovation refers to new strategies, concepts, ideas and organizations that meet social needs of all kinds - from working conditions and education to community development and health - and that extend and strengthen civil society.
This paper aims at building a conceptual framework that could inspire innovation policies able to take into account the new agricultural and rural agenda. The first section presents an overview of the change agriculture and countryside are experiencing, giving evidence that the present phase requires innovation policies aimed at pursuing ‘radical’ or ‘second order’ innovation: that is, innovation based on new goals and new rules. In the following chapter, the paper will review the evolution of innovation studies in agriculture, showing the progressive shift from a ‘linear’ and ‘exogenous’ conception of innovation to a ‘system’ and ‘endogenous’ approach. The core of a new conceptual framework is illustrated in the next section, where ‘second order innovation’ at micro, meso and macro levels is discussed. A discussion of innovation policy guidelines coherent with the illustrated framework will conclude the paper.

2. The changing context

There is a widening consensus around the fact that agriculture is undergoing a process of deep change processes. Among the others, McMichael states that the agro-food system is undergoing a new phase of restructuring and concentration along with globalization (McMichael, 2004). ‘..Closed commodity chains are rapidly replacing wholesale or spot markets and are governed by non-agricultural sectors, using global sourcing and advances in processing and transportation technologies’ (Pimbert et al. 2001, pp 7). New forms of control ‘at a distance’, such as standards made by the retailers, are replacing old forms of direct control. Since the early 1990s, much debate has ensued about the possible transition of contemporary agricultural regimes from a ‘productivist’ to a ‘post-productivist’ era (Wilson and Rigg, 2003). Ploeg and others (2000) state that both in practice and policy a new model of rural development is emerging, as the modernization paradigm that once dominated policy, practice and theory is being replaced by a new rural development paradigm. Goodman (2003) underlines the emerging ‘turn to quality’ in the agri-food system and links a set of new alternative agro-food networks as a response to it. Cloke (1997) stresses the role that cultural studies have played for a new understanding of rurality and rural policies (see also Morris and Evans 2004).

The pace and the intensity of the change in agriculture and in rural areas signal a ‘second order change’, challenging widely shared assumptions and reframing the whole system (Bartunek, and Moch 1987), in our case of agricultural and rural relations. Dealing with this type of change requires ‘second order’ or ‘radical’ innovation, that is innovation based on new goals and new frames.

The distinction between ‘first order’ and ‘second order’ innovation brings to the concept of innovation paradigm, that is a grammar for innovation: a rule-set defining the relevant needs, knowledge, heuristics used to innovate. Within a paradigm, innovation is incremental, that is builds upon already existing achievements. Once established, therefore, paradigms facilitate first order innovation, based on search and application along with given trajectories. Second order/radical innovation implies, on the contrary, adopting new paradigms. In this case innovators rewrite the grammar of innovation, change the relevant knowledge and even the relevant objectives of innovation. As the consolidation of a paradigm make some groups prevail over others (academic schools, types of knowledge, big/small farms, rural/urban groups, input providers, etc.), it is not surprising that alternative paradigms emerge as a result of a political game between coalitions who defend not only ideas and visions of the world, but also interests. As Lang and Hausman (2004) highlight, different paradigms live together and each of them is supported by different societal groups, and their relative strength depends not only by their economic success but also by political games and by the shape of policies (See also Nestle 2002).

Over the years, the term has developed several overlapping meanings. It can be used to refer to social processes of innovation, such as open source methods. Alternatively it can be used to innovations which have a social purpose -like microcredit or distance learning. The concept can also be related to social entrepreneurship (entrepreneurship isn’t always or even usually innovative, but it can be a means of innovation) and it also overlaps with innovation in public policy and governance.’ (from Wikipedia, http://en.wikipedia.org/wiki/Social_innovation).

3 First order change is, on this regard, change within a system, normally aimed at adapting it.
IMPACT\(^4\), SUS-CHAIN\(^5\), MULTAGRI\(^6\) projects and a increasing number of case studies demonstrate that alternative practices and policies in the agricultural and rural fields have accumulated enough knowledge to let us speak of ‘paradigmatic shift’. In the following table some of the elements of an alternative paradigm are contrasted with a conventional innovation paradigm:

<table>
<thead>
<tr>
<th>Conventional paradigms</th>
<th>Alternative paradigms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economies of scale</td>
<td>Economies of scope</td>
</tr>
<tr>
<td>Specialisation</td>
<td>Diversification</td>
</tr>
<tr>
<td>High response to external inputs</td>
<td>Reduction of external inputs</td>
</tr>
<tr>
<td>Productivity of labour</td>
<td>Added value</td>
</tr>
<tr>
<td>Chemical, mechanical and biotech technologies</td>
<td>Agroecology, communication, organization technologies</td>
</tr>
<tr>
<td>Decreasing employment and exclusion of non-agricultural rural residents</td>
<td>Empowerment of rural population</td>
</tr>
</tbody>
</table>

However, it can be said that in contemporary agriculture and rural development practices different paradigms coexist, and new paradigms find a strong resistance to change in old paradigms consolidated into concrete actors, discourses, institutions, socio-spatial patterns, laws and technical standards. Innovation policies should gain awareness of the coexistence between different paradigms, and should be more explicit about the paradigms to be supported.

3. Second order innovation: some concepts

Conventional approaches to innovation tend to overlook the importance of the context acting upon individual action. They are based on a ‘linear’ model, whereby innovation happens as a result of a flow of new knowledge coming out from basic and applied research, applied to the production process and, once marketed, diffused to other firms by imitation or by active knowledge transfer initiatives\(^7\).

Given this assumption, conventional approaches have concentrated their research efforts on the concept of ‘adoption’, and tried to understand why, given certain available innovations, adoption rates are much lower than expected on the basis of a neo-classical behavioural model (Feder et al. 1985).

A step forward in understanding innovation has been the theory of induced innovation (Hayami and Ruttan 1970; 1971), that have shifted the attention from adoption to the sources of technical change. While most neoclassical models consider technological change as exogenous variables, according to the induced innovation model ‘successful economies develop technologies in accordance with market price signals to loosen constraints on growth imposed by factor scarcities’ (Olmstead and Rhode 1993, pp 100). ‘..Thus the land-abundant, labor-scarce United States developed labor-saving techniques; Japan, a land-constrained, labor-abundant economy, developed land-saving methods’ (Olmstead and Rhode 1993, pp 102). As Olmstead and Rhode argue, ‘..this hypothesis represents a significant step forward from many theories of development in that it incorporates changes in technology and institutions as factors endogenous to the economic system’ (pp 101). At the same time, a micro-economic extension of this theory would show that it is not that farmers follow irrational models of behaviour, but that there are economic reasons not to adopt given innovations.

\(^4\) Ploeg et al. (2000)  
\(^5\) http://www.sus-chain.org/index.htm  
\(^6\) www.multagri.net  
\(^7\) For a history of the linear models, see Godin (2005)
As Ruttan itself in a much more recent paper admits (Ruttan 1997), induced theory of innovation has not taken into consideration the inside mechanisms of innovation, treated as ‘black boxes’, and recognises the role of the evolutionary theory initiated by Nelson and Winter (1973; 1974) and path dependence theories initiated by Paul David (David, 1985). In the same article, Ruttan advocates for a more general theory bridging insights of the three theories, and identifies in Dosi’ work (Dosi, 1982) a promising effort in this direction.

In the last years, innovation studies have blossomed. In the attempt to get inside the black box, they have intensified their interdisciplinary openness by developing new theoretical frameworks that focus on learning processes. As known, learning is based on adapting flows of information to existing cognitive frameworks or on improving existing cognitive frameworks. The awareness that individuals learn through interaction with their social and physical context has developed studies over the importance of different contexts to learning pace and direction. Moreover, not only individuals learn, but organizations as well. Innovation studies increasingly underline that innovation has a systemic nature, it is the outcome of collective action and depends on the social structure where in innovators operate.

Another aspect innovation studies have taken into consideration is geographical and sectoral distribution of innovative performance. Why certain areas are much more innovative than others? To what extent innovation is related to physical proximity, as regional systems of innovation literature would claim? Why innovation transfer does not happen so easily from place to place? And with regard to sectoral distribution, why are some sectors more innovative than others?

As a result of the attempt to respond to these questions, an increasing agreement has been reached among scholars over an approach to innovation as a change in the configuration of hybrid networks. In a conventional approach, innovation is mainly embodied into technological artefacts (improved seeds, machines, new fertilisers), and its successful application is related to the capacity of the users to learn to ‘adopt’ them according to given guidelines/blueprints. In the new approach, the very innovation occurs when the network of production changes its way of doing things, so that innovation is mainly related to the resulting pattern of interaction between people, tools, natural resources. This approach gives us a key to understanding the evolutionary trajectories taken by innovation in different temporal, geographical, sectoral contexts. The approach also links conceptually those who produce innovation to those who benefit (or suffer) from innovation, as a problem may emerge at any point of the network.

This approach makes learning the core of innovation processes, as any change in social or economic organisation improving a certain state of the matters brings to a change in the available knowledge. Moreover, it highlights a specific type of learning – social learning – which affects shared cognitive frames at the basis of coordination into a network.
3.1 Second order innovation at micro level

Following this approach, the process of innovation can be represented as follows:

![Diagram](image)

**Figure 1. Innovation as a learning process**

The context is perceived by the subject through information. Evaluation of this information brings to the assessment of a given situation. If the context is evaluated as source of a problem or an opportunity, the subject starts a process of search, which eventually may generate a novelty. ‘A novelty is a new way of doing and thinking, a new mode that carries the potential to do better, to be superior to existing routines’ (Ploeg et al. 2004, pp 1). From this definition it emerges clearly that innovation is not only technological innovation: any successful change in production, consumption, distribution routines can be considered a novelty.

Major changes in the natural, economic and social environment of human and organisational behaviour call for new behavioural patterns and mental paradigms in order to cope with the new problems (Hämäläinen 2004). Central to these problem-solving cycles are the cognitive frames of the subject (see section 2.3): they allow selection and evaluation of all information. Each problem-solving cycle modifies – reinforcing or weakening - the cognitive frames of the subject, so that new problems, new search directions and new solutions are evaluated according to the new configuration that cognitive frames have taken along with past cycles.

This approach to innovation explains why innovations follow specific trajectories: cognitive frames are both resources and constraint for action. They are resources as they reduce the time and the effort necessary to take decisions and to act; when similar situations repeat many times, action becomes routine, and it does not need any effort to decide. Cognitive frames are also constraints for action because they make much more difficult to deviate from consolidated patterns of decision and behaviour. According to Hämäläinen, ‘(…) established cognitive frames focus attention on traditional variables and explanations that may no longer be relevant in the changed environment’ and therefore result in ‘mental rigidities’ (Hämäläinen 2004). If there is no or very little change in established practices and cognitive frames, it may result in mental rigidities hampering innovativeness. To build new cognitive frameworks can be very costly, both to ‘unlearn’ old frames and to invest in extra learning activity.
3.2 Second order innovation at ‘meso’ level

Learning does not happen in a void. Cognitive frameworks are socially constructed, so that they become common goods within relevant networks. All actors participating to a network contribute to build cognitive frameworks. Successful novelties strengthen new cognitive frameworks and activate new learning cycles.

Bandura (1977) has been probably the first to introduce the concept of ‘social learning’ to explain how, while social structure affect individual learning, learners change their environment. Evolutionary economists look at the knowledge created into firms, which are seen as knowledge processing entities (Amin and Condehet 2000) and look to common frames, routines, lifeworlds as the specific genetic endowment that allows firms’ specific evolutionary patterns (Nelson and Winter, 1973). An increasing number of studies and projects have showed how social learning can be mobilised to meet agricultural, environmental and rural development goals.

Social learning is at the roots of ‘social capital’ (Portes 1998), that is social ties – often originated from outside the economical realm - that can be mobilised to activate economic activities or to feed innovation processes. Applying network approaches, Burt (2001) puts into evidence how social ties can be employed to fill ‘structural holes’, that is ‘potential connections between not yet connected cluster units’ (Powell and Grodal 2005), or, as in the case of ‘redundant ties’, as sources of trust, loyalty and resilience of networks. Using the relative weight of the two types of ties, he draws a classification of networks according the grid of Figure 3:

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The ‘meso’ level of analysis explains also geographical or sector differences in innovation activities and performance. To this regard different types of knowledge can play an important role. **Tacit knowledge** is build through direct experience (learning by doing\(^9\)), so that its transfer requires physical presence and face to face interaction; **codified knowledge** translates mental frameworks into symbols, and this allows an easier transfer through communication. The reason why innovation concentrates geographically is that codification can’t translate all of the cognitive potential embodied in tacit knowledge, especially because it does not take into account the specificities of the context in which knowledge is mobilised. In addition to tacit/codified knowledge, sector performances are explained also by the distinction between synthetic and analytical knowledge (Asheim and Gertler, 2006 pp 295). **Synthetic knowledge** is mainly created through recombination of different existing knowledge bodies though testing, experimentation, simulation. **Analytical knowledge** has more to do with deductive processes and abstraction, and relies strongly on scientific knowledge and highly formalised models. Different industries may be characterized by different mixes of tacit/codified, synthetic/analytical knowledge base, depending on the object of production, the story of the industry, the institutional and physical context.

### 3.3 Second order innovation at macro level: socio-technical systems/networks

Starting from a (social) learning approach to innovation, an increasing range of scholars have tried to establishing links between the ‘micro’ innovation processes and the ‘macro’ conditions for change. Actor-network theories (Latour 1984, Callon 1986), Giddens’ theory of structuration (Giddens 1984), Focault theory of governamentality (Foucault 1972), Granovetter’s theory of embeddedness of economic action (Granovetter 1985) are increasingly taken into consideration.

\(^9\) The concept of learning-by-doing has been used by Kenneth Arrow in his design of endogenous growth theory to explain effects of innovation and technical change. Lucas (1988) adopted the concept to explain increasing returns to embodied human capital. Yang and Borland (1991) have shown learning-by-doing plays a role in the evolution of countries to greater specialisation in production. In both these cases, learning-by-doing and increasing returns provide an engine for long run growth. Recently, it has become a popular explaining concept in the evolutionary economics and Resource-Based View (RBV) of the firm (from wikipedia).
An increasing attention is given to the role that material elements play in innovation processes. One of the reasons why technologies for the use renewable energies don’t spread as fast as hoped, notwithstanding their availability, is that it is necessary to build new energy infrastructures and dismissing old infrastructures, which have been built with huge investments. Knowledge is incorporated into tools, infrastructures, artefacts. A tool (be it a software, a processing machine, a harvester) transfers knowledge of those who have invented it and of the context where the tool has been conceived. At the same time, once it is introduced into a new context a machine changes the production process as it requires a different organization of labour, new inputs and new outputs, and therefore produces a new mix of knowledge.

Actors, rules/regimes and artefacts are interdependent. For example, to operate a given energy infrastructure requires specific actors, skills, organisation, coordination rules, and influences energy consumption and production patterns. Likewise, in the food system, consumers’ lifestyles and structure of the retail sector and affect heavily the way food is perceived and consumed.

To catch in a framework this interdependence Rip and Kemp suggest the concept of socio-technical system, defining it as ‘Relatively stable configuration of institutions, techniques and artefacts, as well as rules, practices and networks that determine the ‘normal’ development and use of technologies’ (Rip and Kemp, 1998). The concept of socio-technical system (STS) is worked out at length by Geels (2004) who also reconstructs the genealogy of the concept.

Summarising Geels’ model, we could represent a socio-technical system as follows:

Socio-technical systems are characterised both for the elements included/excluded and for the shape that relational configurations take.

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10 The term artefact replaces, in Geels’ terminology, ‘material systems’, which in my view may create confusion on readers.
**Actors**
From the considerations made above, our concept of innovation process involves a great deal of stakeholders both as beneficiaries of innovation and as agents of innovation. When we talk about global warming or sustainable development, for example, many of us are aware that the solution is not only on the production side (that is, improving energy efficiency and using a higher proportion of renewable resources), but also on the consumption side (for example, reducing waste, recycling, adopting sustainability consumption principles). The same can be said if we talk about specific quality of life problems of rural areas. Radical innovation, therefore, may emerge as a common effort to reshape production/consumption patterns.

(Actor-) network approaches can help us to understand the microdynamics of these processes when different paradigms coexist. As we know, actors may belong to different networks, and their identity, values, norms and actual behaviour are mediated by these belongings. Concrete choices depend on compromises between values, needs, constraints, compulsions. Belonging to different networks, actors may be exposed to different paradigms, that imply different ways of behaving and thinking. A shift from a paradigm to another can be seen as a ‘detachment’ from a network and an ‘attachment’ to another one.

![Figure 5. Multiple identities and networks](image)

**Rules and institutions**
Rules have different forms: they can take the form, among others, of cognitive frames (or codes), norms, laws and technical rules. **Cognitive frames** are socially agreed rules of interpretation and signification of the external world. We have said above that definition of problems depend on cognitive frames. Collective cognitive frames concur with broader systems of rules and institutions to learning and action. They are embodied in discourses and narrative through which people make sense of their environment. New codes to read the elements of their territory and to evaluate their relevance as economic resources give rural actors the key to start a process of building development repertoires (Ray, 1999) based on cultural traditions and natural specificities, which can be mobilised into economic activities.
Norms are the socially accepted rules people use to decide what is good and what is bad. The strength of norms derives from the fact that they make up part of individual actors’ lifeworlds. People follow certain ‘moral’ patterns of behaviour not because of fear of economic (or physical) sanctions, but first of all because they are part of their conscience. Rose (1996) illustrates how the so-called ‘advanced liberal’ approaches identify ‘communities’ as subjects of social and economic policies, considering that they can be - thanks to the moral commitment of their members - effective instruments of compliance and therefore of control at a distance. At the same time, ethicisation of some economic activities such as consumption can be a lever to promote social change from below: scholars have shown that consumers can be ‘invisible mouths’ affecting the political sphere through their choices (Lockie, 2002), and can be active players for a reconstruction of food chains re-embedded within societal values (Hinrichs, 2000). In rural development processes, ethics has shown itself as a very important mobilizing resource. The concept of ‘stewardship’ is increasingly considered in relation to farmers’ management practices (Worrel and Appleby, 2000). Lowe (1997) illustrates how rural change has happened in Britain as a result of ‘moralisation of the environment’: as farmers have been increasingly blamed by society for polluting, agricultural policy networks have responded progressively by adapting agricultural practices and policies to less polluting patterns.

The strength laws exert upon daily activity of rural actors depends, apart from the strength of controls and of repressive activity, on the level of legitimation of the State within a network and on their consistency with moral norms of the same network. One of the most relevant examples concerns environmental and hygiene regulations. In these cases, laws define targets or constraints, but there is indeterminateness enough to allow different interpretations. Successful communication processes based on co-operation between local health authorities, producers’ associations, local institutions and research bodies have improved the homogeneity of interpretation and made possible the use of techniques forbidden until now.

Technical rules mediate social action with the physical world. They orient changes in the landscape as well as in the production process, and the characteristics of technical rules affect the way people organize their objectives and their labour (Busch, 2000). They affect innovation as they give shape to actor-networks related to production, excluding some elements (tools, types of knowledge, skills) and including others; they are the outcome of specific social representations (for example, technical rules concerning hygiene and safety can be inspired by rather diverse visions of the food industry (Marsden, 2001)) and produce specific languages. Today, technical rules represent one of the most important aspects of creation of rural identities and their translation into economic activity. From specification of quality characteristics of typical products, to rules for defining products as ‘organic’, to more recent initiatives in the field of agro-tourism or in the environmental certification, technical rules are the necessary tool to differentiate rural products and services and to create a trust relationship with customers.

Artefacts
Artefacts can influence in substantial ways innovation patterns and intensity; they are physical constraints to action and at the same time they can enable social action. Machines set the range of possibilities for social associations in the labour process. Built environments provide both barriers and enabling tools for social associations. Sparse housing, poor roads, lack of meeting points (a square, a bar, a school) are traditionally among the most relevant factors of rural underdevelopment.
Built environment is produced and reproduced through social interaction: norms and codes, and laws set out the limits within which the built environment can be shaped. Constraints generated by the built environment can be bypassed through different forms of social organization (for example, rural radio can connect sparse population). Built environment can also be analyzed as a system of signs: rural signifiers can communicate to people the social representations of rurality embodied into the landscape (Phillips, et al. 2001). To analyze the interaction between material and immaterial components of rurality is of particular relevance in post-rural theories. Material components can become part of the symbolic capital of an area, as signifiers of specific features of the rural area (Phillips et al. 2001). There are several examples across Europe of how traditional food, rare breeds, ancient paths or outstanding buildings become symbolic nodes which convey a large range of meanings related to local identity.

3.4 Dynamics of second order innovation

From the arguments above we have learned that innovation occurs at different levels of structuration of activities, but also that each of innovation occurring at one level may affect the others. In order to design appropriate innovation policies, we need to understand the dynamics of innovation, that is how micro level innovation can generate innovation at higher levels of structuration.

The dynamics of socio-technical transitions can be illustrated as in Figure 6.

![Figure 6. The dynamics of second order innovation](image)

The model, adapted from the transition school (see for example Geels 2004) suggests that radical innovation may proceed as progressive embodiment of new way of doing and thinking into higher structuration levels.

Novelties, as we have said above, are localised ‘breaks of the routines’. This means that novelties reconfigure hybrid networks wherein they operate. But their further development is limited by compatibility with external constraints, that is with actors, rules and artefacts. Development of biofuels, for example, needs refineries, adapted engines, appropriate incentive or taxation systems, appropriate cultivation techniques and logistics, consumers willing to switch from petrol to biofuels.
Networks ‘close’ into steady systems when actors’ identities are part of common cognitive frameworks as well as well as consequences of their action are largely coincident with their expectations and therefore. In a farmers’ market, for example, producers may expect from consumers a more empathic, less bargaining-oriented approach than in conventional supermarkets.

Closure is much easier at small scale rather than at larger scale, and the shift from the small to the bigger can be explained as progressive aggregation of small systems into upper level networks.

Rip and Kemp (1998) call these small units of innovation niches. Niches can be defined as socio-technical networks governed by paradigms different from those prevailing into the dominant socio-technical systems. Niches are not only characterised by their dimensions, much smaller than socio-technical systems. Their main characteristic is that they are spaces whereby norms, rules, routines of production, distribution and consumption are looser, subject to a rapid evolution. Using Latour’s (1984) concepts, in niches there are much less ‘black boxes’ than in dominant socio-technical systems. Niches are the places where new paradigms emerge as an effect of learning processes. In niches there is a large share of ‘tacit knowledge’. Niches are networks wherein learning and societal embedding (capital formation, set up of distribution, dissemination of knowledge, gaining of user acceptance) processes are activated (Kemp et al 2000).

Summarising, a first step of the process of structuration of innovative patterns is the ‘closure’ of novelties into niches. Brunori and Rossi (2000) have illustrated these processes by analysing the development of wine routes in Tuscany as progressive aggregation and reciprocal adjustment of roles and identities between wine producers, local institutions, tourists, agri-tourist farms, etc. Once consolidated into systems, wine routes can act as actors into higher level networks, for example by lobbying with regional administrations or creating networks of wine routes. As long as niches develop and consolidate, they modify the networks wherein they operate, and challenge dominant rules, actors, and artefacts by putting pressure on them. They are, therefore, incubators for radical innovation. For example, alternative food networks (Goodman 2003, Marsden and Renting 2003) introduce new norms of consumption which, to be satisfied by retailers, would induce retailers to change the ways they choose, distribute and communicate the products.

11 The socio-technical regime based on green revolution emerged in a socio-technical landscape characterised by the post-II world war era, with its emphasis on growth and on stability guaranteed by the Bretton Woods order (McMichael 1992) and on a strong role of the State in regulating national economies. This landscape generated a socio-technical agricultural regime based on coupled support (policy) mass consumption (consumption), chemical and biotechnology research (scientific), and on an organization of society based on mass parties and labour unions.

Its crisis can be traced back to the oil crisis and the consequent neo-liberal policies the change of socio-cultural trends (more attention for the environment and diminished weight of agriculture on the economy), consumption regimes (increasing attention to differentiated products), and policy regimes (increasing international constraints on protectionism and increasing budget pressures). As a reaction to this crisis, alternative paradigms emerge. One is a neo-modern paradigm, that adopts the principles of the green revolution and adapts it to a changed landscape by advocating an increasing economic concentration and integration and a massive application of new technologies such as biotechnologies, nanotechnologies and information technologies. What we may term the ‘multifunctional’ paradigm is developing through technological and consumption ‘niches’ (Moors et al. 2004), while technological and scientific regimes, strongly influenced by agribusiness corporations and by vested interests in the agricultural sector, change much more slowly.
In general, a regime can be defined as a mode of ordering, a system of rules that coordinate (or, better, ‘meta-coordinate’) networks of actors and things. Regimes are paradigms turned into practices, the incorporation of given paradigms into concrete socio-technical systems\textsuperscript{12}.

When a regime emerges, rules of different form and type concur to the same objectives. A socio-technical system, therefore, is based on a socio-technical regime, that Rip and Kemp define as ‘a rule-set or grammar that is characteristic for the development of a technology and that guides not only the search activity of engineers, but also the actions and the interactions of the other actors involved in technical development’ (Rip and Kemp 1998)\textsuperscript{13}.

In a recent paper, Geels (2004) divides regimes into several sub-regimes, such as:

- consumption regimes;
- socio-cultural regimes;
- policy regimes;
- scientific regimes;
- technological regimes.

The concept of regime helps to understand the forces that resist to change, even when policy goals and support measures are set up. Regimes, in fact, regard the deep structures of human behaviour, from consolidated convictions to daily routines to moral norms. A change of regime requires a strong motivation and a great deal of resources.

However, resistance to radical innovation should not be seen only in negative terms. Innovation trajectories, as we have illustrated before, allow firms to draw upon accumulated frames, rules and infrastructures, which therefore can enjoy periods of accelerated innovation along with the same trajectory. Transition to new socio-technical regimes happen in times of contradiction between sub-regimes, and the process is not immediate nor linear. Innovation policies should be able to accompany transition regimes when necessary and to support the creation of new socio-technical regimes.

The highest level of structuration is the one labelled by Rip and Kemp (1998) as ‘socio-technical landscapes’. We may include into this category situations and events beyond the reach of national policies: global climate change, north-south divides, capitalist regulation, etc. A landscape can be changed as an effect of supranational policies or scaling up of radical changes, but more often changes in socio-technical landscapes are important drivers for radical innovation.

\textsuperscript{12} Paradigms are rules that define problems to be solved, criteria to evaluate opportunities, knowledge base, resource base, heuristics. A heuristic is a replicable method or approach for directing one’s attention in learning, discovery, or problem-solving.

\textsuperscript{13} The difference with the concept of technological paradigm of Dosi (\textsuperscript{1}) is that in the latter case all actors affecting technical development are taken into consideration, and not only those related to the sphere of production. This means that to study innovation processes we should consider, for instance, interaction between producers and consumers as well as distributors, opinion makers, standard setting and controlling bodies, etc., and we should analyse the written and unwritten rules that allow coordination (or lack of coordination) between these actors in fulfilling societal goals.
4. Agricultural and rural Innovation policy principles

Following the arguments above illustrated above, we need to work out a concept of rural innovation policies based on the following statements:

- Innovation policies concern production as well as consumption, transportation, commerce, land use and management, planning, and therefore should involve a broad range of stakeholders;
- Innovation includes both technological and non-technological aspects of human activities;
- Innovation happens in hybrid networks and its pace and effectiveness depend on the shape of the networks;
- Within networks paradigmatic conflicts (for example, between organic and conventional, or productivism and sustainability, public/private bias etc.) may occur;
- Currently, changes are occurring in the socio-technical landscape and therefore innovation policies should focus more on second order innovation rather than first order innovation.

Innovation policies cannot be taken in consideration separately from agricultural and rural policies. A focus on second order innovation implies that much more emphasis should be put on the problem definition and on the coherence between societal problems and innovation activities.

A few questions may arise on this regard:

- What are the relevant problems, and which are the priorities to be addressed?
- How to stimulate change?
- What are the most appropriate support schemes?
- How can the process be organised?
4.1 Relevant problems
The literature shows that a ‘demand driven’ approach to innovation services has been chosen in many countries (Rivera et al. 2002). For example, with the so called ‘voucher schemes’ public subsidies are given directly to farmers or groups of farmers, who are encouraged to express their innovation demand through the market mechanism. In theory, this should stimulate them to improve their evaluation of the quality of the services and to select the most effective and efficient ones.

Demand driven approaches see it as the duty of the market to select relevant problems to be solved by innovation. But these approaches take for granted that a choice is made with the intention to address farmers’ problems and goals. Should innovation policies respond to farmers’ or to societal problems? The relevance of this question emerges as we acknowledge, especially with the increase of environmental awareness, that farmers’ interests and societal interests may diverge. There is, therefore, the need to make a clear distinction between private interests and public interests. In Table 1 we have classified problems emerged into agricultural policy discourse on the basis of two criteria: dominant public/private interest and dominant/alternative paradigm.

<table>
<thead>
<tr>
<th>Public</th>
<th>Private</th>
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<tbody>
<tr>
<td><strong>Existing paradigm</strong></td>
<td>Reduction of negative externalities</td>
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<td>Non trade-distorting support</td>
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<td>Efficiency and effectiveness of spending</td>
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<td>Food hygiene</td>
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<td><strong>Alternative paradigms</strong></td>
<td>Sustainable use of renewable resources</td>
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<td>Creation of public goods</td>
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<td>Equity</td>
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<td>Food quality</td>
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Table 1. A classification of policy goals

Private problems affect mainly the private sphere: their solutions may be neutral or even negative to public welfare. On the contrary, for problems of dominant public interest, solutions could have neutral or even negative effects on existing farms. Producers’ motivation to act will be very different according to the expected advantages/disadvantages. And even in the case of private problems compatible with alternative paradigms, it will be very different to stimulate innovation on already motivated farmers or on farmers still adhering to the existing paradigm.

Among the classified objectives, at least two of them deserve particular attention. The first concerns the creation of public goods. The second one regards the competitiveness of farms within an alternative paradigm. How can innovation policies contribute to increasing the rate of production of public goods? And how can farmers’ and rural entrepreneurs’ economic motivations be met in the new context?

4.2 How to stimulate change?
According to Smith et al, there are two main groups of drivers of innovation:
- External pressures;
- Internal pressures.

External and internal pressures interact with each other, so that forces within an industry can ‘adapt’ to external pressures, ‘anticipate’ them, contributing to a change in the external environment, or try to raise defensive barriers to external pressures.
Among external pressures we could include:

- political and moral pressure, such as environmental, food safety, ethical concerns, etc.;
- new knowledge available, as for example in the field of IT or in biotechnologies, generated externally to the industry but with a potentially high impact on it;
- change in the competitive scenario;
- changes in the broader scenario (what Geels (2004) calls ‘landscape’ which include, for example, global climate change, Kyoto agreements, trade liberalisation, oil prices, etc.);
- policy pressures as norms, subsidies, governance arrangements.

Internal pressures come from within the socio-technical network itself: in the case of producers, they regard consumers’ demand, related industries, rivalry within the industry, endogenous resources (including material and immaterial infrastructures, human and social capital, etc.) (Porter 1990).

Both internal and external pressures may have different effects: on one hand they can foster change along a given trajectory (we will call them integrative pressures), while on the other hand they may foster a change of trajectory (we will call them critical pressures). For example, changes in societal needs regarding agriculture may generate a concentration of demand of strongly motivated consumers (willing to pay differentiated products) which may encourage farmers to change radically their style of farming and start new trajectories. This, for example, has happened in the case of organic farming at the beginnings, and it at the roots of most of Slow Food initiatives (Brunori, 2007).

Innovation policy, on this regard, can contribute to steer the change by:

- filtering in a selective way external pressures;
- supporting adaptive capability;
- changing the balance between internal pressures.

Smith et al. (2005) classify transition contexts along with two criteria: ‘degree of steering’ by the State, and ‘resource locus’, that is whether resources for change come mainly from production systems or outside them.

![Figure 7. Innovation policies and innovation paths (from: Smith et al. 2005)](image-url)
• In the corner [I] we have situations whereby, as an effect of a coincidence between endogenous resources and appropriate measures of support, ‘endogenous renewal’ has happened. To this type many of the successful cases of rural development initiatives apply, like those described in IMPACT case-studies.

• At the opposite, [III] we have ‘emergent transformation’, with a low level of steering and mainly external resources. This is the case of Brasil and Argentina process of structural change giving rise to a monoculture of soja stimulated by an increasing demand of feed by European animal production systems (Trigo and Cap, 2003).

• Corner [II] applies to the ‘green revolution’ program, with its strong emphasis on science-based technologies, transferred with a heavy support from the State, applied with a top-down approach to a ‘backward’ environment.

• In the corner [IV], finally, we could place the situation of farms that, having followed so far the ‘green revolution’ paradigm, as an effect of decoupling, cross-compliance and market liberalisation reorient their innovation trajectories mainly relying on their own resources.

4.3 Definition of appropriate support measures

As Winter (1997) stated already ten years ago, ‘farmers needed as much, probably more, advice and information to reverse productivism than they did to get it going in the first place’ (pp 372) But what to do with those farmers who are not motivated to change their attitude towards productivism? A recent paper of Klerks et a. (2006) comments this trend through the analysis of a case study in the Netherlands, that illustrates a voucher system created to give advice for the compliance to a compulsory ‘nutrient management scheme’. Their main conclusions are that:

• when the purpose is to encourage individual farmers to act on a public interest issue through a voucher system, a clear and relatively stable public policy is very important;

• for a one time project with a limited life span it may be difficult to gain the trust and respect of actors in the agricultural knowledge network;

• services and activities should be defined in relation to a specific public interest issue, depending on a careful diagnosis of both the problematic situation and the landscape of services already available;

• creating incentives, awareness building, and the articulation of needs are important pre-requisites for achieving demand-driven extension (in the substantive sense) on public interest issues.

When transition is the goal, advice and knowledge are not enough. On one hand, innovation policies for a transition to new socio-technical systems should be able to act upon actors’ cognitive schemes and motivation, that is on the conditions that influence and constraint action, and encourage the emergence of novelty and their consolidation into niches. On the other hand, innovation policies may be more effective when integrated with appropriate regulation and support measures.

Table 2 provides a classification of existing support schemes in the field of agricultural and RD innovation according to conventional/alternative paradigms and public/private objectives.
The first group of support schemes, those in box A, are aimed at adjusting existing technological trajectories to make producers comply with public interests rules. In this case, there should be a mix of compulsory rules associated with incentives or with compensatory premiums, and services should be oriented to awareness building, demonstration, advice with a high share of public contribution. We may locate cross-compliance measures and related advice services in this box.

The most appropriate target for market-driven mechanisms is box B. In that case, farmers see a clear connection between revenues and advice, and the State could top up the costs when private interest does not enter into conflict with public interest.

A totally different set of instruments is required when alternative paradigms are to be encouraged to develop. Both in boxes C and D, motivation and creation of new knowledge are of key importance. To adhere to alternative paradigms, actors should have a vision and a set of values that motivate them to look beyond short term advantages, and to evaluate in different ways costs and benefits of innovation. Of course, economic incentives and also active creation of markets (for example, through public procurement or through specific technical standards) are important to make innovation activity viable.

Table 2. Classification of support schemes according to type of paradigm and type of objectives

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<th>Public</th>
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<tr>
<td><strong>Existing paradigm</strong></td>
<td>Compulsory standards</td>
<td>Voucher systems with high share of private participation to costs</td>
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<tr>
<td></td>
<td>Voucher systems with high share of public contribution</td>
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<tr>
<td></td>
<td>Awareness building</td>
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<td></td>
<td>Demonstrations</td>
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<tr>
<td><strong>Alternative paradigms</strong></td>
<td>Creation of new knowledge</td>
<td>Creation of new knowledge</td>
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<tr>
<td></td>
<td>Visions and expectations</td>
<td>Awareness building</td>
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<td>Social learning</td>
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<td>Discourse creation</td>
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<td>Economic incentives</td>
<td>Economic incentives</td>
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<td></td>
<td>Creation of markets</td>
<td>Support to strategic niche management</td>
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4.4 How can the process be organized? Governance of change

Following the above illustrated approach, an appropriate governance pattern of innovation should be worked out. Analysis should be drawn on the basis of the following questions:

- Who to involve in the decision processes (this means defining what Smith et al. (2004) call ‘regime membership’)?
- What are the appropriate knowledge infrastructures? How to establish appropriate links between research, training, extension and support systems?
- What balance should be chosen between public/private, central/decentralised structures?
- How to assess the effectiveness and the efficiency of the public policies and supports?
**Who to involve in decision making?**

A key issue is related to representation of interests. Within the corporatist model prevailing in the preceding phase, official farmers’ organisations and cooperatives were the legitimate communication channel between the State and farmers (Winter 1997, Brunori 2007). In several countries, farmers’ organisation had a very strong power over agricultural policy decisions, and in many cases they were strongly involved in extension and to some extent in research as well.

With the crisis of the productivist regime and the emergence of rural development discourse, new actors have come to the fore. Organic farmers, for example, felt not represented adequately by conventional farmers’ organisations; some of the most innovative farms would look for direct communication with administrative bodies, without being filtered by farmers’ organisations. Moreover, as the discourse shifts from agricultural to the rural other rural actors look for representation in the decision making process. Some of them, for example, small and medium enterprises, belong to strong associations whose involvement in decision making could shift the balance in decision making.

As for public interests, the issue is even more complicated. Speaking generally, public interest should be adequately represented by public institutions. But in many cases, political systems are affected by serious problems of representation, with political parties not being able to channel societal needs into policy decisions. In this context, the involvement of consumers’, environmental and community NGOs can open decision making processes to new issues.

**What are the appropriate knowledge infrastructures?**

From the points above illustrated it emerges clearly the need for a new governance of innovation services. In fact, appropriate knowledge networks should be able to:

- be effective and efficient in promoting the production of public goods, and if possible to make private interest and public interest converge;
- stimulate the growth of new paradigms and support niche development;
- strengthen and mobilise endogenous resources, and in particular human and social capital through improved social learning capacity;
- provide access to knowledge already available elsewhere and integration with existing knowledge;
- improve network connectivity;
- facilitate interchange between tacit knowledge and formalised knowledge;
- facilitate adaptation of niches to existing regimes by negotiating changes of rules.

All these aspect require:

- public bodies able to clearly identify objectives of public interest, to set up research, training and extension programs coherent with them and to carry out appropriate and effective evaluation procedures;
- capacity to valorise the emerging of niches ‘from below’;
- a multiplicity of innovation agencies/groups/organisations embedded into civil society and capable of adapting rapidly to the changing environment;
- a plurality of innovation networks including producers, users, processors, experts, able to guarantee their continuity in the time through access to an appropriate mix of public and private resources;
- funding schemes designed to balance cost-effectiveness with the need of innovation agencies themselves to invest in human and social capital.
How to assess the effectiveness and the efficiency of the public policies and supports?

Critiques to the efficiency and effectiveness of extension services have generated a growing demand of monitoring and evaluation procedures. However, most evaluation schemes have efficiency, more than effectiveness, as their main object. Effectiveness, in fact, is not easy to evaluate. As Alex and Byerlee state (Alex and Byerlee, 2000), effectiveness of AKIS programs is evaluated in terms of productivity, that is with a productivist paradigm. And also in this case, how to identify the specific role of AKIS programs on productivity?

A monitoring and evaluation system coherent with the above illustrated framework should be based on the following principles:

- it should distinguish public goals from private goals;
- it should detect learning processes at micro, meso and macro levels;
- it should identify socio-technical systems in which innovation occurs;
- it should detect how innovation policies act on novelties, niches and regimes;
- it should detect signals of transition from novelties to niches and from niches to regime.

Monitoring and evaluation can have also a specific effect on innovation. Appropriate monitoring and evaluation systems can in fact start learning processes at institutional level. This, within the terminology above illustrate, may produce ‘third order’ innovation, that is capacity to generate and to implement new paradigms. For this reason, however, monitoring and evaluation should be based on participation and should be based on a strong component of self-monitoring and self-evaluation of the actors involved in innovation policies.

5. Concluding remarks

In the present paper we have developed a concept of innovation according to which: a) Innovation occurs into hybrid networks and involves a broad range of stakeholders; b) innovation is addressed both to technological and non-technological aspects of human activities; c) innovation has to do with learning activities; d) hybrid networks are governed by paradigms; within and between socio-technical systems different paradigms may coexist; e) innovation based on prevailing paradigms proceeds along a given trajectory, while innovation based on new paradigms challenge the existing frames and patterns of behaviour.

On this basis, we argue that rural innovation policies coherent with the new agricultural and rural agenda should distinguish between public goals and private goals, address second order innovation, and take explicitly into consideration the existence of different paradigms. What is at stake is a different approach to steering knowledge systems. Rather than a top down approach, a systems approach based on recognition of plurality of interests, participation, social learning and encouraging innovation from below should prevail.
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