AALBORG UNIVERSITY

THE AGRICULTURAL INNOVATION SYSTEM

THE KNOWLEDGE ISSUES IN THE BULGARIAN AGRICULTURAL SECTOR

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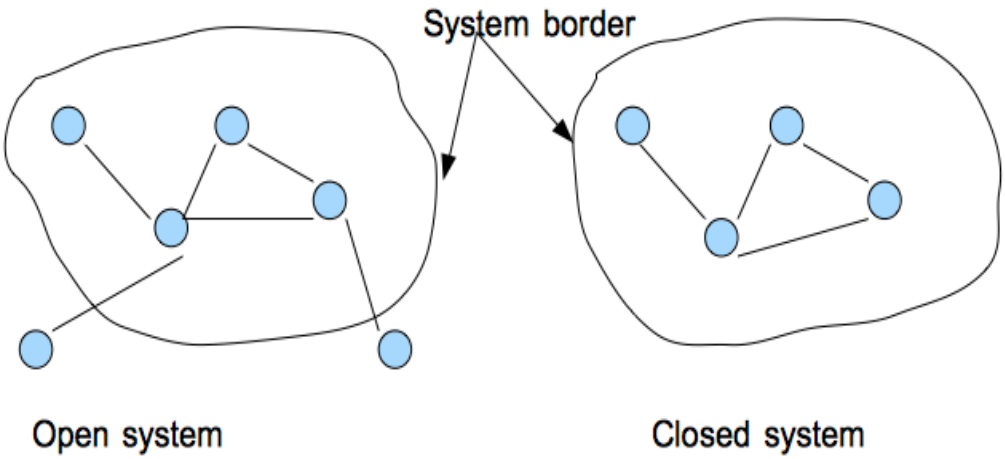
I Goal and Methodology of the project

The system approach will be the one used in this project. According to Abnor and Bjerke, *a system is a set of components and the relations among* them. For examining singular system elements through this approach it will be not enough its study in isolation, but it has to be considered in the surrounding where the component is located.

Systems can be open and closed, while the first are studied in its environment context the second are not. Figure 1 shows these differences. In this research the open system will be used. The term environment in this case stays for *what lies outside the boundary of the system* and consists of important for the system factors, which often are beyond the control of the system.

Figure 1: Open and closed systems



The main object of the project is to understand the functionality of the agricultural innovation system in Bulgaria. Often system of innovation is used as a direct tool for governance, but here it will be used for analyze if innovation can easily occur in the agricultural system of the country. Implementing system of innovation does not necessarily mean that innovation is present at the level of interest. Therefore, it will be sought to identify factors, which could hamper and assisting innovation activities to take place.

Consequently the concepts of innovation and knowledge need special attention. However,

both are broad concepts and some specification in the beginning have to be done.

- Innovation – in this project innovation activities will be limited to the one that have crucial role for the economic system and are not necessarily generated through R&D: **extend product range** (inside and outside the production field)**; develop environment-friendly products; increase marker share; improve product quality; reduce environmental damage** (Oslo manual). To understand better the innovation performance it will be given more importance to the role of demand conditions (demand of knowledge) in the sector, the innovative input to the sector, and less to the competitiveness context of the sector and the supportive industries or sectors.
- Knowledge – it is the most important component for enable innovation. The theory states that system of innovation serve the function of creation, diffusion and utilization of innovation, but it could be considered that it is also about creation, diffusion and utilization of knowledge. For the purpose of creation and the diffusion of knowledge in the project will be studied how it is created, if it is advanced and specific knowledge or it is practical; also its codification for the transferability, i.e. how afterwards it is accessed. As main source of knowledge in this research will considered the one from educational/research institutions (higher education institutions; government research institutes and privates) as well from generally available information (professional conferences, meetings and journals; fairs and exhibitions). In the project will be sought also to see what knowledge is needed in the agricultural system to encourage innovation. Competences, which are essential for the human capital will be included under the therm of knowledge.

In addition it will be important to reckon the institutions, in terms of their quality to support knowledge development and knowledge transfer and consequently innovation activities of the privates. In this project the considered institutions are national and european laws, national and european guidance and programmes; norms, habits, behavior and incentives of the actors within the system of innovation. The primary role of institutions could be said is to serve the exchange of knowledge between the actors.

As said before, open system will be used for the examination, because of the importance of the system's surrounding and other external factors, such as dependence of other sectors' knowledge and environmental legislation. Nevertheless, when the study is toward a given system of analyze, its boundaries have to be defined. In an evolutionary and interdependent economy will be rather

difficult to put rigid borders of the innovation processes that take place within some system of analyze. This is especially hard when the focus is on one of the most dynamic and complex element of the system – the knowledge. It is an asset, which is accumulated on a given base through further development, codification and diffusion. Therefore the boundaries of the study will be limited to the creation, diffusion and utilization of knowledge in the Bulgarian agriculture; and more precisely related to the crop plantations, since they have been traditionally important and are still regarding the agriculture output, export and employment. For better comprehending of the diffusion and utilization of knowledge it will be regarded in two sub-groups.

However, it has to be clear that systems evolve and in this project will be considered external and internal factors, which influence changes in the agricultural system of innovation. One challenge ahead is to afford environmental problems, which create significant dynamics in all systems of innovation. Thus, the project deals with the environment as external factor for changes. In addition, as part of sustainability it be included the conception of degrowth, which principles imply that development is not strictly about economic growth, and a broad set of rules and values should take place as a level of legitimization as well as at individual behavior.

The creation, the diffusion and the utilization of knowledge are processes related to actors of the system. In the project the attention will be limited to private farmers, public organizations for knowledge creation and of course, the relations between them. The work will try to find out if the second actors could provide farmers with the needed knowledge to enable innovation (in the already specified therms from Oslo manual). The european and the nation political context are also considered in the analyze, because they are the background of economic processes in the Bulgarian agriculture. They can be understood as part of the institutions.

For the empirical study are chosen three actors. It is clear that only one representative (sample) of the different groups is not enough to have complete conceive of the Bulgarian agricultural system. The first is an institute for knowledge creation. It is part of the Agricultural Academy, which is public organization representative of the Bulgarian science and education, i.e. a political instrument for the creation and diffusion of knowledge at national level.

The second actor is a private farmer of medium size, which is expected to point out the knowledge needed on the national level and the accessibility to it. This examination will reveal the efficiency of public structures to provide privates with the *right* knowledge that will enable the innovation. However, from purely economic point of view, it could be expected that his main interest is profit optimization, reachable by employing the necessary means of production. This

mean that environmental concerns and employment of environmental-friendly inputs or practice hardly could take place.

The third actor that will be analyzed is a bio-farming structure. The interest for it is because in the project problems with sustainability are treated. As pointed by the Oslo manual, innovations which reduce environmental damage, increase the quality of the products or develop environmental-friendly products are important. The interest in the bio-farmer will be limited to understand their role and reliance in terms of satisfying agricultural demand in the Bulgarian agriculture; but issues related to the input and the output of knowledge or innovation of course cannot miss.

In addition, in the project will be considered that innovation systems are different among countries. The distinction will be between industrialized countries – called the North – and developing countries – called the South. This discrimination is made because developing countries have different economic structures and problems of justice, democracy, low level of income and social well-being. In that situation, beyond the quality of the produced knowledge, the development and the access to knowledge put doubts about its efficiency. Therefore, for countries from the South will be more opportune to consider the inclusive innovation system, i.e. where the diffusion of knowledge and the well-being should benefit also marginalized and vulnerable individuals.

It will be misleading to analyze *ceteris paribus* the dynamic processes of knowledge, without analyzing the base of the Bulgarian agriculture and more general factors, which influence the performance of the sector. Indeed, according to Oslo manual some of the factors, which can hamper the innovation process are structural, like: lack of information on the market, lack of skilled personnel, resistance to change, lack of infrastructures. For the study of the basic structure of the agriculture will be used secondary source, such as governmental documents, reports by different public institutes and information from the national statistic.

For more detailed analyze of knowledge creation, diffusion and utilization will be made case studies with the above mentioned three actors. They will be approached by direct open interview in order to catch facts, which could have been not considered.

II Introduction

Innovation has become one of the top priorities for national economies. Governments try to push innovation process with expectations for economic growth, increase of national competitivenesses and social well-beings. Often policy makers design innovation plans, which just reproduce successful activities for innovation without considering different structures and specificities of the systems. It is largely believed that the more scientific-based and advanced is the knowledge, the most innovation is stimulated.

Today the agriculture seems a non attractive business, like the ICT or the nanotechnology industries. However one thing should be sure: the demand for food is constantly increasing. Consequently, the sector could be expected to seek for new opportunities, reachable through new technologies and the application of the science in it.

In the last twenty years in Bulgaria the sector has lost its importance. In this master thesis will be examined the agricultural innovation system in Bulgaria. The innovation system will be seen as an analytical tool to identify factors that foster and hamper innovation processes withing the sector. As a cardinal element of innovation is considered the knowledge plus its creation and way of diffusion. However, it could be expected that agriculture in Bulgaria (and in general, agriculture) as a low-tech sector is not characterized by intense flow of knowledge like in other scientific-based sectors (e.g. pharmaceutical); and that the sector requires more practical than advanced knowledge. The Bulgarian agriculture sector is reckoned as an open system, where external factors have influence on it. Furthermore, there will be regarded causes for the dynamics in the system.

Developing countries often tend to apply directly policy and *best practices* for innovation from industrialized nations. However, there are particularities in developing countries (poverty, unemployment, justice, low-income and low-productivity, etc.), which cannot be neglected when studying innovation dynamics in a systemic approach.

In addition, one of the major concern today is the environment. Its deterioration causes irreversible effects in both countries, but in developing countries the negative consequences and the cost they have to pay are bigger. Notwithstanding that sustainability is more affordable by rich countries, the task is for both as well as for every single socio-economic actor. Therefore, the sustainability issues have to be seriously treated and seen also as an opportunity to existing problems of the Bulgarian agricultural sector. To consider environmental problems into every kind of innovations and system of innovation is fundamental duty to all national governments.

III Why the agricultural sector is important?

1. Introduction

Agriculture serves the most important demand of human being: the food. While for other fundamental goods and raw material could be find substitutes, for the agricultural cannot. Agriculture stands for cultivation of animals, plants, fungus and other life forms for food and products used for sustain human life. The idea of "food security" nowadays is fundamental and the task of agricultural to fed people has been of primary importance. Therefore, it could be considered as basis for political and social stability (Schwebius, 2008).

Agriculture has played crucial role for the development of human beings, especially for the invention of technologies and techniques used for domestication, cultivation, conservation and exchange of agricultural products. These were the first goods that have enabled communication and transactions between individuals and groups (Diamond, 2005). Indeed, the development of the agriculture has been directly connected with the development of human civilizations.

Moreover, agricultural is very important sector in therms of work employment. Small farmers and large agricultural companies provide occupation to millions of people, generate income and help the poverty reduction. In most countries the sector remains the biggest provider of work employment. In 2007 one third of the world's workers were employed in this sector; and agricultural production accounts for around five percent of the gross world product (International Labour Organization).

Modern agriculture depends on competences, policy and science. The last in interconnection with the others has produced huge quantity and quality of knowledge and technology for improve agricultural production. For instance, the chemical industry has provided many products, like pesticides and fertilizer that have increased the agricultural yield per unit of land (measured by total weight and rarely of their quality). Employment of machinery in the production process has also made more efficient and has intensified the agricultural output. Biotechnology and pharmaceutical advances have additionally enhanced improvements for crop production making the sector more intensive. Hence it could be said that beyond work employment, generation of income and reduction of poverty, agriculture plays a key role for absorbing and developing other related

industries and technologies. However, the progress of agriculture has caused ecological damage, natural catastrophes and unmeasured negative effects on human beings (Alier). Moreover, the constantly increasing global demand for agricultural products will request more advanced technologies, machineries and knowledge for more intensive production.

As a challenge to environmental problems and quality of the food, the organic farming seeks to give an answer. It has pointed to the rejection of non-organic practices with no pesticides and fertilizer used in the production process. This sustainable farming gives e new dimension to agriculture, policy and knowledge development. Also, fundamental part of organic farming are the relationships that farmers have to establish with the final consumers and the location where they can place the proper production. Several issues could hampered the diffusion of these productive structures. For example, the demand for those products, being more expensive, markets for placing the bio-products and missing governmental aids for organic producers were one of the major impediments (Belz, 2000).

2. Agriculture belongs to low-tech sectors

The term *low-tech* or *low-technology* sector refers to the low or no employment of R&D into the production process of a given sector. The concept actually is best applicable to sectoral level. Traditionally, sectors such as the food industry, the paper and the wood have been classified as low tech industries (OECD). It has to be added that not all innovations demand big R&D expenditure.

Indeed markets or suppliers and customers in some sectors could be more important source of innovation than the production of knowledge in R&D departments. R&D often produces advanced knowledge for high-tech sectors such as pharmaceutical or the nanotechnology industry. Agriculture in most of the cases need efficiency, improvements in the production or distribution process, i.e. the sector often needs “practical and pragmatic ways by doing and using”. More precisely, practical knowledge is generated in application contexts of new technologies and obeys validity criteria such as practicability, functionality, efficiency and failure-free use of a given technology (Hirsch-Kreinsen, 2008). Hirsch-Kreinsen emphasizes that major driving forces for low-tech innovation are changing technological paradigm and demand differentiation. Key features of those sectors are in-house practical knowledge in the context of a distributed knowledge base and the largely managerial based competence to make use of and to expand this knowledge. In doing so,

the resources and capacities for strategic action are in the most cases limited, as the low-tech sector is quite generally dominated by small and medium enterprises.

What is more, low-tech sectors could be characterized by incremental innovation, which means continuous improving on small-scale to existing product lines and further improvement of those products or processes. Tidd and Bessant (2009) describe incremental innovation as “doing what we do but better”.

Interest in low-tech sectors is because in industrialized countries low-tech sectors employment account for more than 60 percent and are still driving force for major export and economic development in industrialized countries, like Germany (Hirsch-Kreinsen, 2008).

IV Structure and definition of sectoral system of innovation.

Defining the sectoral system of innovation is easier than defining the regional one, and harder respect to the national system of innovation – where the national boundaries are the natural lines of that system. Sectors are different branches of the economy. For example, if looked broadly these could be the agricultural sector or the service one. Going narrowly sectors can stay for textile, telecommunication, aerospace, food processing, pharmaceutical and others, which in the same time can be part of another sector with bigger boundaries. A key part in sectoral system analyze is in the interaction and interdependence to other sectors and sub-units. The attention of this project will be on the a rather narrow view of agriculture, and more precisely on the plant cultivation, excluding from the sector the subunits of the fish and forest industries, the dairy manufacture, the food processing industry.

As in the broad conceptualization of agriculture, the narrow also tries to emphasize interdependence, linkages and transformations spanning over a different range of products, actors and functions. To make complete the meaning of "agricultural innovation system" given actors and specific interrelationship, which enhance the flow of knowledge will be analyzed further.

Before the statement what system of innovation is, it will be appropriate to note that innovation does not happen in isolation, but in collaboration with other organizations, which behavior is shaped by institutions. Thus it has to be clear that the most important feature of innovation is relationships and interactions between the components of the system.

An important definition is the one provided by Edquist who defines system of innovation as "*all important economic, social, political, organizational, institutional, and other factors that influence the development, diffusion and use of innovations*" (Edquist, 2005). There are additional notions by the author, which are relevant in order to examine system of innovation (SI).

a) One of them is that he puts the learning and consequently knowledge in the center of the SI. The author points three main learnings, which are interdependent:

- new products and new processes (innovation). It leads to the creation of **structural** capital (a matter of organizational learning). Innovation does not depend only on R&D, but calls for technical experimentation, technology adoption, market investigation and entrepreneurial

actions.

- **Research and development**. Generally R&D is important factor for enabling innovation process In most of the countries universities are important public actor for performing R&D activities through governmental subsidies. However, in industrialized countries it is afforded mostly by private actors. There are cases in rich countries where the innovation has occurred without big investments in R&D (Norway and Denmark)
- **Competence building** leads to the creation of human capital. The author points to distinguish the difference between vocational and academic education.

b) Another point is the employment of historical and evolutionary perspectives in the SI; thus system of innovations evolve over time in a largely unplanned way. Broadly looked, this explains that every single innovation system is in some extent unique.[1] Hence it has to be comprehended that regional, national or sectoral system of innovation are more an emerged outcomes of different factors in a complex interrelationship and interdependence than a governmental tool for the respective level of innovation management. Moreover, Edquist highlights that most of OECD countries use system of innovation as a label than as an analytical tool.

On this subject, the author states: "*if we knew all of the determinants of innovation processes in detail, we would not be able to control them and design or build system of innovation on the basis of this knowledge. Centralized control over system of innovations is impossible and innovation policies can only influence the spontaneous development of SIs to a limited extent.*"

Indeed by the above notion Edquist underlines that system of innovation accentuates non-linearity, but interdependence, i.e. the innovation is shaped by the elements of the system plus the relationship between them and an eventually control over a given system is rather a complicated task.

1. Definition of sectoral innovation system

The definition of sectoral system of innovation, used in the project will be the one presented by Malerba:

"*A sectoral system of innovation and production is a set of new and established products for*

1 According to Lundvall and Edquist (2003), the Danish National System of Innovation is more an outcome of spontaneous development than the result of targeted policy. Geels (2004) also argues that socio-technical systems are the effect of activities of human actors.

specific uses and the set of agents carrying out market and non-market interactions for the creation, production and sale of those products. A sectoral system has a knowledge base, technologies, inputs and an existing, emergent and potential demand. The agents composing the sectoral system are organizations and individuals (e.g. consumers, entrepreneurs, scientists). Organizations may be firms (e.g. users, producers and input suppliers) and non-firm organizations (e.g. universities, financial institutions, government agencies, trade-unions, or technical associations), including sub-units of larger organizations (e.g. R&D or production departments) and groups of organizations (e.g. industry associations). Agents are characterized by specific learning processes, competencies, beliefs, objectives, organizational structures and behaviors. They interact through processes of communication, exchange, co-operation, competition and command, and their interactions are shaped by institutions (rules and regulations). Over time, a sectoral system undergoes processes of change and transformation through the co-evolution of its various elements"

As how can be perceived, knowledge, technologies, inputs and demand are specific for every single sector and even between the same sectors across countries. For example, the differences in the agricultural innovation system between rich and poor countries could be expected to be significant.

In the definition is underlined the heterogeneity, in terms of learning, knowledge base and culture of different actors. This points to a very micro level in innovation system theory, because it goes to singular individuals and emphasizes the individuality of economic agents – their personal beliefs, expectations and conditional behavior. Moreover it is clear that those actors responsible for the creation, diffusion and commercialization of products or knowledge are institutionally dependent.

As said by McLuhan: "*the actors are environmental, professionalism is environmental*" (McLuhan, 1967). This mean that actors are subordinated, for good or bad, to their environment and the system they are located, or known as to the institutions. Hence, it should be clear that institutions, in their soft and broad understanding, may help or hamper economic actors to perform their innovation strategies, depending of the circumstances. There is not a golden rule that embrace all the situations.

Moreover, given national institutions such as rules, laws, etc may favor specific sectors. If the sector is big enough and important – in therms of employment, generated income, national strategy – its institutions may have influence on the national ones. But in certain cases, some sectors

become predominant in a country because the existing institutions of that country provide an environment more suitable for certain types of activities and not for others. So the relations are bi-directional.

Crucial role in the formation of a sector plays the demand – the existing, the emergent and the potential one. Sectoral system demand is not seen as an aggregate set of similar buyers, but as composed by heterogeneous agents with specific attributes, knowledge and competencies who interact in various ways with producers (Devetag, 1999). Demand is a factor that pulls technologies, absorb new products and give feedbacks to already existing production. Indeed, Porter emphasizes four drivers influencing the performance of the national industrial clusters. On the case of the sectoral innovation system these factors could be considered also important.

- The first is represented by the demand conditions. There are different examples regarding the role of demand to stimulate given sector or technology to develop. In USA these roles have been played by the military sector, while in UK it was to the defense research establishment.
- In a knowledge-based economy central authorities tend to the creation of knowledge and innovation, i.e. to concentrate more on the production side and little attention is attributed to users and markets, assumed to be "out there" (Geels, 2004). It is important to say that consumption is more than simple buying and so adoption needs given level of knowledge, information and capabilities for the right consumption or utilization. In addition, feedbacks from users are primal for improvement of new products or technologies and thus to make easier its employment on the the market.

  Sophisticated and demanding customers stimulate the development of given technologies. Also, demanding customers may encourage local companies to offer better and unique technologies and consequently to become worldwide present, depending of both competence – of the producer and the user. In addition, technologically advanced users may anticipate needs of given industry and through well established mechanisms for market feedback to suggest product improvements or to enable the innovation to take place. The role of demand could be interpreted as a pavement to new products and innovation. The quality of demand is a fundamental factor, influencing the whole innovation process.
- The second driver, explained by Porter is the role of the input to the sector of

interest. An innovative input - research from universities, specialized human capital and resources (scientific, technical and managerial), information infrastructure, the availability of risk capital – influences in a positive way the operation of a given industry or sectoral system of innovation. In addition, here is the case to mention that suppliers of components and subsystems play a major role in affecting innovation, productivity increases and competitiveness. Suppliers are characterized by specific attributes, knowledge and competencies, with more or less close relationships with producers

- The third driver is the local competitive context, i.e. how much it incentives investments in innovation and in the same time reinforce it. Here competition between local firms plays crucial role, because it could stimulated them to offer constantly new products or to improve the existing ones. Moreover, firms could learn how to be efficient, dynamic and how to establish collaboration with external partners for the use, development and diffusion of knowledge and innovation. The hint on "local" exemplifies that companies are surrounded by local environment, which can be competitive and thus they have to be more efficient, because are menaced by the others and in order tho survive and/or prospect they have to improve process and product performance all the time.

- The fourth determinant is about related and supporting industries. What is important here is the density and interconnectedness among firms and industries. The positive externalities, wants by the others, as well as the exchange of information and knowledge spillovers feed locally connected firms.

According to Malerba, using the sectoral system approach is opportune, because it shows the system failures; and consequently it points where exactly policy targets must be addressed.

2. The function of systems

It was acknowledged that the process of transforming knowledge into innovation, i.e. to its practical application is a long process and the role of the entrepreneur is fundamental. The

knowledge could be defined as the base, or the starting point of any innovation process. Hence the main function of an innovation system could be said to be about the creation, diffusion and use of knowledge.

Jacobsson and Johnson (2000) have developed the concept of "functional pattern", i.e. how the functions of a given system of innovation (development, diffusion and use of innovation) are served. The functional pattern points seven different functions, which are analyzed separately as well as the interrelationship between them. As a scheme they use the work of Hekkert and Negro (2009):

1. Entrepreneurial activities – the role of entrepreneurs is fundamental. This is the actor that turns knowledge or newness into innovation and practical application. Entrepreneurs are people with specific personality and courage, willing to take risk.

2. Knowledge development – in the knowledge-based economy, the knowledge is the most valuable resource. It is an asset that can be analyzed as income (competence), as well as output (innovation) in the production process. Also, knowledge can be privately owned and bought or sold on the market (Lundvall, 2003). Here learning plays an important role, because it is one of the ways knowledge develops.

3. Knowledge diffusion – the flow of knowledge between different institutions is helped by different mechanisms and channels of communications. To talk about network (as done by Hekkert and Negro, 2009) is rather a broad concept, and so more attention is needed on the specific mechanisms of knowledge exchange.

4. Guidance of the search – it represents targets on different level, mostly national or local. It is where actually the state points where the business and policy makers should go. Or by Carlota Perez's words it is about designing technology trajectories.

5. Market formation – the market is fundamental aspect of every economic system. It has to be considered that markets are often the reason for the failure or the success of innovation. In the first case, this is when are missing basic marker mechanisms or there is no demand for new products, because the old ones have a substantial market share or just because people are not familiar with the existence or the way it is utilizable. In these cases often the

government uses different policy to restore the missing market mechanisms or to promote innovation (like tax relieves or public demand) and to absorb these new goods, hence to create the market for them.

6. Resource mobilization – in order to progress a given sector or technology, beyond its demand on the market, financial resources and workforce (especially the qualified one) are essential.

7. Creation of legitimacy – new products and innovation have to be helped by the institutional framework. Laws and rules can advocate given sectors or technologies. Depending of the importance of the sector these institutions might come from the sector itself, or in other words, if the sector has achieved a strategic importance, the rules applied at broader level will be the one from the sector. However, group of interests and lobbies also belong to this function and it has to be considered the possibility that incumbent actors may try to suppress innovation by exercising their power and control. According to Hekkert and Negro, weak functioning of "creation of legitimacy" is an *indicator for a poorly functioning innovation system and a poor alignment between institutions and the needs of emerging innovation system.*

Individual performance and positive interactions between the different functions strengthen a given (sectoral) system of innovation. Combination of functions may have effect on other functions.For example, resource mobilization and knowledge diffusion could aid the knowledge development function.

The above used functional pattern is used to describe and analyze dynamics within Technological System of Innovation (TSI). For the study of Sectoral System of Innovation (SSI), *Guidance of the search,* which can be called "National Strategy for Sectoral Development" and *Creation of legitimacy* will be examined together, since both are rather dependent of governments and policy makers. Moreover, the *Knowledge diffusion* and *knowledge development* also will be regarded together as the function of any innovation system: *the development, the diffusion and utilization of innovation.* They have to be extended and relationships with other sectors to be considered and included (as part of open the open system approach), because inter-sectoral exchange of information and competences are fundamental in the development of sectors and also the knowledge itself.

Besides, it has to be considered eventual obstacles in the above mentioned functions. For instance, problems with resource mobilization are possible to occur. One of them is lack of qualified workforce, but a bigger impediment could be the lack of funds or of attractiveness for the people to join a given sector, coupled with lack of qualifying opportunities (Gerstlberger, 2004).

From the definition of sectoral SI firms[2] are the active players of innovative activities and are key part of every system. These actors carry the function of the innovation system. Firms include also users and suppliers who have different types of relationships with the innovating, producing or selling firms. The role of users is extremely important in several sectors, such as agro-food or instrumentation (Von and Hippel, 1998). In a sectoral system there are non-firm organizations, such as universities, financial institutions, government agencies, local authorities, and so on. In various ways, they support innovation, technological diffusion and production by firms, but their role differs among sectoral systems.

Firms have commonalities and at the same time are heterogeneous (Malerba, 2005). Hence, the importance of network existence. Their heterogeneity – in terms of types, sectors, beliefs, targets, customers, competences, behavior and organization – creates interdependence and complementarities, thus it becomes a central characteristic of a sectoral system. Thus the notion about interactions and exchanges of information among actors has central place.

3. The sources of knowledge in the sector

3.1 General overview

Todays economy could be called with no doubts knowledge-based economy. It means that the most important factor for the production and consumption process is the knowledge. This economy is the successor of the bulk economy, based on intensive labour and capital employment (Arthur). Knowledge is not a static asset and it evolves over time. Also, the knowledge determinates the specific path of economic development. Learning is probably the most important part for knowledge development and therefore the knowledge-based economy can be titled also “learning

2 According to Malerba, the most appropriate units of analysis in specific sectoral systems are not necessarily firms, but individuals, firms’ sub-units (such as the R&D or the production department) and groups of firms (such as industry consortia).

economy". Being crucial means of production, then it should be clear that knowledge is not easily accessible. Private companies do not have incentives to invest in it, if is reachable by everyone. This is also the reason why they keep it or protect it by patent, and do not share the knowledge. This is why often States intervene and produce it financing schools, universities, research centers for generic or specific knowledge. Afterwards, the issue of its distribution is not an easy process.

Knowledge as asset for economic development and part of innovation system could be divided into external or internal to the system. In the open system approach importance have both external to the system and internal knowledge.

3.2 Different kinds of knowledge

The taxonomy of knowledge divides it by different indicators. The ones that are important for this project are: generic vs. specific; implicit vs. explicit

3.2.1 Implicit and explicit knowledge

Knowledge can be deeply rooted in local organizations, labour and institutions and so difficult to be codified and transmitted. It has to be considered that codified knowledge is not an accumulated stock of information and it is not independent of its location, holder and time. However, knowledge can be easily described, written and shared with others. To these points, Lundvall suggest a subdivision of the knowledge as:

- Know what – means to know a specifying thing that refers to facts and informations. It is easily represented and its understanding is not complicated. This is for example, a historical fact or statistical data, which points to *what.*

- Know why – is about explanations and causes of processes and dynamics. It tries to inform about laws and principles in different spheres of human live. Know why has played central role in chemistry and physics. In technology development it has reduced the time of

experiments and the quantity of errors in the trial-error process. Serving the function of explanation, the *know why* should be well delineated and reachable. It roots principally in science and may exist in a codified form. However, despite the fact that it is titled as "accessible" (through internet and other information channels), the code could be complex that and to give meaning only to outstanding people (Lundvall, Johnson and Lorenz 2007).

- Know how – is about competences, which are difficulty separated from the owner. It stresses the skills, the professionalism and the abilities of individuals to perform tasks in a specific way. It is embedded in every single socio-economical actor and this is what make him or her unique. This is an practical and not theoretical ability. Managerial and productive skills are good examples of this individual-specific knowledge, which cannot be replicated and it is hardly codified and shared with others. Know how is acquired through experience and learning process; also more skills and competences are used, the more they develop. In additional, it is the type of knowledge with the most limited public access.
- Know who – points to networking and social relations. With know who, needed information or knowledge can be accessed, even if not owned. This kind of knowledge open the perspective for collaboration and sharing of *know what, know why* and *know how.* Know who is becoming more important with the interdependence of companies and the more composite knowledge. Moreover, new products typically combining many technologies, each of which is rooted in several different scientific disciplines, makes access to many different sources of knowledge more essential. Know-who involves information about who knows what and who knows what to do. But it also involves the social ability to co-operate and communicate with different kinds of people and experts (Lundvall, 2003).

From the listed subdivision of knowledge it could be perceived that know what and know why are more explicit knowledge and easily accessible and movable, while know how is tacit and its transferability is difficult. *Know who* is difficult to be attributed to some of the two categories, since it includes both skills, personal capabilities and intuition to find the right connection and who to contact and on the other side the needed information could be regarding *know what* or *know why*. Tacitness of knowledge is important to be deepen, because it is connected to transferability of knowledge and may hamper it.

There could be found differences among sectors in the usage of implicit or explicit knowledge. Some science-oriented sectors base their activities mainly on codified knowledge while others operate and compete mainly on the basis of unstructured and experience-based implicit

knowledge. However, there are no pure cases. Even in the most strongly science-based sectors tacit knowledge will be a key element in their competitive position (Lundvall, 2003).

3.2.2 Generic vs. Specific knowledge

Talking about innovation it is largely considered innovation brought from scientific research, technology advances, or patents granted. According to Nelson (2004) over the twentieth century most technologies have come to be connected to and supported by different fields of science. Thus innovation presumes that the role of formal R&D must be enhanced and improved the access to explicit knowledge. Nevertheless, in most areas results of scientific researches are not directly used for technology development. There are low and medium sectors, where practical knowledge is more important, i.e. other factors, such as interaction with suppliers and customers, information, feedbacks from the markets and other firms or departments are more important; and here R&D usually plays a secondary role.

In addition, when States decide to intervene in the process of knowledge creation to foster the competitiveness of local companies and to encourage the innovation process, they have to be mindful to consider the distribution of that knowledge. Generic knowledge, such as basic data and information, which are useful and can be accessed to a big amount of consumers could bring more economic and social benefits to the system. In that case is preferred to consider inclusive innovation system[3]. Generic knowledge could be achieved through publicly funded research, out-sourced to private companies, R&D centers and academic institutions. However, in order to be afterwards easily transferable it has to be well codified and this code must be comprehensive to socio-economical actors. This research could be called "basic research", which is defined by OECD as: "*experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view*." Often its outcomes do not have direct or immediate commercial benefits and does not have any particular application. But in long term, basic research serves for many innovations and further applied research.

On the other hand form the point of accessibility, if the produced knowledge is used by

3 It regards distribution of benefits to different groups and especially the low-income group. Also it helps to promote sustainable economic growth and maintain social harmony and stability.

restricted amount of utilizers and for particular purpose it could be called specific knowledge. It is generated mainly in private companies for their own needs, but it can be generated also through public funds in public or private organizations. Lobbies will will push government to invest in given sectors or technologies, which are connected to their field of research and production. Even if admitted that this specific knowledge is publicly available it could be not apprehended, because of the difficult codification; unutilized, because it is too much advanced to be employed in relatively simpler production process of some groups; or expensive in therms of tax payment or patent fees. This specific knowledge can be achieved through applied research, for which the definition of OECD states: "*original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective*". Also applied research deals with specific problems and is in general empirically based.

An additional comment about learning could be made to complete the understanding of knowledge development. Specific research projects will often be triggered by practice, which could embrace problems with new products, processes and user needs. Thus, other form of innovation must be considered; like the DUI mode, which is mainly based on learning by doing, using and interacting. Learning is a side-effect of the process of production, utilization, marketing or innovation. This kind of knowledge is acquired when different problems are confronted. Finding solution to them, improve skills and capabilities of firms, employees and managers. Rosenberg is the one who introduced the concept of "learning by using" to explain why efficiency in using complex system increased over time. The notion of "learning by interacting" emphases how interaction between producers and users in innovation enhances the competence of both (Lundvall, 1988). Learning by doing and using normally involve interaction between people, departments or different sectors. Empirical surveys show that successful innovation depends on development of links and communication between design departments, production and sale (Rothwell, 1977); but it could be added also sectors. The DUI mode can intentionally be promoted by building structures and relationships which enhance and utilize learning by doing, using and interacting. In particular, organizational practices such as project teams, problem-solving groups, and job task rotation which promote knowledge exchange can contribute positively to innovative performance of the level of interest (firms, departments and sectors).

Generic vs specific distinction could be seen from a different point: Is the produced and distributed knowledge the one needed of marginalized and weak socio-economic actors, i.e. underdeveloped, developing and countries in transition process what kind of knowledge they need.

3.3 Mechanisms of knowledge transfer

Knowledge transfer deals with the codification, the organization and the diffusion of knowledge. The transfer of knowledge can be from internal or external source to the system of analysis (firms, nations, geographical locations, technologies or sectors). This point will not be deepen, since in this section the attention will be primary on several tools and technics for knowledge exchange. On a micro level, transferability and knowledge sharing is possible with job rotation, task exchanges, etc. In order to transfer knowledge members are moved from one department or organization to another. However, also at a firm level this is not an easy task, because there is the issue of adaptability of the members. Hence for sectors analysis this is not the case, because changing work positions between sectors is very difficult and costly; and often there might miss incentives (Argote and Ingram, 2000). For example, an employee of a biotechnological institute will hardy move into agricultural cultivation. The only thing that is possible to a sectoral level is to enhance the communications, the meetings between different members, achievement of practical experience and engagement in mutual projects.

On of the main actor for knowledge creation in a given system, or the sectoral system of innovation in this case is the academia. On one hand codified scientific output like publications, scientific breakthrough and patent from universities are relevant input for industrial innovation, on the other, collaboration and contracted research seem to be much important form of transfer for implicit knowledge (Bekkers and Freitas, 2008). The authors in their research point six different channels of knowledge transfer between universities and industries:

- Scientific output and informal contacts
- Labour mobility
- Collaborative and contract research
- Contracts with professional organizations
- Specific organized activities
- Patents and licensing

What is more about the issue with universities knowledge transfer, in Sweden for example there is a relatively new rule for university professors: called “the third task”, performing beyond their tasks of teaching and making research; it consists in interacting with the surrounding society of

the university they work for – especially firms.

There are different researches showing that the relationships between universities and productions defer greatly among sectors. For example, in Germany the highest knowledge interaction is found in mechanical engineering and civil engineering, which however, are a lower science-intensity – measure by average level of scientific references per patent (Meyer-Krahmer and Schmoch, 1998).

Movement of students to companies is relevant mechanism for knowledge transfer. Here the flow of knowledge is actually bidirectional from academia to firms and vice versa. Internships and projects for companies could enrich both organizations: universities with knowledge about new tendency, technologies or vision; and companies with new theories, approaches, important academic knowledge, etc. A research by Balconi and Laboranti (2006) emphasizes that the most efficient knowledge transfer between universities and industries is in electronic and electrical fields. Besides, several authors find that firms, which invest extensively in R&D, are more prone to have absorptive capabilities and to learn and interact with universities.

It was pointed out that there is tacit knowledge, which is deeply embedded in its social actor. This is the knowledge, which is very difficult to be transferred. For instance, know-how could be taught and learnt in interaction between the master and the apprentice (Lundvall, 2003). What has to be mentioned here is that heterogeneous agents are connected, through market or non-market relationships in a network and the knowledge is transferred by means of collaboration, cooperation and long-term arrangement (Edquist).

Another important feature (as a function of the system) of a system of innovation is to understand what nurtures the system. For example, in a study of pharmaceutical and biotechnology sector, Malerba highlights that universities, venture capital and national health systems play a major role in the innovative process – that they are important elements in the creation of dynamism and development of the system. In the next chapter will be seen some dynamics that might occur to innovation systems.

V Boundaries and evolution of the sectoral system

The difference between system of innovation and and sectoral system of innovation could be said that are in the boundaries of the sector, i.e. to the specific uses of the established or new products the system carries (Malerba, 2002). As specified in the beginning, the boundaries of the analyze will be limited to crop plantations.

The evolutionary economy emphasizes that systems evolve through exogenous, endogenous or both changes. In sectors where innovation processes occur rather rapidly, then it can be assumed that the boundaries of that sector are dynamics.Hence, sectors are not static, but they change and may embrace other sectors. This can happen if the sector under analyze is big enough in order to demand goods and knowledge from other sectors. For example, this is what has happened with today' huge ICT sector determining on the semiconductor one. Moreover, the boundaries between the biotechnology and the agricultural sectors for example, seem to be smaller and smaller, because of their strong interconnection and interdependence. Thus it can be reasserted that the boundaries are dynamic concept and cannot be fixed, because they change over time.

According to Geels (2004), there are different drivers that enable changes in a given system:

- Changes in the landscape – climate changes, broad cultural changes in values, ideologies, political coalition.
- Internal technical problems – they can trigger actors to explore new directions. The problems could be not only technical. In agricultural sector for instance, it might occur infections and disease. And thus to make available on the market new product.
- Negative externalities of other systems or products may have effect on the sector under analyze (environment impact, health risk, etc.).
- Changing user preferences – because of negative externalities, cultural change, policy de-orientation and taxes.

The above mentioned drivers could be regrouped in two fields: external and internal changes.

1. Exogenous alteration

From the definition of sectoral system of innovation, is recalled that learning, behavior and capabilities are bounded by sectoral knowledge, technologies and institutions. This point is unlikable with the above said – sectors become more interconnected of others, in therms of knowledge, demand, workforce, resources and so more interdependent. Proceeding from the evolutionary perspective it should be said that most of the systems are not closed organizations and they evolve. More precisely, channels and instruments for exchange of information between sectors or between different actors, which stand outside the system, can enable that change. In that way the need for transfer of newness, information and knowledge open up the boundaries of a sector; after that this process has become substantial and continuous, in terms of time, the boundaries could be expected that will disappear. In addition, the entry of new actors or sectoral freshnesses into the system may also give a start for new sectoral trajectories.

The hint on actors, tries to suggest that players in a system could be active players. They will interact with other actors, outside the system, which are supposed to be different in their conditional understanding, learning, behavior and knowledge. Besides, the hypothesis that between actors of different sectors can be find more similarities, than from the same sector, should be considered for the case.

The above listed Geels' drivers, *changes in the landscape* and *negative externalities of other sectors,* can be included into exogenous causes for sector alteration. What has to be said here is that there is limited individual control, especially for the case of "changes in the landscape". In the second case, policy makers, governmental authorities and lobbies can intervene through pressure, regulations and taxes in order to reduce or increase the effects. What is more, from *changes in the landscape* is that political changes and coalition may have enormous effect of a given product or sector. For example, talking about boundaries expansion, the political and economic coalition between the states member of the European Union made a huge enlargement of the agricultural sector, which is no more national but is European agriculture; and it is managed through different european tools, policy and programmes. The expansion have created dynamism, generated by new threat and opportunities.

Going back to Malerba's explanation – that learning, behavior and capabilities are bounded by sectoral knowledge, technologies and institutions – the idea of the author could be that firms search mostly for similar technologies or knowledge and operate under similar institutional settings, but not do not search diversity or complementary. This, of course, depends of the managerial

orientation and perception about the economic surrounding. Beyond this, institutions, looked in the broad sense – culture, beliefs and expectations – call for differences in the actor behavior. For example, a farmer located a small and isolated village could seek efficient production or market for its products and therefore, react differently from the same working in a big agricultural company with its own R&D department.

2. Endogenous alteration

System are constructed by interdependent actors in a complex way. Thus it could be said that systems not only interact with the external surrounding, but they are also characterized by internal changes. To mention again Geel's driver, *changing user preferences* and *internal technical problems* are some of the causes for the occurred internal to the system dynamics. Users may change their opinion and orientation about a given product. For instance, these changes in preferences have happened regarding the nuclear power issue after the events of Seveso in 1976, Chernobyl in 1986 and Fukushima in 2011. The causes can be external to a given system, but the effect is that the internal preferences has changed. One example is the shifted orientation in Switzerland from industrialized agricultural product to organic farming after the disaster in Seveso and Chernobyl (Belz, 2004). Moreover, changes in preferences might occur afterward the user has learnt how to deal with a given technology. From an other side, every system may encounter internal difficulties or technical problems. Therefore, an opportunity is created and a top-down or a bottom-up decision has to be taken.

Formation of new agents — both new firms and non-firms organizations—is particularly important for the dynamics of sectoral systems. New actors and firms bring in the innovation and production processes a variety of approaches, specialization and knowledge, and contribute to the major changes in the population of agents and in the transformation of technologies (Malerba, 2002).

Hence, it could be said that internal changes, which are the outcome of the complex co-evolution of also internal to the system technology, knowledge, learning, demand and institutional set, are fundamental characteristic of any system. So, changes have their consequences, not only in a quantity terms, but they bring about the transformation, the evolution and the development of the system.

VI The innovation system concept looked from the South

In this project for countries of the South will be interpreted developing, underdeveloped and countries in transitional process, i.e. the countries, which economy has changed from centrally planned to market oriented. The UNSTATS (2010) distinguishes countries between Developed (North America, Europe, Japan, Australia and New Zealand), or called North and developing regions (the rest of the world) – the South or developing countries. The economy of countries from the South is similar, regarding: the export depends principally on agriculture and extractive industries; manufacturing is mainly concentrated on simple consumer goods for basic needs (the importance of demand side was exposed before), such as food and clothing; commerce of imported commodities.

However, they are also very heterogenous and they differ in therms of cultures, habits, geography, resources and power, but have in common the concept of development as material economic growth, which is of primary importance and it is above concerns about environmental problems.

Sustainability problems are not issue only about developing countries; developed countries, indeed, are responsible for the majority of environmental damages on a global scale. It is very unlikely that developing countries would wish to move toward sustainability if rich countries are not willing to move first (Goodland & Daly, 1996). Therefore, the challenge of sustainability for developed countries should be addressed to find a sustainable way to preserve their high levels of well-being whilst eliminating the environmental burden they created. While for less industrialized countries it is necessary to find a sustainable way for catching-up North countries without threatening their ecosystems.

1. Introduction

In this chapter the attention is on innovation, development and opportunities, which the countries from the South might have. Countries from the former communistic bloc have encountered different factors, which have hampered the economic development: deteriorated social

welfare system, corruption, decreased production and exportation, shift from production to commercialization of goods, the low competitiveness of national economies. The Washington Consensus did not provide efficient recipes and solutions to the occurred problem, it has just generated more questions without answers. After years of transactions, it seems that people are more unhappy and confused about the system of governance. After the failure of the central state, the free market model has failed as well. Beyond some successful short-term growth processes, there were created a lot of inequality, corruption and distribution of capital in pre-chosen people. The access to means of production have remained in political groups, and in practice the Schumpeter's entrepreneur rarely have occurred. Among people of Eastern Europe, there is a perception about the central state, taking care of everything. Low individual decision taking, corruption and poverty did not established the right entrepreneurial activities.

The modern economy has been called already a *knowledge-based economy*, i.e. where growth and development are mostly based on knowledge, technologies, science, advanced education and flow of information. The countries from the South have serious delay in this field. They are ineffective in producing, utilizing, spreading and application of knowledge – the basic input for todays economy. Lacking infrastructure, bad education and many other factors influence in a negative way the economic development of those countries.

2. The understanding of innovation system approach in the South

Applying the concept of innovation system has great reward for understanding the dynamics of the innovation process and the economic development at the same time. It is useful, because points on the relevance of different social actors; underlines not only economic factors, but also institutional, social and cultural in a holistic way. This is why for an efficient working of innovation system, not only economist are needed. Used in a knowledge-based economy framework the system of innovation approach highlights that there are specific interactions between the members of the system then others. Thus this approach has proved among evolutionary economist and policy maker from different countries to be better respect to statistical analyzes and orthodox political economy studies. Therefore, system of innovation is largely used as a tool by industrialized countries to understand concrete dynamics in the innovation process.

Developing countries also attempt to use this approach not for economic analyze, but more as an instrument for economic development. Indeed, Lundvall and Johnson (2000) argue that innovation system is the appropriate conceptualization as analytical tool and guide for policy making at the same time. However, countries from the South have highly specific economic and social characteristics. The differences in institutions, natural, intellectual, social and production capital suggest systemic and interdisciplinary analyze, pointing in those differences in order to understand and promote innovation process. Countries from the South will not be able to solve their problems, unless they do not develop their own innovation capabilities (Arocena & Sutz, 2005).

Arocena and Sutz state some observations about the system of innovation, which are important when the approach is looked from the *South*. The author's argument is about Nations System of Innovation, however the points raised are appropriately applicable also on sectoral innovation system and system of innovation as a whole.

- As mentioned before, national system of innovation (or system of innovation) is an ***ex-post*** concept from the North, emerged as a result of economic, social, institutional and cultural processes in a given level of analyze. On the other side, countries from the South see the system of innovation as an ***ex-ante*** tool for governance and enabling innovation.

- The *ex-ante* tool for system of innovation has its normative weight. After a practical employment, it could be thought of "best practice" or general application, risking to remove institutional differences and particularity of different economic situations. Moreover, Arocena and Sutz debate that when understanding system of innovation is kind of misleading to talk about "bad" and "good" practices. This is because the approach should seek for differences and adaption, or in other words to be as a passive represent of the environment than an active creator of it. Differences between actors, sectors, users and producers should not be removed toward the "perfect system of innovation", but conserved; channels of information and knowledge transfer between them must be established in order to enable exchange and dialog. Indeed the authors state: "*A National System of Innovation that takes into account user-producer knowledge asymmetries will probably be more effective in the promotion of useful innovations than one that does not pay attention to this type of problem*". After they continue: "*to avoid*

copying or just following the latest policy fashion, some points of reference must be identified, something like a normative guidance, that at least in part will be quite specific".

- Countries from the South, which try to applicate the system of innovation often seek to create institutions and organization, which could foster the innovation process. However, established in a top-down manner they are ineffective and rarely serve as a bridge between actors of the system. Moreover, in the South the "best" institutions are sought in order to replicate them in a local context. And so, similar institutions in different geographical area often have completely different performance, and the impotence of them is due to "imported practice" instead of independently created institutions and practice. Institutions develop in response to changing economic and social conditions.

- The system of innovation as a subject; as a tool for policy making. To mention again Edquist, not all of the factors, influencing the efficient performance of the innovation system can be found, analyzed and applied in practice. Therefore, countries from the South should be cautious to rely only of the "right" implementation of this approach. It should be context-specific.

- An advantage of system of innovation is that it treats problems as inherent part of any system. At the same time they can turn into opportunities if explored as possibilities. Problems could be internal or external to the system. Briefly, for example, the first could be sectoral institutions, entrepreneurial activities and education within the sector. The second could be negative externalities, political framework and technology development outside the sector of interest.

To expand a little bit more the upper mentioned concepts, it could be said that institutions are in a co-evolution process with technologies and the existing knowledge. This is an appropriate explanation, why technological knowledge is deeply rooted in specific institutions of societies, and its content and availability change across nations or regions, even if the the adopted factors have been the same (Altenburg, 2008).

However, the Schumpeter's *creative destruction* does not work in the same *efficient* way in the South. This is because in those countries entries and exists in the economy occur too often and

have more or less the same durability on the market. Market failure and short-term orientation of private companies are some of the causes for the non efficiency of this dynamic. So fostering entrepreneur activity is not always a good governmental practice. In addition, when the innovation process or the start-up of a company is driven by demand pull, i.e. the entrepreneur has a business ideas and knowledge then the economic success is more probable, then when she or he is driven by escaping of poverty or unemployment. The last often occur when there are missing social safety systems. This is typical when the entrepreneur seek for money and make self-engagement into a business activity with low entry and exit barriers that turns into over-supply, price competition, low specialization and reduced profits.

3. The application of the innovation system in the South

Arocena and Sutz points on the importance of interaction between actors and institutions. In a knowledge-based economy, the interconnection between science – technology – development has a central role. So central authorities could intervene to foster the innovation process.

However, the employment of the approach for countries from the South, should be always systemic and consider some peculiar factors, such as poverty, which limits the aim to invest in innovative capacities; low income – low productivity; corruption and access to knowledge. Governments in those countries could be characterized by short-term interest (re-election), instead of their central role: the improvement of the social welfare. Moreover, in implementing innovation strategies, the central government often underestimates private corporations, non-governmental organizations, public-private partnerships as process-facilitator or program implementers (Altenburg, 2008). The author also argues that developing countries have limited capacity to design, implement and monitor complex policies[4].

What has to be underlined is that innovation system study rarely addresses the problem of poverty and distribution effect of science and innovation. For an efficient innovation application, central governments from the South should target their policy toward the peculiar factors. This means, innovation oriented to reduce poverty; to increase work occupation; to stop pollution, excessive urbanization; to enable the flow of information, ideas, human rights, etc. Consequently,

4 An issue that call for Simon's notion about how to treat the complexity.

countries from the South should orient their policy toward innovation programs about the upper mentioned problems, instead of preparing strategies to develop sophisticated and advanced technologies.

Potential candidates are research for improving agricultural yields, water management and sanitation, or development of cures for diseases, infections among the most marginalized of the societies and increase of the social wellbeing. The challenge is not primarily to develop "new to the world" innovations, but the development and broad diffusion of affordable and adapted technologies (Altenburg, 2008). It could be summarized that the generation of high income is more a second step, and at this point is a job of policy makers from the North. This does not mean to exclude investments and research on advanced technologies in the South, but simply that they have to be addressed to the most vulnerable and marginalized member of the socio-economic system. In addition, investment in technology capabilities: technology adoption, adaptation and diffusion could play more efficient role than the establishment of R&D centers for cutting-edge innovation. Altenburg defines this orientation of the innovation system as "inclusive innovation system".

The author stresses that *prestigious national technology projects* have heavy socio-economical weight, especially for the public finance, and they do not serve the existent need of the system. One of the reason of these projects is that the distribution effects benefit the group on the top of the pyramid. What is more, is that sophisticated technologies have highly entry barriers – at all levels, from research, design, production to marketing and commercialization – and people from the borderline could not be benefited; and in the same time are the majority of them to pay these very expensive investments through tax-payment. The author's conclusion is that the challenge in front of policy maker is to build inclusive and poor-oriented innovation systems. Inclusive means that the innovation process has to benefit marginalized societies in terms of income and employment. Also in this way, it should be expected that the emerging and more efficient productive activities, replacing the old and less efficient ones have to be accessible to poor people and more precisely to be addressed where poor people work, live and educate.

VII Sustainability and innovation systems

What has been said up to now about system of innovation was mainly about internal and external dynamics, relationships with socio-economical actors and the most important economic asset – the knowledge. Innovation system rarely consider social elements like justice, equality, democracy, socio-cultural relationships; and to talk about system of innovation without reckon the social aspects in which the system exists is rather unthinkable.

Besides, there should be considered the increasing global demand for food and agricultural goods. It is due partly to the greater world population and consequently their demand and also to the increasing consumption of goods that people from the North have. Satisfying these needs is reflected in the process of extraction to production, to distribution, to consumption, to disposal. This linear method has produced massive pollutions of water and air, deforestation, soil erosion, lose of biodiversity, increased usage of bio-mass and agro-food for industries and increased concentration of carbon dioxide. It should be clear that from this perspective the economic system needs constant flow of materials, capital and supply of energy accompanied with significant amount of wastes. But, decreasing of waste is not a matter of recycling, which still demands consumption of energy. It is more a matter of diminishing the consumption, and consequently the production and demand of raw materials (Alier and Schneider, 2011).

From this point it could be hardly talked about positive externalities. Instead it has to be underlined that the cost are translated into marginalized people. Managers of companies often seek competitiveness by keeping low prices, obtainable through externalizing the cost to those people. And damages like human life, human rights and disabilities are never included into the economic prices (even if they could be). Moreover, policy makers and economist rarely consider that economic systems operates within a given limits, like the environment they are located in.

So far very little has been done, although the increasing number of NGOs working on the issue with sustainability. Even powerful organizations like UN has produced only slogans (Alier and Schneider). Today national debts are sought to be paid through more production, consumption or in other words: through economic growth, or inflation squeezing the debtors. And this is happening not only in the South, but also in developed countries. Pointing on economic growth is inefficient way considering the upper mentioned situation of the actual economic system and it can

be added that not all the debts will be paid. More production and more consumption are obtained through more natural resources, increased working hours, later retirement, overwork, more roads and airports, single use of products, unfair taxes, fiscal paradise, etc (Alier and Schneider).

In addition, it is largely believed that technologies will make the economy sustainable and the deteriorating environment could be stopped. However, the amount of technologies that are environmentally-friendly is limited. Often technologies increase the production and the consumption; beyond these, it is present more technical division of work, more exploitation, bringing productive and consumption capacities to their limits (Alier and Schneider). The Authors give an interesting example, point that in 1760 the extraction was little, because the process of extraction was expensive. With the technological development the cost has reduced and extraction has increased. The same example could be find in many other technologies, like electro-domestics, cars and computers which are becoming cheaper and more often changed for new ones, instead of repaired. Furthermore, this last is rarely possible, because of new standards, requirements, forms, etc.

At that point it must be emphasized the *rebound effect* of consumption, which imply that any gain in energy derived from the use of more efficient technology is usually canceled by an increase in consumption (Fournier, 2008). Even if we think of environmentally-friendly technologies like for example, more economic automobiles, or more efficient engines, which imply reduction of the price for traveling, people people will not reduce their expenditures for traveling, but will simply travel much more having the same cost. Similar example could be given with simple goods, food and services – by reducing their prices, people consume more in terms of quantity and consequently increase the waste.

Alier and Schneider argue that consumption could be limited, if there are no resources, not time for consumption or there is not an actual need for consumption. However, these do not seem to be sufficient to overcome problems with the deteriorating environment. What is needed is both changes in the mindset of people and policy for sustainable development, or to be more precise regarding the topic of this project – sustainable innovation system. The attention on reducing consumption is addressed especially for rich countries, where people have major possibilities for consumption.

The upper mentioned situation, points toward some of the characteristic of degrowth, which will be recalled later. First of all, what sustainable development is has to be viewed.

1.Sustainable development

The big economic growth after the second world war has provided wellbeing for millions of people and policy makers, scientists and citizens have put little attention if that growth is sustainable in long-term period. Sustainable development stays for a design of resource use, which have to meet the needs of the present without compromising the ability of future generation to meet their own needs (UN report). Sustainable development is not related only to economy, it includes also social and cultural aspects of human existence, which are fundamental to understand long-term development process.

Originally, in neo-classical theory in the concept of growth has been embedded the understanding that growth has no limits. Environment has been understood as external to humanity and mostly to be used and exploited and environmental problems have been seen mainly as local. Promising view was that knowledge and technologies will overcome natural and environmental problems (Hopwood, Mellor and O'Brien, 2005).

However, Georgescu-Roegan (1975) pointed that there are ecological limits to growth. The author spent most of his life trying to apply the principles of thermodynamics to economics, reaching the conclusion that economic activities have several limits that are, of course, due to entropic[5] dissipative nature of the economic process. According to the second law of thermodynamic, indeed, any productive activity implies an increment of entropy with a consequent irreversible degradation of increasing amounts of energy and, under certain conditions, also of matter. Since the biosphere is a closed system, one important conclusion follows for the economy, the basic objectives of the economic process – the unlimited growth of production and income - being based on the use of non-renewable energy and material resources, are in apparent contradiction; and it creates irreversible effects on it.

There are ecological economist who prefer to consider the development as evolutionary process with constant feedback between the economy and the natural environment (Costanza and Daly, 1987). Ideas such as irreversibility, non linearity and uncertainty are fundamental notions, which have to be communicated and understood by socio-economic actors.

In addition, the concept of sustainable development has become globally aware as a result of the increased consciousness about environmental issues; socio-economic problems with poverty,

5Entropy is a thermodynamic property, which is used to determine the energy available for useful work in a thermodynamic process. It is a measure of the disorder in thermodynamic process.

human rights, justice and inequality; recognition that environmental problems are not local, but global; and concerns about the future of humanity (Hopwood, Mellor and O'Brien, 2005). Also, to meet todays environmental problem, means to think about a “common future”, to afford the concept of wellbeing in a broader sense – and not only to economic growth and increased consumption, also by policy maker to consider for a more coherent relationship between economy and ecology.

Hopwood, Mellor and O'Brien stress that society and economy, independently if they are in industrialized or rural surrounding will always need the environment, since it is fundamental factor for human existence – it may menace people health, livelihood and peace. Some of the challenge ahead is to overcome the idea that humans dominate the nature and that the environmental problems are not local, consequently actions and impacts have to be considered globally for avoiding displacing problems from one place to another and moving pollution across boundaries.

In this way of thinking, innovation system – national, regional or sectoral – should be an sustainable systems; and innovation at whole should be an eco-innovation oriented. The redirection of the innovation system towards sustainability requires not only a great effort in terms of environmental innovations, but also more radical changes in the technology regime of many different sectors (C. Freeman & Soete, 1997). Thus a coherent understanding of innovation calls for research of routines, organization settings, markets and institutions that characterized the subjects involved in the process. The knowledge that underlies the innovation phenomena depends on a multitude of factors such as culture and institutions among many others. Considering sustainability and inclusive innovation systems, there rises the question about the outcome of such a system: what kind of knowledge then a sustainable system of innovation needs?

Logically, the response could be that sustainable knowledge is needed, i.e. knowledge that advantages also marginalized individuals, does not deteriorate the environment, the justice, people rights' and in the same it should ensure a decent human life, out of poverty and social conflicts.

2. The degrowth

It seems that combining development with sustainability is very difficult task. One of the main problem remain that often development is based on the principle of endless growth, aided by increasing consumption and production, and consequently degradation of the environment (Fournier, 2008). As a response to growth problems, in France was born a relatively new movement,

called *décroissance – degrowth*. It might seem very radical, and in this project will be presented only briefly. Regarding the vision of *degrowth*, it criticizes indicators such as GDP for a correct measure of wellbeing, because it ignores *goods* as: justice, equality, democracy, human and ecosystems health, quality of life and social relations. For example, increasing diseases, accidents, obesities, ecological disasters and wars contribute to economic growth through the consumption of insurance, medical products, weapons and services (Scott-Cato, 2006). Thus seems illogical to consider always growth as a tool for increasing the wellbeing of people.

According to Schneider, the degrowth vision call for:

- frugal innovation – based on less consumption and acceptance of the natural limits
- less private cars and more public transport and bicycles
- common goods – where more sharing could be possible and not empty houses
- more non profit companies
- less travel and taxation of excessive advertisement and consumption
- democracy – where institutions should be the product of citizens (bottom-up)[6]
- less goods and more social relations[7]
- despise fashion and manufacture of durable and repairable goods
- reduction of the working hours and acceptance of cultural diversity
- adjustment of capacity to produce and consume
- organic and local food – this is dependent of the level of consumption and the population, i.e. the consumption of food has to be reduced to a level that could be satisfied only by organic agriculture. According to Georgescu-Roegen mankind should gradually lower its population (Georgescu-Roegen, 1975).

It can be noted that the upper mention issues imply first of all cultural understanding and change of the personal mindset. The degrowth vision is applicable rather in industrialized countries, where overconsumption is a real phenomenon, but in developing countries[8] where poverty and malnutrition are still present would be ridiculous.

6 For example, in China the "*Law of Circular Economy*" involves local communities in the decision making process.

7 Georgescu-Roegen recognizes that economic process, like any other life process is irreversible and irrevocable. Also he highlights that the real output of economic process (or of any life process) is not the **material flow** of waste, but the still mysterious **immaterial flux** of the employment of life.

8 Overconsumption is not a problem only in the developed countries. In the South could also occur.

At this moment, policy implication could consider an alliance between the environmental justice in developing countries and the small degrowth movement in industrialized countries (Alier and Schneider, 2011).

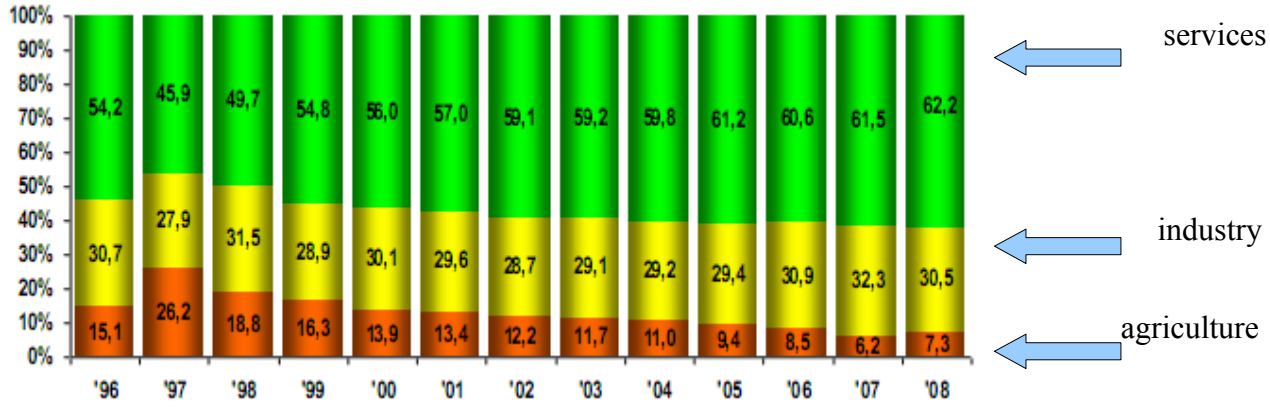
VIII Study case: the Bulgarian agricultural innovation system

1. Introduction and basic economic indicators

Traditionally the agriculture was the most important sectors of the Bulgarian economy. Despite all the problems and contradictions in its development after 1990, the sector remains one of major pillars of the Bulgarian socio-economic life. The positive economic growth in in other sectors in the last years has reduced the relative weight of agriculture in terms of created GVA (Gross Value Added) and employment, which for 2010 accounted for around 20% of the total employment and for 64% of the self-employed people. The level of the employed people in the sector has been decreasing from 2001, where it was 25,8% and 24,6 in 2005.

Figure 1 shows the gross value added in the period from 1996 to 2008. However, according to the Scientific Consultancy Committee on Agriculture (SCCA), the sector will remain of crucial importance for the future and largely will determine the overall economic and social conditions of the country.

Figure 1: Gross Value Added in percentage 1996 – 2008



Source: National Statistical Institute, 2008

In 2008, the agricultural sector formed around 7.3% of the Gross Value Added (GVA). In addition, the sector marked 24.6% increase respect to 2007 (in service and industry there were increases of 5.9% and 3% respectively). Within the agricultural sector, in 2008 the services contributed for 6.8%, the products of livestock for 30.7% and 54.8% were of plantations.

2. New perspectives after the entree to EU

With the admission to the EU in 2007, Bulgarian farmers have happened upon in a radically new situation. It has identified new challenges for the sector and if before 2007 the sector was rather closed and the main factors determinating the development of the agriculture were internal, after the opening in that period there was a shift to external factors, such as european regulations, market opportunities and different programmes from CAP (common agricultural policy).

It could be summarized that there are three main elements influencing on the development of the Bulgarian agriculture:

- the condition of the sector, occurred processes and its internal changes
- tendencies in the national, european and global agricultural development
- problems related to employment of new technologies and mechanisms for control and governance of the sector (for example CAP opportunities)

What is more, SCCA suggest that now private actors, as drivers for internal dynamics, have to be more active economic players, because the central government cannot resolve all of the difficulties in the agricultural sector. This is reinforced with the application of CAP, which imply that the role of the State has to be diminished and the function of the market forces extended.

However, with this shift there have to be clearly defined the responsibilities of the State. Its role has been aimed to:

- to enhance relationships between economic actors;
- to perform regularly control of the quality over the products and the production process of the agricultural sector;
- to assist agricultural producers to achieve better quality for their products through: provision of education and consultancy; development of the necessary research and development; creation of a befitting business environment for innovation; sharing the risk with the agricultural producers
- to decrease the administrative burden and the bureaucracy for those firms
- to identify the “bottlenecks” and the weak point of the agricultural sector, which are exposed to risk with the changing surrounding

Another thing that has to mentioned is that with the entrance to the EU, the boundaries of the sector have been expanded and the national agriculture has the possibility to serve a bigger market – the European one, but in the same time local farmers were threaten by foreign competitors, which have offered on the local marker lower prices and better quality. These are because of the economy of scale of big agricultural producers and their efficiency in the production process helped by advanced technologies. Here could be recalled the notion of Geels for exogenous factors influencing changes in a given system to occur, i.e. *changes in the landscape.* Thus it has created dynamics to which Bulgarian agricultural producers have to reply – to take advantage of new possibilities and to protect their products menaced by the new competition. After that changes have occurred, in this case the attention turns into one of the main function of the system (of the *functional pattern)* – activeness of entrepreneurs, which according to Schumpeter are the accelerator for economic changes and are also highly creative, which imagine new solutions and look always for opportunities.

Going back to CAP it should be mentioned that in '50 when it was established, the focus was to guarantee an effective and strong agricultural sector. Farmers were fostered with substantial financial aids, but also managerial skills and technological improvements have been considered. Hence it is clear how come that the old European members have an advanced and competitive agricultural sector. These were also the expectations of Bulgarian farmers. But the reforms of '90s have brought a total privatization, demolition of the old productive structures and no support for farmers. Therefore, before the entrance to the EU, Bulgaria had one of the most underdeveloped and poor agricultural sectors among EU members (Agricultural Academy).

Nowadays, the focus of CAP is slightly different and it is toward regional development policy; environment and biodiversity problems; production of safety and healthy food. It points also to keep the current level of agricultural production and not its increase. These targets are not beneficial for Bulgarian farmers, because this mean to keep the actual low level of production; while Bulgarian farmers need the opposite - increase and intensification of the productivity (SCCA). With the modifications in CAP, the European Union intents to reduce the intensification of agricultural production, while Bulgarian farmers necessitate the opposite.

It could be concluded that the application of the new norms of CAP do not match the need of the Bulgarian agricultural sector, and they actually could destroy many agricultural producers. The issue is because the sector has serious structural problems, which first have to be resolved to bring about the gain in the effectiveness, improvement of the agriculture production and recovery of

traditional sectors. CAP cannot overcome local agricultural problems, so it is up to the government, together with privates to establish clear policy for sustain agricultural producers.

3. Analyze of the productive resources in the Bulgarian agricultural sector

According to the Ministry of Agriculture and Food (MAF), in 2009 there have been registered increments of the investments in the sector, which is prerequisite for expected positive trends, but as proportion of the total investments they actually decline.

Despite increased investments activities in the agricultural sector, the technological level of production remain low. This affects workforce productivity, which is currently about three times lower than the same of other sectors of the economy. This is also the reason for the low incomes in agriculture, which is about 40% below the national average level. Compared with the average workforce productivity in the agricultural sector among the EU members, the Bulgarian level is one of the lowest. Low productivity in the Bulgarian agricultural sector is the result of the low degree of mechanization, poor quality of the seed and breeding practices, outdated building park, amortized technologies and inefficient cultivation techniques, post harvest storage, etc. These are also responsible for the low quality of the final products.

In 2006 the National Statistical Institute reported that from the all 2.729.690 hectares of used agricultural area, only 111.599 hectares (4.1%) are built with irrigation systems, which consist mainly of old canal where water consumption is high and the achieved result are very low. In addition, much of the technologies and the machineries, used in the agricultural sector are morally and physically outdated and are fully depreciated. The expenditures for maintenance are extremely high. Only about 8% of the machineries on the sector are under the age of 5 years.

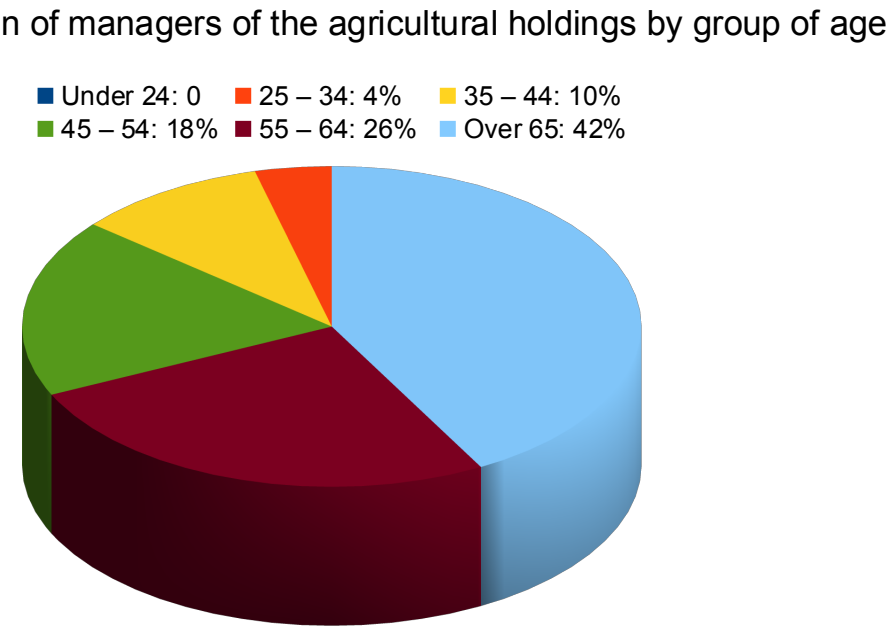
Another determinant for the competitiveness of farms is the energy-supply of the agricultural equipment and its effective usage. This indicator has been used for comparing opportunities, the condition of the sector and the investment policy in Bulgarian agriculture. For example, in majority of OECD countries the energy-supply of the machineries is around 250-460 hp per 100 ha of arable land, while in Bulgaria it is around 100 hp per 100 ha of arable land. Therefore, in order to achieve the high level of productivity like in industrialized countries, significant investments to introduce new technologies are needed.

According to the report of SCCA, most of the agricultural labour force is employed in small farms. 75% of the agricultural workforce are engaged in farms with less than 1 ha of land and 93% in farms with less than 5 ha of land. This determines also the high share of family workforce employed in the agriculture.

In addition, an important issue in the Bulgarian agriculture is the aging workforce. While in 2005, the people employed in the sector, which were under 35 accounted for 9.4% of the total employed in the agricultural sector, in 2008 they decreased to 7.9%. In the same period the proportion of the number of persons over 55 years passed from 56% to 58.7%. The age structure is essential, because the majority of elderly farmers do not have vocational or even high-school education, while the majority of young farmers have high-school and university degrees.

The characteristics of the Bulgarian agricultural production, the relatively low incomes and the adverse working and living conditions in rural areas do not encourage young people to engage in agricultural activities. In the distribution of managerial positions, in 2008 only 4% of the managers are under 35 years and 68% are above 55 years – see figure 1.

Figure 1: Distribution of managerial positions by different ages, 2006



Source: National Statistical Institute, 2006

Above it was mentioned that the majority of the agricultural producers do not have vocational qualification or high education. Therefore, it could be said that is necessary assistance

for the entry of young and educated people into the agriculture to ensure dynamism and to foster increasing productivity in it (SCCA).

According to an investigation of the Agricultural Academy (AA), the biggest proportion of the interviewed farmers (33.9%) gain better qualification through consultancy practices with scientific staff. In second place with 28.3% of the examined farmers have indicated that they improve their qualifications through self-directed teaching. Also, it has been registered significant decrease in the interest for long-term education. From the inquiry AA concludes that it is the most important institution about diffusion and employment of new knowledge (national or from abroad) in the Bulgarian agricultural sector. Regardless of the access to the generated knowledge by AA, the institute points out that the number of farmers, which use internet for this purpose is still insignificant, while the brochures are the most used for access of AA's knowledge, followed by handbooks.

The analyze of the Bulgarian agricultural sector would be incomplete if the existing structures in the country are not analyzed and the system approach not used. To enable an efficient production, the productive resource should be combined in specific organizational forms and structural problems considered. Of the characteristic of these resources depends not only their application in practice, but also the perspective of the agricultural sector.

4. Structural problems of the Bulgarian agricultural sector

1. The privatization is blamed to be the main responsible for the big land fragmentation. It has created dualistic structure. The privatization has distributed the land in a way that today in Bulgaria there are too many farmers with too little land. This trend continues and today, due to the process of separation of the land to the owners and successors. Even in Dobrudja, a region with the most developed production the average size of property decreases. Therefore, in Bulgaria smallholders dominate the agricultural sector. In 2007 the agricultural producers were 493 thousands, of which 376.000 had less than 1 ha of land, or in other words around 70% of the farmers in Bulgaria keep 5% of the arable land. The remaining 117 thousands are subdivided as:

- 93 thousands for those with less than 5 ha of land;
- 13 thousands with land between 5 and 20ha;
- 3,5 thousands have land between 20 and 50ha;
- two thousands are those with land between 50 and 100ha;
- 4,2 have more than 100ha.

The data can be seen on the table 1.

Table 1: Number of agricultural holding in EU, 2007

Size (UAA)	Total	<5 ha	5-<20 ha	20-<50 ha	50-<100 ha	>=100 ha	Average
			in 1000				ha/hold
EU-27	7310.8	3 523.3	2 314.0	786.3	387.5	299.6	22.0
BE	46.2	10.4	13.7	13.3	6.8	2.0	29.7
BG	117.8	93.6	14.5	3.5	2.0	4.2	24.3
CZ	25.9	8.0	7.0	4.4	2.3	4.3	134.6
DK	44.4	1.7	17.0	10.5	7.1	8.2	60.0
DE	348.5	63.4	117.8	81.9	53.4	32.0	48.4
EE	12.8	1.9	5.6	2.7	1.0	1.6	66.5
IE	117.9	4.8	41.3	49.3	18.0	4.5	34.1
EL	711.1	506.5	167.3	30.2	5.9	1.3	5.6
ES	939.5	462.1	269.6	109.7	49.2	48.8	25.4
FR	491.1	99.5	95.6	99.0	106.6	90.4	55.7
IT	1 383.3	939.6	320.6	83.2	27.0	13.0	9.0
CY	28.1	22.8	4.1	0.8	0.2	0.1	4.9
LV	44.4	5.6	24.6	9.2	2.8	2.2	32.2
LT	85.3	19.3	46.5	12.6	3.9	3.0	25.0
LU	2.2	0.4	0.4	0.4	0.7	0.4	58.4
HU	140.8	76.6	39.9	12.3	5.7	6.5	28.8
MT	7.6	7.3	0.3	0.0	-	-	1.2
NL	76.7	21.5	23.1	21.0	9.2	2.0	24.9
AT	130.9	30.7	59.5	31.8	7.1	1.8	19.7
PL	1 128.1	391.3	612.1	101.2	15.8	7.8	12.3
PT	181.6	109.9	50.0	12.0	4.4	5.4	18.3
RO	866.7	566.5	271.5	14.9	4.5	9.4	11.0
SI	61.5	31.6	26.7	2.8	0.3	0.1	7.5
SK	15.8	7.8	3.9	1.3	0.7	2.2	119.2
FI	66.6	5.4	22.9	24.2	10.9	3.2	34.3
SE	57.5	5.1	19.1	15.4	10.0	7.9	51.9
UK	178.5	30.4	39.6	38.8	32.1	37.6	80.3
NO	49.8	6.1	24.1	16.6	2.7	0.4	20.7

Source: Eurostat

2. The land fragmentation has affected the production structure. Now the national agricultural production is characterized by strong dualistic structure – a huge number of small, semi-subsistence farming and small in number, but large production units. According to the last agricultural censure 77% of the farms in Bulgaria are with 1 hectare of land and they work just 7% of the country's land. Vice versa, 3000 production units, or 0,4% of the farmings of Bulgaria handle 76% of the arable land. Large production structures achieve high agricultural output and are mainly occupied in grain and oilseeds crops. These plantations are preferred, because of the stable

demand, increasing prices and their relatively easy conservation.

Big land fragmentation and the relatively small pieces of arable land hinder the development of modern and efficient agriculture, while at the same time create a significant barrier for long-term investments in the sector.

Moreover, big amount of farmers with little land or small quantity of livestock do not permit the accumulation of capital, the application of technology and the development of knowledge, which are fundamental factors for an intensive production process. For example, in the crop industry for farmers that have arable land only over 100 hectares make sense to have advanced machinery and technologies, if not the cost are not covered[9]. This means that are mostly big agricultural companies to utilize new technologies in order to enhance more efficient production and to achieve economy of scales. Similar is the issue with the advanced knowledge, which is used mainly by big agricultural corporations.

On the other side, the dominant productive structures (small farmers) do not have resources and possibilities to engage in research activities with the public research institutes.

3. An uneven development of the different agricultural branches – with a good level of yield is the grain, the oilseed and tobacco production. However in sectors where the country traditionally had a market advantage – vineyards, fruits, vegetables and the sheep industry – a significant deterioration in the last years regarding their production has been registered. In addition, the uneven development of singular agricultural segments not only constraints the correct crop-rotation and made increase the soil erosion, but it impedes farmers to overcome problems about unfavorable natural and climate conditions and to interact effectively with each other.

4. Notwithstanding the positive balance in foreign trade of agricultural and food products is due to few basic goods like grain and oilseeds. For other product, where the country was traditionally strong producer (fruit and vegetables), in the last years it has been reinforcing a negative balance to prevail on the foreign trade regarding those products. Also, it is worsening the percent of the agricultural trade to the total

9 This information is from a previous research, made for a Danish company, producing machinery for the crop spraying and interested in market expansion in Eastern Europe.

foreign trade, thus the dependence from abroad is increased and the macroeconomic indicators are deteriorated.

5. Scarce investments in agriculture in absolute and relative therms. In the last 4 – 5 years the share of loans for the sector is between 1,5 – 2% of the total loans for Bulgarian economy. This is quite insufficient and inadequate and raises questions about the future of the sector.

6. Not operable and underdeveloped market structures and mechanisms. Many of the traditionally important cultivation such as fruits and vegetables, wines and livestock are hampered just because of these missing market structures, where producers can place their goods. The existing markets and market institutions are strongly dominated by significant number of traders, resellers and dealers, which hinder the development of normal and direct market relations for agricultural producers.

5. The science and the knowledge in the Bulgarian agricultural sector.

So far, the attention has been on analyzing some basic determinants of the agricultural sector. As how was mentioned before the central point of interest regarding the innovations processes happening in a given system would be the relationships between different actor in that system and the creation, diffusion and utilization of one of the most important resources in the modern knowledge-based economy: the knowledge. The National Statistical Institute and other major centers for analyzes in Bulgaria rarely present information and rarely make investigations about the stock and the development of the knowledge.

Regarding creation and development of knowledge, The Ministry of Agriculture and Food reported data about the education and the consultancy in the country, which tries to serve the popularization and incorporation of important knowledge for agricultural producers. For the creation of knowledge, public institutes have been involved mostly in general analysis of the soil, different plants and animal products – in 2008 there were made 32 thousands analysis. The most used way of knowledge distribution are brochures, newsletters and flyers (for 2008 there were performed around 42 thousands of these activities), and few are the lectures and vocational courses

for farmers. Scarce are the activities of public institutes explaining the knowledge/technologies utilization.

In the repost of the Scientific Consultancy Committee on Agriculture there are missing investigations about the development and the utilization of the knowledge in the agricultural sector. The only thing that the SCCA suggest as part of the recommendation for future policy is:

> *"The agricultural science must become a real factor in the whole process of production management in the agriculture and the processing industries. This cannot be done without the central governmental orders in developing research projects and programs in accordance with the need of agriculture and the processing industry. Only in this way can be used the full potential of universities, research institutes of Agricultural Academy and the Bulgarian Academy of Sciences, agricultural schools, the National Consultancy for Advices in Agriculture, to assist farmers and especially sub-subsistence farms with potential for growth by creating scientific parks and clusters in order to enhance public – private partnership, to attract investments and implementation of technology transfer."*

However, beforehand it has to be analyzed if this scientific output is needed and if the outcome of scientific parks, where often the knowledge is very advanced is something that agricultural firms actually require. Other things that need more attention, considering the issue that countries from the South have are: poverty, justice, inequality, etc. and of course the knowledge distribution.

The data collected through secondary sources are not enough to understand the dynamics about the main function of innovation system: the development, the diffusion and utilization of knowledge. Therefore, primary data – collected directly from first hand experience – are needed to make this analyze.

6. The Agro bio-institute – a centre of excellence in plant biotechnology

The first interview was made with the Agro Bio-institute (ABI) as research center, which today is part of the Agricultural Academy (AA). The reason why it was chosen is because in this

project are sought more details about the process of knowledge creation, distribution and application; and the secondary data does not permit to go in detail.

The main research activities of ABI are toward:

- Biotic stress in plants
- Abiotic stress – mechanisms of tolerance and model plant studies
- Plant genetic resources
- Genomics of agriculture plants
- Plants and metabolites
- Biodiversity
- Gene cloning and expression
- DNA marker system
- Bioinformatics

In addition the research center is occupied with supporting activities and services, which are the following:

- Production of pre-basic planting material
- Analysis of plant health status
- Feed and food quality evaluation
- Information system for dairy cattle
- DNA marker system – genetic authenticity and seed homogeneity
- DNA sequencing and fragment analysis
- Analysis of metabolites

The Agro bio-institute (ABI) has been established in 2000, according to the Regulations for the National Centre of Agricultural Sciences (NCAS) to the Ministry of Agriculture and Food (MAF), Bulgaria. ABI is a successor of the Central Laboratory of Molecular Genetics and Genetic Biotechnology (genetic engineering) – founded in 1985 to the Agricultural Academy (t) renamed as Central Laboratory of Genetic Engineering (CLGE), developed further into Institute of Genetic Engineering (IGE).

The research of ABI is chaired by Scientific Council (SC). ABI is the only institute in the country, whose activities have been evaluated and directed since 1988 by the International Consultative Council (ICC) – leading foreign and national scientists in plant biotech area are ICC members. Since 1995 ABI represents Bulgaria at the International Centre of Genetic Engineering and Biotechnology in Trieste, Italy . From 1995 to 1997 ABI has been included in Norman Borlaug Institute for Plant Research at the De Montfort University, Leicester, UK together with institutes and universities from UK, Czech Republic and China. In 1999 the Institute has been selected as a Centre of Excellence in plant biotechnology in the frames of INCO 2, FP5 EC Programme, and is responsible for the co-ordination of scientific investigations and training in the field of plant biotech on the national and regional level. Since 2000, ABI is a member of European Plant Science Organization (EPSO), and since 2002 – a member of European Federation of Biotechnology (EFB) and sub-regional centre for Eastern Europe in the field of regulations and a control of GeneticallyModified Organisms (GMO).

In 2001 ABI and Sofia University "St. Kl. Ohridski", Faculty of Biology registered joint company – AgroBioTech Park Ltd. Since 2004 ABI became a founder of Black Sea Biotechnology Association (BSBA). In 2007 ABI took up the initiative to establish Joint Genome Center (JGC) – joint infrastructure project between Sofia University "St. Kl. Ohridski" and Agricultural Academy.

The main purpose of ABI is to conduct fundamental investigations in the area of cellular, functional and molecular genetics aiming to solve practical problems. Methods and technologies for clonal micropropagation *in vitro*, systems for *in vitro,* regeneration of somatic and reproductive cells, *in vitro* selection of resistant plant forms, production of biologically active compounds in plant tissue and cell cultures, the application of ELISA technique and specific antibodies for plant viruses taxonomy, cellular and biochemical markers during *in vitro* cultivation, DNA based marker systems for diagnostic purposes, variety testing and identification, methods and techniques for gene transfer etc. are routinely applied.

The main achievements of ABI are:

- development of new forms possessing economically important traits (resistance/tolerance to diseases and herbicides);
- improved food and feed quality;
- CMS donors;

- development of technologies for *in vitro* cultivation of medical plants;
- preservation of plant genetic resource is one of the main research and practical area;
- development, improvement and application of GMO instruments and bio-safety;
- risk assessment and public perception

The main research units of ABI are working groups, which currently work on: plant genetic resources, abiotic stress, biotic stress, functional genetics – legumes, functional genetics – cereals, molecular genetics, bioinformatics and biotechnological information centre.

In addition, ABI ensures the success of scientific investigations based on project principles – from the budget, as a legal entity in the frame of AA, second disposer of funds trough MAF, and AA respectively; competitive projects – National Fund "Scientific Investigations" (NF "SI"), Ministry of Education and Science (MES); European Commission' Framework Programs (FP 5, FP 6 and FP 7) and others international organizations (ICGEB, MAAE, NATO, COST, etc.); bilateral projects; contracts with national and international companies, private persons, donations etc.

ABI has equipped laboratory and field facilities, as well as trained permanent personnel: the total of 50 persons, including 24 researchers, of which 1 full member of Bulgarian Academy of Science, 1 Professor, Dr. Sci, 13 Senior scientists, PhD, and 9 Research fellows, PhD.

Education in plant biotech is one of the main missions of ABI. From 2001 and now the institute is accredited for PhD training on Genetics and Plant protection. Since 1985, 104 PhD thesis have been elaborated, 77 of them successfully defended. At present 9 PhD students are extra-staff in ABI. According to agreements between ABI and higher schools, joint MSC programs are realized and scientists from ABI are lecturers in student' education. Since 1985 ABI organized 75 international scientific events. Fundamental and applied results have been published in scientific publications, books, brochures, etc.

6.1 What is the knowledge orientation of the Agro Bio-institute?

The first question of the interview was focused on understanding the orientation of the Agro Bio-Institute and more precisely, to understand if the research made within ABI is coherent with the

national strategy for agricultural development, or with the need of private companies (demand oriented).

The interviewed underlined that first of all ABI is occupied with the application of biotechnology in the agriculture. Their product is mainly fundamental science, or basic knowledge (basic research in OECD terminology), which does not have direct application and immediate commercial benefits; however it is necessary for future research. In Bulgaria there are not private research institutes making basic fundamental science for agriculture.

The path which ABI follows could be divided in two parts:

- *International orientation.*

  Globally the field where the Agro Bio-institute is occupied could be defined as an object of primary strategical point. Nowadays, the application of science in agriculture has reached a point where the production of the sector, despite the advanced technologies incorporated in the production process, hardly can follow the constantly increasing demand for agricultural products. To consider also is the fact that the production cannot be incremented by large increasing of the yield. The gap between demand and supply is due to increment of the global population and also the well-being, which means that people demand more quantity and more quality in the same time. Moreover, this discrepancy between the potential and the actual demand from one side and the supply of the agriculture of the other is additionally assisted by the growing usage of bio-mass into other industries.

  The above described situation suggests that today there are new opportunities for the agriculture, which could be achieved only through some revolution, like the biotechnology. However, its large application is related with many apprehensions and therefore it is not unanimously accepted, especially in Europe where people are very concerned of biotechnology and GMO.

  So to summarize it could be said that globally ABI is not engages with some specific strategy, but rather is oriented toward present-day agricultural threats and opportunities and also it follows the trends for a biotechnological *revolution*.

- *National orientation*.

  In Bulgaria there is a missing perception about the national agricultural strategy. There are

no clear ideas of which are the needs of private companies. The reason, according the the interviewed is because the whole scientific field in Bulgaria has not been reformed from *the period of the changes – 1989,* which means a total domination of the central State. Companies, academia, research institutes and privates were governed by the Sate; they had to follow the central decisions and to perform national commands. This commitment has destructed private sector and also the entrepreneurship. This is a big issue, because today, when the private sector prevails over the public, the first does not have clear criteria about the needed knowledge at first place; and secondly there are no real governmental incentives to do so, such as tax reliefs for those investing in knowledge development. Beyond this, well developed agricultural companies and big farmers can relatively easy find the necessary knowledge and innovation from abroad.
Therefore, it can be said that often the interest for innovation is nurtured from external to the national institutions for knowledge creation.

However, despite the major importance of foreign centers for knowledge creation and diffusion, the Agro bio-institute continues to be engaged with important research about the knowledge. This happens because every country has its own particularity, which often is underestimated when the transfer of knowledge took place. The Bulgarian agriculture is different from the one in Denmark or in USA, for instance, and the knowledge or the innovations there difficulty can be applied directly in the country, because of the specificity of conditions which always have to be considered. In this area, the Agro bio-institute is occupied with examination and possible adaptations of the knowledge produced abroad.

6.2 The access and the distribution of knowledge in the agricultural sector

The very point of the second question is to understand the factors, which determinate the distribution of the generated knowledge.

The interviewed pointed out that before answering, it has to be consider the productive structure of the Bulgarian agricultural, which has been influenced negatively after 1989 by the huge land fragmentation. According to informal data, in 2010 around 90% of the arable land is worked by 5% of the total amount of farmers in Bulgaria. These five percent are the main agricultural

producers and also they are the most important in terms of satisfying the internal demand for agricultural goods.

The problem is that there are too many small farmings, which actually do not contribute seriously for the GDP in the agriculture. Therefore, it will be rather misleading to talk about Bulgarian agriculture as a whole. Instead, in order to analyze internal to the sector dynamics and processes it will be more opportune to divide it to small and big private companies.

In addition, there is a third group of private agriculture producers, which are not officially registered as farmers. These are self-sufficient farmers, which produce only for their own needs and rarely reach the market: and if so, it is mostly illegal.

For the group of small and self-sufficient farmers hardly could be said that some innovation arrives to them. The kind of relationships they have with other farmers or other socio-economic actors are based mainly on simple exchange of goods, deals with seeds, easy techniques and basic *know-what,* which can be called informations. These are practices that do nor require scientific research to occurs. Considering also the big amount of those agricultural productive structures it should be clear why is the low activity of national research centers for agriculture.

Knowledge and science are assets that are for the *other group* – the group of big agricultural producers. They demand and they have what to offer or to suggest where the science should go. Moreover, those producers have the potential for further knowledge development and are important actors for constructive feedback to knowledge creation organizations. But unfortunately for Bulgarian institutes, engaged in research activities majority of big agricultural producers access knowledge from outside the national institutes. This practice is possible, because there are not problems with the access of foreign knowledge.

Hence it can be inferred that the relationship between national research centers and institutes, such as ABI and big agricultural producers is scarce.

Regarding the issue of knowledge and information availability, which can be reached by large number of farmers, it could be said that there are not particular problems with it accessibility. The easily accessed knowledge is rather basic and could be reported also as information. It consists mainly for improvements and efficiency for the production process, like primary norms about cultivation and advices. However, this kind of knowledge rarely leads to important innovations among small farmers.

The information is easily accessed, even from specific newspapers and agricultural magazines farmers can inform themselves. Consultancy for agriculture are also present and besides *know-what* they provide information regarding *how* to cultivate crops, *how* to seed, *how* to spray, *how* to feed animals, etc. This accessibility is relatively cheap or sometimes it is for free, because there have been used several European Union's programmes that seek to assist farmers with fundamental knowledge in order to meliorate agricultural production. However, the above mentioned *how* is not the one reported in the theoretical framework, where it is about individual competences, skills and practical ability.

Thanks to its geographical position and favorable climate, Bulgaria traditionally has had important agricultural sector. This has created important economic actors in the field of seeds selection and chemicals. These companies have tried to be in constant contact with farmers, in order to understand their needs. Also they have established mechanisms of feedback with agricultural producers. But nowadays whit the presence of big multinational companies and the easy accessibility of information, national private companies and research centers are exposed to risk of survival, because they have faced huge competition, especially in financial resource. If Bulgarian farmers looking for innovation and advanced knowledge were in bigger number, it could be expected that during the years, the relationships between them and research centers or the academia or other companies within the sector would have created stronger dependence and a right guidance of research for the last ones. Moreover, medium and big agricultural producers often have a strategic vision regarding their activities and what they might need. If this is shared with the institutes engaged in knowledge production, then between the scientific field and the economical actors of the sector more coherent links would have taken place; and also the science will be closer to privates and their request for knowledge and innovation.

6.3 The access to ABI's knowledge

The previous question has emphasized accessibility of knowledge and information in more general terms, like the one present on the market and the one offered by the government through advisory committee. In this part are sought more in details links for knowledge access, i.e. to the concrete access of knowledge from the Agro bio-institute.

Firstly, it has to be recalled the field where the institute operates. It regards basic research, which does not have immediate application and commercial benefits. The product of ABI has to be finished such as final good. At the moment, the artifacts in GMO of the Agro bio-institute do not have effective employment in the production process in the Bulgarian agriculture. To achieve a final product in the field is rather a complex and very expensive procedure and only very big companies can do it. The regulation of the European Union is heavy and disadvantageous for these products; also it punctuates that in order to have final GMO product on the marker, this product has to be equipped with specific dossier, which cost is around 20 millions of Euro. It should be clear that this can never happen with Bulgarian farming structures, which have 1, 5 or 50 hectares of land (small farms).

Therefore, it can be inferred that in the field of fundamental science, which is the main activity of the institute, there is scarce demand at the moment and the relationships with the private sector are not intensive

Secondly, beyond researches which do not have direct employment, the ABI produces knowledge which has practical orientation. Here the demand and consequently the relationships with privates are bigger. The spheres of the Agro bio-institute, where the access of knowledge is greater are:

- crop biotechnology
- propagation of valuable plants, which is target from more than 40 years worldwide and 35 in Bulgaria
- seedlings

The basic knowledge produced by the institute is publicly available. It can be accessed even through internet. ABI can also provide knowledge to specific requests by agricultural producers or also by other public research institutes. In Bulgaria these lasts are widely spread across the country, depending of their specific field of research and the type of knowledge needed in the region. For example, there is the Institute for the Rose, which is part of the Agricultural Academy and is located in the geographical area where traditionally roses are cultivated. Or in the already mentioned Northeastern part, called Dobrudja that is the most important zone for wheat harvest is located the Institute for the Wheat. These specific institutes provide with knowledge ad hoc, farmers which necessitate it. However, when there is interest for biotechnological agricultural then the different institutes look for consultancy and knowledge of the Agro bio-institute.

6.4 Interdependence between ABI, the State and the Academia

The scientific path in Bulgaria is not conformed with any national strategy for development. This make the science loose and its institutions insecure to perform further research. The central government assigns funds to big amount of research institutes, but without having established before any plan of action or priority. In this way the work of ABI, being not independent of the State, to chose the proper way is very difficult. In the beginning of its scientific research activities, the institute did not know in what direction to address its efforts, because it has been unclear the future of the agricultural science. The strategy could be identified with the *The blue ocean strategy* – to discover in unknown space, without conceptualization of the boundaries and the limits, untainted by competition. Moreover, in this type of *lack of plan* the demand is created and the rules of the game are not established yet, but have to be done.

However, the insecurity in that period has been justified as the only possible one and has pushed ABI to diversify its field of research. The results were that ABI have had specialization in different subject areas without being narrowly profiled. This dispersion in various spheres of research is expressed clearly when the institute engages to concrete assignments by farmers' request. According to the interviewed, the leading public research institutes in Bulgaria, such as the Agricultural Academy and the Bulgarian Academy of Science also have unspecified fields of action.

One of the linkage between ABI and the State is the financial part. The public actors for knowledge creation generally are not financially independent, because of the salaries and the consumables the State pays for.

Moreover, when the institute works on a given assignment by a concrete request of farmer, the pay which the private has to make goes directly in the national budget. The Agro Bio-institute does not have even its own current account. This way of administration, with a heavy State is remained from the past, with the typical for centrally planed economies missing motivations and unchanging work positions. In this way ABI does not have interest and incentive to make research, so it negotiates with farmers to obtain consumable and supplements for the needed knowledge.

Another way to connectedness with the State are the governmental orders, which are served through the Ministry of Science and so there have been established a fund for scientific research. These funds can be accessed together with competition among universities, schools, and research institutes. The winer of the petition receives financing, but the outcome – the produced knowledge – is owned by the State.

The linkages with Universities are weak and insufficient for knowledge transfer. The existent system is still the one of the past, characterized with strong division and lack of communication between universities and other research centers. Another problem is that student are bond in their faculties and do not interact with knowledge institutes. Even master students, have to stay within their universities and their work in institutes is often not acknowledged, because the institutes in Bulgaria are not part of the high education.

Relationships with other institutes for knowledge creation and development are also very poor. The Ago Bio-institute participates frequently to seminars and other professional meetings, where the institute creates new contacts with other socio-economic and scientific actors. These events are also important in terms of acquired knowledge and important information. Nevertheless, theres is problem with working together or group works. It is rather a common practice in Bulgaria to work individually and not in unions, where the sharing of knowledge and *know-how* could be greater. In group works often there is the feeling of competitiveness and consequently conflicts between the engaged actors. Too rare are as well the joint knowledge developments. There is the impression that different knowledge production structures works in a independent of other institutes, despite their common field of research.

Going back to the financial issue, it could be concluded that a present problem is that national financing has been reduced recently, but there is a shift to apply to European Union programmes, such as the framework programmes. In order to be financed, knowledge institutes have to present their proper experience in the sector, publications and the work they have already done. Involvement in European framework programmes is also a new opportunity for national research centers to establish contacts with foreign agricultural producers and also to extend their knowledge sphere. Besides, the financing is times better for the knowledge institutes than the national one.

6.5 The Agro Bio-institute and relations to environmental problems

Whit this point is tried to see the approach of ABI to environmental problems, which could be seen not only as business opportunity, but also for a new field of knowledge development.

According to the interviewed, afterward the disputes and the discussions in Bulgaria about the GMO and the genetically modified food, there have been a lot of rumors by big number of eco-organizations, NGOs and agricultural producers, expressing themselves as organic producers, but without the needed knowledge for this kind of activity. In addition, organic food can be said that is a luxury good for wealthy people and industrialized countries. Only few people might believe that organic agricultural production will provide food for the entire human population. Moreover, organic food production may have only some proportion of the whole agricultural output and to be the business and the occupation of the smallest farmers.

Also principles of degrowth for reducing the consumption is more a challenge for rich countries, where overconsumption is really present. In Bulgaria or other developing countries, where poverty and undernourished are present is not appropriate to talk about consume reduction.

Therefore, the conventional agriculture is more than fundamental. It serves the increasing demand for agricultural goods. For instance, even a local need of 100 hectares of wheat could not be satisfied with organic production. The example of Switzerland shows also that organic farmers are only a fraction of the total agricultural producers. Besides the fact that this is one of the richest country in Europe and its consumers can afford the more expensive bio products. It has to be added that the country has also other very well developed industries.

Is the intensive agriculture that guarantees high crop and livestock yields and also profits to farmers, needed for further investments in technologies and knowledge development. Nowadays in Bulgaria there is the concern about the quality of the food. Therefore, different commissions exercise control and monitoring, especially toward the big agricultural producers. Something that is missing for organic farmers. After that the last once have proven that are organic any additional controls do not take place. It could be said that in Bulgaria there is more thrust in big agricultural companies that in small farmers, engaged in bio production.

In addition, on the interview it was highlighted that GMO is actually a clean production, that does not need chemicals and other toxic materials, but there is scarce information regarding what GMO actually is. There have not be proven any negative effects or consequences of this kind of agricultural production. For instance, one of the last occurred dangerous threat, like *Escherichia coli*, has come from clean agricultural production.

One important thing that needs to be considered is where the above information was acquired from. The direct interrogatory was with the public research center – ABI, which is part of the Academy of Agriculture. Secondary data and informations were accessed from governmental reports and other documents coming from institutes such as the National Statistical Institutes, the Agricultural Academy, the Bulgarian Academy of Science, the Ministry of Agriculture and food that are all public establishments. Besides the mentioned structural problems of these materials it could be perceived that farmers in Bulgaria are not interested in knowledge as productive source, but more in financial help, EU funds and their need for new machineries. Without doubts, the solution to these problems is of primary importance. However, to understand better the situation with the knowledge and farmers' needs it will be more appropriate to interrogate directly farmers, instead of accessing secondary data. Therefore, for the next interviewed was chosen a private farmer.

7. The private farmer

The farmer that was interviewed could be categorized as a middle size farmer. He grows maize, wheat and potatoes crops, which are cultivated on approximately 100 hectares of land. The farmer is self-employed and there are not other workers in his productive structure. He is agricultural producer from 15 years, and the machineries he uses now are around 8 years old. His farming structure is located in Southwestern zone, which is one of the most unfavorable for agricultural production.

7.1 The demand of Bulgarian farmers

This open question will try to give clearer understanding about the necessities of Bulgarian farmers and the need for knowledge (from a farmer representative point of view and not from reported information in governmental reports) in the Bulgarian agricultural sector. Moreover, during the interview there were added several sub-questions in order to assist the main goal of the inquiry.

It was pointed by the farmer that the most needed element in the Bulgarian agriculture system is the knowledge. Qualifications of farmers and employees in the sector are scarce or even missing. Professional literature and courses of instruction about practice and techniques for land treatment are very needed by the major part of farmers. Good production is hampered by lack of basic knowledge about how, when and what to sow. Also, the sector needs knowledge about optimal practices for fertilization[10] and crop spraying. In addition, every crop cultivation has its specificities and dependence of meteorological and climate conditions, so farmers must consider them instead of applying the same techniques for different plant. Hence it could be said that all these above are about practical knowledge and that the sector does not require for now advanced or scientific knowledge.

The low level of education among agricultural producers is very problematic for the sector; and competent workforce for it is of primary importance. However, in the last years the situation with the education is getting better. There are increasing numbers of young and well educated farmers, helped by EU programmes. In addition, today approximately 50% of the students are engaged in farm productive structures.

According to the interviewed, the first step for the bulgarian agricultural is in increasing the education among farmers and diffusion of practical knowledge. Afterwards it is the turn of subsidies and modern machineries and technologies. If the first step is not accomplished or skipped, then there is the risk of inefficiency and waste of resources.

7.2 The access to the needed knowledge

In Bulgaria quite often the Ministry of the Agriculture and Food organizes various seminars and professional meetings on different subject of matters. The main benefits for privates of these events are the created contacts between farmers.

Proficient and specialized journals, newspapers and magazine are widely spread and easily accessed. They are informative, but often descriptive information of different farmer's experience prevails. Moreover, most of these informative materials are advertise oriented and the promotion of chemical companies or machinery dealers, for instance are explicitly presented.

10 If for example, the fertilizers are more than the needed it may have negative consequences for the agricultural yield and if the soil improvement practice are insufficient there will be also with negative results.

Another source for knowledge exchange are internet forums and portals, which are relatively well developed, but the access to these as a source of information or for opinion exchange is limited, because of the low number of visitors.

7.3 Relationships with knowledge institutes and other farmers

As mentioned above, on seminars and vocational courses farmers mostly get to know each other. Afterwards they establish relationships for information exchange. The information is limited and it is largely regardless of prices and practices for agricultural production placement. However, these contacts are crucial for the Bulgarian agricultural system, because through them cooperation among farmers and also favor oriented behavior take place. Opportunism – where one of the major unfair act is to take qualified workforce from other farmers, by offering slightly better salary – is also present and this often restraints relations between local actors in the agriculture. Thus for avoid negative experiences with local farmers the cooperative relationship are mostly with farmers from other areas in Bulgaria. In addition, it has to be said that competition is not among Bulgarian farmers, but the menace is by big foreign agricultural producers, which are able to deliver their goods at lower prices.

Linkages with firms of other sectors are modest. The food processing industry is the second major consumer of agricultural products (after resellers). However, farmers are not willing to be engaged with contracts, because they put a certain level of rigidity at pre-fixed prices.

The relationships to knowledge institutes could be divided into public and private.

The relations to knowledge creation institutes are essential for Bulgarian farmers. It could be said that the most important and needed knowledge by farms has to be as a final product, ready to be used in practice, like the seeds for example. New and improved hybrids are the main factor, which determinants increases in the agricultural yield. This kind of knowledge is accessed on the market, i.e. through conventional market relations of demand and supply.

In Bulgaria, there are several international companies that are in the business of seeds

supply. The seeds existing on the Bulgarian market are mainly imported seeds from Netherlands and USA. These companies have their own research and development departments, which provide them with valuable and advanced products. Another thing that must be considered is that they are private companies and therefore rigorously follow the market needs and are also shaped by market principles and mechanisms. These firms have created strong feedbacks with farmers and so they cannot permit to make mistakes and to not fulfill farmers' demands. Even in case of dissatisfaction these companies provide significant compensations. In addition, international companies often use local farmers, which reflect typical local characteristic, for experimentations and for support product development. Thus their relations are further strengthen and mutual dependence is created.

In the field of seeds provision, Bulgarian companies cannot supply the same good quality. The interviewed pointed out that the research of the public knowledge creators in Bulgaria is inadequate and insufficient. The knowledge incorporated into seeds (such as new hybrids) is poor, which explain institutes' ineffectiveness for satisfying farmers' necessities. This is why the domestic knowledge is not preferred. But also regarding the practical knowledge, big agricultural producers are agronomists and also they are more knowledgable respect to public experts.

The above described state is due partly because of the low earnings in those organizations and consequently missing incentives and brain drain. However, it should be considered that those knowledge structures have been established in a non market oriented context. Their administration is ruled by old and incompetent personnel, which do not have business attitude to follow market needs. Moreover, differently from private companies, which seek to keep closer farmers, to resolve occurred problems and to offer the best they can, Bulgarian public institutes seek solely selling without further feedback and often do not take responsibilities in case of bad products. In addition, it is very hard to look for customers' (farmers as consumers of knowledge) rights against the State institutions.

So, it can be inferred that the domestic generated knowledge is poor and scarce; the lack of responsibilities by public institutes for the created products strengthen further the disinterest in it. This has led to underutilization and no further improvements for the Bulgarian seeds, for which there is also a prognosis that in the near future they will be out of the market. Even in traditionally important and well developed branches, such as vegetables, today is really rare to find agricultural producers using Bulgarian seeds.

This tendency could be clearly seen, considering the number of visitors on demonstrations of new products or processes organized by private foreign companies (big attendance) and public institutes (low attendance).

However, during the interview it was stated that Bulgarian seeds (especially for the wheat) have huge potential, because they have good basis, but they need qualitative production and significant improvement by knowledge organizations. Something that public institutes cannot do, because of poor knowledge, management and market orientation. Right knowledge and management should happen in order to get better Bulgarian public institutes and make them financially independent from the central State.

7.4 Market and placement of the agricultural production

It was already mentioned that one of the reason for contact among farmers is information about prices. According to the interviewed, one of the biggest problem for agricultural producers is the missing market mechanisms. There are not agriculture exchanges to place the production. Because of the underdeveloped markets, the sector needs modern market tools, such as the e-commerce or e-exchange. The actual situation is that the merchandising is made through resellers, which are very powerful and they decide about the prices, i.e. the price for the agricultural producers are set by few persons instead of reflecting the normal demand-supply market principles. It should be clear that these persons are also lobbing against an e-exchange establishment. The problem is additionally fed, because accessibility to foreign markets is not possible, if the quantity of the production is under a given amount.

8. Sustainability and bio-agricultural farmer

It was logical to include bio-farmer as an actor of agricultural innovation system, because from one side internal structural problems – which create internal to the system dynamics – may create business opportunities and from the other, as part of the open system, environmental issues cannot be excluded from the analyze. This pointed me to see the problems as opportunity for bio-farms, which can reduce the environmental damage, improve the quality of the agricultural output and create environmental-friendly products.

Today environmental problems cannot be neglected any more and so a crucial task of both academic and privates actors is to consider them for a real application in practice. It is a duty for developing and developed countries. Sustainability embrace different aspects of the human and nature conservation. Beyond the economic view of sustainable development that does not deteriorate the environment, there are other points regarding human rights, bio-diversity, social inclusion, soil protection, deforestation, etc.

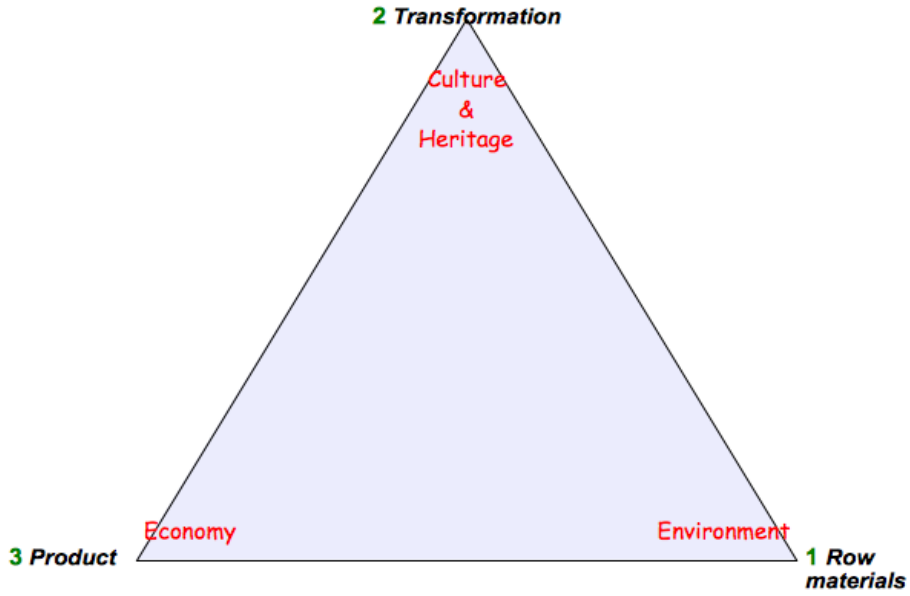
Consequently, the last interview was made with an bio-agricultural socio-economic actor, which is characterized with the above mentioned conceptualization of sustainability.

8.1 General overview of the bio-farmer

This actor is among the first bio-farm in Bulgaria and it is from 5 years. It is registered as non-governmental organization (NGO). The main earnings are from donations. However, there are also volunteers that participate with work for which they receive agricultural products. One of the main cultivations are fruit orchards, beans and peas, rye and permanent plantations, which are spread on gardens and arable land of around 5 hectares total. Moreover the farming structure works also with herbal cultivation and use of different techniques for gathering. In the near future there is a plan for bio soap production.

According to the farm, the concept of sustainable development could be exhibited by a common set of activities ruled by the total interaction between three main aspects, or called also *field of responsibilities,* intercrossing each other. These three aspects and their components, which are presented in figure 2, generate activity for sustainable development and are of primary importance for each individual, organization, company or community system that claim to support sustainable development.

Figure 2: The three aspects for sustainable development



The three aspects and their sub-activities by the farm are presented below :

a) Ecological aspect: this aspect comprises the set of activities related to the natural world – the environment. The creation and the adequate management of this aspect account for the practical application of the sustainable development concept as well as preparation of the necessary conditions for the development of the other two interrelated aspects – social and economic.

- a1) Combating the erosion and effort to improve the soil structure. Because of deforestation, the erosion is washing out the nutrient soil practice. The farm builds walls against the erosion – composed of living and non-living natural or recycled matter – it is basic condition for retention of organic matter and new soil formation.
- a2) Care for spring zones and water infiltration – the appropriate measure for spring zones and water infiltration ensure stable water discharge over time and could recover dried water sources. It is important to study and make research for achieving the balance between weight of the soil volume above the water, soil porosity and the existing vegetative cover and its properties
- a3) Management of the forest. By understanding the key characteristics of the forest and acting in favor of the biodiversity and against financial short-term interest, the sustainable forest management could transform it into restorable source of materials, food and energy.
- a4) Formation of vegetative cover of ecological compatible and useful for the

mankind plants. According to the interviewed, it is necessary that people restore and maintain this cover focusing on the primary importance of the plants for the ecological balance and their immense usefulness. The formation of vegetation cover composed of ecologically compatible plants provides healthy environment, clean water, air and food. Moreover, it provides resources for the development of different products and opportunities for adding value and developing sustainable microeconomics.

- a5) Maximum waste recycling. For example, using plants for different material degradation. Therefore, by using already developed techniques or new knowledge, the waste could be reduced, re-used and entirely recycled. In the figure 2 it is the passage of 3 (products) to 1 (raw materials).

b) Social aspect: it covers the activities performed by a given organism that is using traditional and specific skills and knowledge in order to enable its existence and lifestyle. It is addressed to improve the quality of social life. The real implementation of the cultural background for passing on knowledge and skills is a method based on the practical experience. The farm works for conservation of plant genetic and cultural heritage.

- Truth, respect, honor and duty are basic features used for transfer of the accumulated knowledge of the elderly people to the young. Communication and socialization are needed for ensure knowledge flow, values between the generations, human comfort and to prevent social exclusion.

c) Economic aspect: its aspect embraces the activities related to the manufacture of goods, products and services, and their realization. It is an instrument that makes public the concept of Sustainable Development by delivering systems of Sustainable Production and Sustainable Consumption.

- The concept looks for providing the opportunity for the people to earn money by doing good to the Nature, to produce high quality and healthy products.

8.2 The knowledge in the bio-farming structure

It can be said that the farming structure is occupied with experimental agriculture, which is

about combining savage and domesticated plants. The purpose is to create new plants and seeds, which reflect the geographical, the soil and specific climate conditions. The obtained new seeds in this way are adapted and are sown in local fields. Consequently it could be said that a main activity is the production of local-specific seeds. In this way, the organization works on the conservation of typical plants and seeds, which are menaced of expiration because of the imported hybrids that need chemical to grow. Therefore, the knowledge created is *extracted* from local people, so it is very context specific and represents local particularity. Nevertheless, there is general knowledge that the farm structure tries to diffuse, instead of keeping for themselves. This knowledge is about best practices of how, what and when to fertilize using natural products (called *compost*), seed and grow different plants. As part of the general knowledge, the farm pays special attention to the importance of the moon phases. These natural factors often are seriously underestimated by the academia and never used in practice by the majority of agricultural producers.

For the above stated activities it is clear that a significant level of knowledge and research is needed. The very basic knowledge could be acquired from academic books, which however often generalize it. However, the practice of the farm is to use local knowledge of the local people and to develop it further. The exchange of knowledge is not easy, especially with other actors, like the forest management, where the responsible public organization does follow outdated plans for wood treatment.

The farming has regular relations with doctors who make researches and analyzes on natural fertilizers, water purification and the soil. Often laboratory examinations are used for the product of the bio-farming and for the prove of their better quality (in terms of vitamins and minerals). Moreover, in collaboration with doctors there have been created new natural medicine on herbal basis.

Relationships with Universities and schools are rather one-way. The point is that theory and practice are unfortunately very distant in Bulgaria. Therefore, the bio-farmer is not interested in theories from the academic world. Internships and other programmes very often take place in the farm, because of the students' need to acquire practical updated and fundamental knowledge. It has to be said that there are students from different fields, such as agronomy, anthropology, pedagogy and social sciences. This variety of areas is because the farming structure is engaged in the broad sense of sustainability (presented in figure 2).

8.3 Market relations

Most of the jobs by this bio-farming structure do not have financial benefits. It is difficult to say to serve some market, despite the interest of some food chains to place bio-products. So far the farm uses the principle of barter for products or services; also maximum cooperation among local people and similar actors is present. However, if there is a excess of agricultural products, it is immediately distributed (because of the bid demand) to other bio-producers, private consumption and rarely to bio-restaurants, for which the farm receive donations.

The interviewed pointed out that are not interested in certificates for commercialization, because in this way the access to their knowledge will be restricted and the farmer will start to earn of the used local knowledge, while the aim of the bio-farmer is the diffusion of the knowledge and practices for healthy food.

9. Discussion

It was said in the theoretical frame that innovation system is more an outcome then a direct tool for enable innovation. Innovation system analysis is applied to to identify opportunities and bottlenecks for innovation. From the secondary data source it could be inferred that the reported six internal structural problems are the main impediment for innovation occurrence. Infrastructures as irrigation systems, new machineries and modern technologies are of key importance for improvement of the agricultural production process. However, from the structural problem should be recalled the *dualistic structure* (the second structural problem). It was said that 76% of the arable land is managed by large farms, which implement modern machineries and technologies to achieve high production. This mean that the majority of agricultural land gives big agricultural yield. However, these yields are in absolute and not in relative amount (yield per hectare), and so they show little about the efficiency, the intensification of the agricultural production and the work employment. The meaning of second structural problem is that only 0,4% of the all agricultural structures possess serious productive potential and they develop just a small fraction of the agricultural production (grain and oil seeds).

Regarding the knowledge, crucial task of policy maker is to improve the qualification of the farmers and the workforce employed in the agriculture. As pointed by the second interviewed, the needed knowledge is not a science-based, but it is practical knowledge, which diffusion is not

difficult.

Agriculture as a low tech sector does not require large employment of advanced knowledge. Incremental innovations and improvements are the typical in the low-tech sectors. It was said, in addition that these sectors are dominated by small and medium enterprises, something that was seen as emblematic for the Bulgarian agricultural sector. Therefore, these sectors are characterized more with practical knowledge – market information or relationships with consumers could be more important in order to enable innovation or to improve the production and the distribution of goods.

In the functional pattern it was said that markets are the reason for fail or success of the innovation. In the empirical research with the private farmer it was seen that missing market mechanisms hamper the right operation of the marker principles. These do not constraint directly the innovation process, but decrease the opportunity for re-invest and to seek through better and modern technology increases of the efficiency of production or the market share. In addition, it was pointed that market relations with private companies (foreign mostly) are the one used for the needed knowledge acquirement – because of the better knowledge provided by privates. And also mutual co-operations for product development take place, which determines intensive relationships and exchange of knowledge among privates (and almost any with public institutes).

As said by Hirsch-Kreinsen the demand – the existing, emergent and potential demand – in low-tech sectors is a fundamental driving force for changes and innovation. In this case, in agriculture is mostly the demand to drive innovation practices. It was seen that globally the demand for agricultural goods is increasing because of the increasing population, but also for the incremented utilization of agricultural products utilization into other industries, like energy or fuel industries. So, not to exclude is the potential global demand for food (of quantity and quality), which can create serious dynamics in the sector and require application of more advanced knowledge and technologies thus to transform it into a high-tech sector.

This will call for bulgarian farmer first of all to increase the efficiency of the production – through the practical knowledge they need, renew of the machinery park and better market mechanisms. Also, Edquist pointed out that innovation is part of the structural capital and does not depend only of research, but as well of technology adoption and market investigations. These last two elements are needed in the bulgarian agriculture – the old and amortized machineries need to be changed with new and modern ones. In this way the efficiency and the agricultural yield could be significantly improved. Afterward they have acquired the basis, farmers will be prepared for further application of advanced technologies and science-based knowledge.

After the interview with the Agro Bio-institute, it should be recalled that the input in the agricultural sector – science, incorporated knowledge in inputs, utilized machineries, specialized human capital, financial capital, etc. are of very scarce level, and this explains the low value added of the sectoral output. For the related and supportive industry – ABI has pointed out that these industries depend actually of the sector's need and demand. From the biotechnological field, there is too little *support* for the agriculture, which necessities are different at the moment.

The empirical study with ABI, which has shown low interaction and scarce flow of knowledge between private farmers and the public institute. The low resource mobilization, the scarce income in the Bulgarian agriculture, the low value added and the missing national strategy create obstacles for the development of the sector.

Looking the dynamics of a sector, which were divided to external and internal factors influencing on it, there could be said the the internal elements, such the knowledge is weak to enable serous sectoral changes – it it is more internal problems that might create sectoral dynamics. Quantitative accumulation hardly can transform in qualitative modification.

In Bulgaria, it has been more external factors to determinate dynamics in the agriculture. Political decisions like the accession to European Union and the increasing global demand have had influence (potential, in the case of serving bigger demand) on the agricultural system. EU has been more advantageous for the three examined actors because of different programs promoting and modernizing agricultural structure and providing finance (for private farmers); and the opportunity for scientific exchange among public institutions through the framework programmes.

It could be said that economic dynamic nowadays are globally integrated and it is hardly to talk about merely internal drivers. Knowledge, the fundamental asset of innovation, also is not entirely internally generated, but it is interdependently – from other sectors and socio-economic actors – created.

For the diffusion of knowledge important role play the instruments and the channels for its transfer. In the theoretical part were mentioned different possibilities for knowledge transfer (scientific output and informal contacts; labor mobility; collaborative and contract research; contracts with professional organizations; specific organized activities; patents and licensing) between universities and industries, which could have been used in more general therms for knowledge transfer. However, in Bulgaria the most needed knowledge is the practical, which is not difficulty accessed. The Agricultural Academy and its specialized institutes has provided courses

and lectures which seem did not bring significant results regardless increases of the knowledge level. ABI reported that there are few contract researches, but the incentives generally are missing because of the direct payment to the nation account and the low salaries within the institute.

Beside the education by public institutes for agricultural actors, according to the interviewed farmer, the access to needed knowledge is mainly through the market, i.e. the simple act of buying innovative input from private companies provide farmers with the necessary knowledge (incorporated into final products). It was pointed that the knowledge generated by public institutes is poor and their missing responsibilities are the reason why farmers prefer foreign companies' products. It was stated that job rotations and change of work positions meliorate the exchange of knowledge. In the reality this is the case where qualified workforce is moving from one farm to another, but deteriorating relations among local farmers.

The bio-farming structure uses mostly direct communications and real observations of the agricultural practices for spreading and acquiring knowledge.

It was considered that system interact with the surrounding they are located. Environmental problems create significant dynamics in the sector and the potential of them is with big potential for further influences. This is why **sustainable** innovation system could be considered as more appropriate tool for analyze future innovations. Knowledge diffusion to marginalized people, conservation of the environment, increase of the socio-economic well-being might be considered as fundamental for sustainability. From the empirical study it must be added another fundamental element – improvement of the market mechanisms for enable innovation.

The bio-farmer in Bulgaria is important actor regarding environmental problems and having an advanced perception of sustainability. It was seen not only concerning the quality of the food, but also in preserving seeds, treatment of the soil and the water, social activities, recycling practices, diffusion of knowledge, etc. These do not have direct economic befits and it could be expected that there are no incentives for people to engage in sustainable practices. However, from purely economic point of view, he is not important economic actor and does not have business incentives (in therms of generated capital, agricultural yield, work employment and tax payment), but is important for the knowledge generated and also for future bio-farmers. This actor reflect some of the main ideas of *degrowth,* but it was seen that these are not emblematic of the agricultural sector (except the overconsumption of food, which however has not been examined) and especially for the Bulgarian agriculture, which is underdeveloped and needs to acquire efficiency in the production and in the market placement processes. In addition, for developing countries bio-farmers might seem unbefitting and inappropriate, considering the catching-up of industrialized countries – sought

through intensive production.

In the theoretical part it was said that internal to a given system problems or difficulties could trigger to seek new opportunities. Since that structural problems are not resolved, like the suggestion from the EU commission that more structural reforms are needed, it could be considered the option for small farmers to engage in organic and bio framing, since there is the problem of big amount of farmers with too little land. These will not resolve sectoral problems or make the agriculture more developed, but small bio-farmers will be engaged in activities for environmentally-friendly products and increase of the quality of the food, which are sustainable innovations.

Establishments of bio-farmers will call for better marker investigations and mechanisms for easy placement of the bio-production. In this way bio-farmers could become more profit oriented and thus to contribute for workforce employment and increase of the production. It is however connected to an internal dynamic: c*hanging user's preferences*, which means that consumers have to be prone to those products (and probably to pay more). For this possibility it has to be considered the inclusive aspect of the innovation system, i.e. diffusion (and the type) of knowledge and benefits to small and needing economic actors.

From the point of *guidance of the research* and and *legitimization*, the government by law should attempt to enable more relationship between the socio-economic actors. This is especially important for the relations between privates and public organizations, which do not have market orientation. The purpose of this is to make public institutions closer to the private's needs, i.e. to the demand. Interesting example for consideration in this case could be the *the third task.*

Another point of the functional pattern was the entrepreneurial activity. Entrepreneurial dynamics have not been deepened, but the thing that has to be recalled is the suggestion of SCCA that after the entrance to EU, farmers need to be more active players in the economic system and rely less on the State. However, this will be possible if the needed marker mechanisms and institutions, which support the creation, the diffusion and the utilization of knowledge are present.

Moreover, the systemic approach should be always used, in order to consider factors such as employment, poverty reduction and distribution of goods and knowledge for the agricultural producers. In the creation of legitimization it was said the importance of lobbies. For Bulgaria there was pointed about groups of people who has huge influence on deciding the price of the agricultural good, impeding in this way the normal marker forces and mechanisms.

IX Conclusion

It was pointed that agriculture is essential for human existence and social stability in any society. It is also a great business opportunity, because – as how reported by ABI – there is a constantly increasing demand for food. Demand, which probably will require always better and advancer knowledge and technologies; but their optimal employment in practice is possible only when agricultural producers are competent socio-economic actors. So, competences are needed for the present situation and future opportunities in the Bulgarian agricultural sector, where vocational education and qualification were reported as insufficient.

Together with the improvement of the level of knowledge some basic reforms, addressed toward increase of farms' size and improvement of the market, in the sector are needed. In addition, basic platform should be established in order to enable farmers to sell their products directly to who demand it. In this way the basic marker rules of price formation will be on the demand-supply principle. It was stated that knowledge is the fundamental asset for innovation, and therefore it has to be diffused to all socio-economic actors. The needed knowledge today was characterized as basic and practical and therefore, its codification and diffusion should not be problematic.

Generally public institutes provide with this kind of knowledge. However, for the performed research they were pointed to be with poor knowledge, without incentives and with no responsibilities, in this way the public knowledge creators cannot follow privates' needs. These could be resolved with a better business orientation, independence from the State and more incentives. It will be radical to talk about their privatization, but at least private managers could be recommended for a better governance.

Moreover, depending of the economic structures and sustainability consideration the needed knowledge can differ. For more practical and widely spread, the knowledge is of a given type, for more specific and utilized by few actors is another and for organic producers can be completely different. The path of knowledge development depends on internal and external factors – the most significant will be the environmental legislation. However, for countries from the South it could be suggested that the knowledge diffusion has to benefit the most needing productive units and to be created regarding of their necessities.

It will be fundamental to find a way to match the development of an underdeveloped sector, like the agriculture in Bulgaria, from one side and the concept of sustainability from the other. The problem is further strengthened by the potential of the food demand, requiring more intensive

production. The sustainable innovation system has to challenge the difficulty, trying to develop the sector through eco-innovations, environmentally-friendly products, optimization of the consumption and increasing of the well-being also to the most needing socio-economic actors; and this will call for an ad hoc knowledge.

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