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General problems related to innovation and its potential in the Hungarian agro-food sector[1]

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Abstract

This paper stresses that innovation in Hungary leaves something to be desired, and a perpetual lack of innovation also applies to the agro-food sector which, of course, consequently weakens the nation's general competitiveness.

The 2007-2013 period and the subsequent resources provided by the EU present new challenges. It is not overstating the case to say that if Hungary is not able to capitalize on this period, then it will face competitive disadvantages capable of placing Hungarian agriculture in a critical situation. To avoid this, the conditions for innovation and innovation performance must be improved.

The system of innovation in the Hungarian agro-food sector does not lend itself to the application of the model constructed on R+D. Therefore, it appears practical to follow the adaptive innovation model, which would be particularly useful for SMEs.

Keywords

innovation, agro-food sector's innovation, agricultural innovation, innovation models, adaptive innovation

Introduction

A slogan says: "innovation is the engine of progress". In the developed word this thought certainly rings true as the effort devoted to innovation is gaining more and more prominence. In the developed world one sees that research and technical development transform the economy and society (Kleinheincz, 2005). In Hungary the situation is slightly different where, in the 90s, the country already lagged well behind the international standard, and actually worsened after 2000.

In order to improve the current situation we need ideas and mechanisms which bolster domestic enterprises' competitiveness and the national economy. If Hungary wishes to meet EU requirements, it needs to improve its standard of education, research, technical development and innovation.

The dynamism that characterized innovation in the 1970s is long gone. This circumstances surrounding universal innovation problems render it pertinent to deal with agro innovation.

Currently within agricultural production, efforts at innovation are considerably weaker when compared to the 70s when innovation in producing raw materials compared favorably to that in processing and distributing food.

Current problems are also aggravated by the Hungarian agro-food sector's difficulty in coping with the late 80s change in the social system and EU accession.

This general decline could actually lay the groundwork for potential recovery, but this is hindered by an incessant lack of innovation, which could create a hopeless situation throughout the entire sector.

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It has long been said that the domestic agro-food sector requires innovation processes, innovation strategies, and innovation policy to improve its competitiveness.

Therefore, this paper's topic is pertinent since development policy for the 2007-2013 period could be crucial to long-term competition between EU nations. If Hungary fails to take advantage of this period, it could easily and permanently be pushed to the sidelines, which would be regrettable as Hungary needs a prosperous food industry. Numerous forums have outlined the challenges facing the agro-food sector.

The study analyses:

- The elements typical to the innovation category
- The main characteristics of domestic innovation, especially in the period following transition
- The characteristics of the previous process and environmental conditions related to agro innovation
- How the agro innovation model can be developed
- The kind of problems that make applying the classical model difficult
- Opportunities present in the agro-food sector which could improve innovation (with focus on SMEs and the opportunities for adaptation

The interpretation of innovation and its influencing factors

Based on Schumpeter's classic interpretation of innovation which encompasses new product, new process, new sales market, new supply market and new organization, there are a number of definitions which strive to clarify the concept of innovation. Let me highlight some of them:

"Innovation is not a single procedure; it is the series of activities interacting with each other. It is not just the discovery of new knowledge, not just the development of a new product, procedure or service, but it is all of the above. It is a process where we can find all the elements from research to service and these have an integrated effect on the collective aim of the elements." (Morton, 1972, in: Szakály, 2002)

"Innovation is a tangible creative thought, usually a very effective new product, technology or organizational procedure that is adapted by society." (Kádas, 1981, in: Szakály, 2002).

"Innovation is such a process where a new product, procedure or service is born from a given idea." (Saren, 1984, in: Szakály, 2002)

"…innovation is an effort aiming to create a concentrated change in the economical and social potential of an enterprise." (Drucker, 1985, in: Szakály, 2002).

"Every idea, method or subject that is perceived as new by the medium accepting it, can be considered as innovation." (Duncan, 1994, in: Szakály, 2002)

According to Gáspár (1998) innovation is "a purposeful, professional and intensive effort done by an organization or an individual developer. This effort leads from an elaborated creative idea till the new product (in an absolute or relative sense) accepted by the users."

This definition:

- considers input, transformation and output as an inseparable whole
- assumes the combination of different innovative factors
- identifies the starting and end point of the whole innovation process
- indicates that the main function of innovation is to stimulate users and to satisfy their needs through new products

In its third issue, the Oslo reference book, written under the auspices of the European Commission, and with the cooperation of professionals from 30 countries, has embraced a definition of innovation that approaches Schumpeter's original idea. According to Schumpeter: "Innovation is the introduction of a:

- new or significantly improved product (goods or services) or process
- new marketing method
- new organizational method

occurring in business practice, at a workplace, or in external relationships."

Compared to previous definitions, this represents as significant change as it removes the concept of "technology" for the product-process innovation. However, this does diminish the role of technological innovation, but enables enterprises with less extensive R+D and also the service sector to use it.

According to the new Oslo reference book, every scientific, technological, organizational, financial or sales activity can be considered as an innovation activity that effectively helps or controls the advent of innovation. This definition covers all activities during the innovation process, and R+D is not directly linked to a specific innovation. Thus, unlike in former reference books, R+D is not defined as a separate type of innovation, but still retains its stature in the innovation process.

The 2004 CXXXIV law on R+D and technological innovation can help people involved in innovation understand each other. This law is known as the law of innovation and was approved by the Hungarian Parliament on 20 December 2004. The following definitions are in the law:

a) **Basic research:** concerning experimental, empirical, systematizing or theoretical work, that aims at extending the academic/scientific knowledge concerning primarily the essentials of phenomena and the observable facts.

aa) **Straight basic research**: research aimed at extending academic/scientific knowledge and not at reaching direct social or economic utility or using the results for solving functional problems.

ab) **Targeted basic research:** Research aimed at extending academic/scientific knowledge that is likely to serve as a basis for solving existing or future problems

b) **Applied (or industrial) research:** original study aimed at obtaining new knowledge, done for the sake of a primarily defined functional target

c) **Pilot or (pre-competitive) development:** activity gained from research and/or practical experience, based on existing knowledge, that aims at creating new materials, products, processes, systems, service or improving the existing ones

d) **Research and Development:** includes the basic research, the operative research and pilot development

e) **Technological innovation:** the mixture of scientific, technical, organizational, economic and sales activities done to improve the efficiency and profitability of economic activities and to achieve favorable social and environmental effects. The results of

these activities are new or significantly modified products, processes, services, newly launched technologies, including changes that are considered new solely in the given sector or in a given organization.

Based on the above references the universal characteristics of innovation are:

- its basic mission is to satisfy market needs and to facilitate economic development
- a strategic tool to improve competitiveness
- it encompasses work phases ranging from R+D to sales
- it potentially aims at primarily developing and renewing a product/procedure
- it is a complex activity based system not abstracted from time and space
- its qualification is based on success.

Based on Hungarian innovation performance during the last 15-20 years, one can state that innovation is in a sorry state. Pakucs (2007) is correct in declaring that, according to all known evaluations, Hungary's competitiveness has worsened. In the 2006-2007 Report of the World Economic Forum, in aggregated ranking Hungary fell from 37th to 41st place.

According to the EU's 2005 innovation index (SII) Hungary ranks 18th among 31 countries. When it comes to the major internationally defined parameters, Hungary lies on the periphery when it comes to innovation.

Although we live in a competitive world in constant fluctuation where there is intense pressure for progress, Hungary's present circumstances do not bode well for the future. In a favorable context, Hungary might actually progress, but Hungary could also decline as the nation is unable to move forward economically. The ratio of the contribution of innovative activities to GDP growth is decreasing (Pakucs, 2007).

When one measures a nation's innovativeness, its potential is defined by the parameters of its current status, its historical traditions, its size, natural resources, and geographical location. Other factors are the knowledge level and norms of its society, and how organized its society is. Of course there are other factors too.

EU expansion has altered Hungary's relationship with Europe. By adding 10 additional members, then followed by Romania and Bulgaria, the EU has proven its theory as to how countries with differing levels of development can function together.

However, this does not eliminate the need to bolster international aspects of research and development since relative advantage within the system is based on the difference between accumulated knowledge and that which can be converted into a production force.

Clearly every country should strive to increase its relative innovation position, or at least preserve it, and Hungary is no exception. But it is not easy to handle this problem as, due to long-term development issues, conflicts emerge between individual and societal interests.

Moreover, it is pertinent to stress that innovation is not a short-term phenomenon, and only the future can tell whether investments will prove profitable or not. In Hungary's current situation, it is hard to decide how to distribute socially limited resources: health care, education or culture?

In Hungary "brain drain" is a definite problem. Hungary's professional elite constantly receives promising and lucrative job offers from abroad, and this threatens the quality and ranks of the Hungarian research community, and the nation's ability to recognize and solve essential problems.

Obviously it is in Hungary's national interest not only to hang on to its domestic talent, but to entice foreigners to move to Hungary. To accomplish this, Hungarian society has to become much more dynamic than it is now.

Of course EU membership does not entail only opportunities, but also responsibilities. According to Losoncz (2008), Hungary, regardless of its deficiencies and weaknesses, must conform with R+D technological and innovation policy.

In March 2002 the Lisbon Program for internal EU equalization decided that the ratio of R+D expenditures for member states has to reach 3% of GDP by 2010. However, "The Kok report" reviewing the program at its midpoint indicates that there has been little progress, and that cheap Chinese and Indian imports increase the problems (Kok, 2004).

A US analysis confirms that increasing R+D expenditures bolsters growth. This study tried to ascertain if there was an optimal ratio for R+D expenditures. Jones and Williams (1998) deduced this optimal ratio based on how R+D expenditures affect social return.

By social return, they mean how much future consumption is increased by one extra unit of resources invested in R+D now. As a result of the study, they discovered that this ratio could even be 100% in terms of synergic effects. The study concludes that the current level of investment in R+D falls 2 or 3 times short.

Innovation in Hungary

Table 1 data show that in Hungary R+D expenditures were 0.7-0.8 % of the GDP till 2000 and 0.9-1.0% since 2001.

Obviously Hungary can only meet European norms by growing faster than developed countries. Currently Hungary does not meet these conditions. The aims of the above mentioned innovation law cannot be questioned, but specific solutions are still missing.

Table 1

Distribution of he Hungarian R+D expenditures by financial sources

Title	1998	1999	2000	2001	2002	2003	2004	2005	2006
GERD* (md Ft)	71.2	78.2	105.4	140.6	171.5	175.8	181.5	207.8	238.0
GERD*/GDP (%)	0.70	0.68	0.82	0.94	1.01	0.95	0.89	0.95	1.00
GERD*/person (USD)**	72.2	76.4	96.2	125.6	147.1	145.1	144.8	164.9	..

***G**ross **E**xpenditure on **R**esearch and **D**evelopment
** At **P**urchasing **P**ower **P**arities (PPP)
Source: Hungarian Central Statistical Office's Issue of Research and Development, 2006

In order to approach the EU target, Hungary's GDP would have to triple. Based on widely held professional opinion, Losoncz (2008) states that if R+D expenditures do not reach 1% of the GDP, then these expenses will be totally ineffective. The critical mass of expenses is 1% of GDP. The Hungarian figure is at this critical level. In 2004 Hungarian R+D expenditures entailed 31% on basic research, 32% on applied research, and 37% on development.

Again, clearly Hungary can only approach European norms by growing faster than the developed countries. A precondition for fast growth is to increase innovation related expenditures.

Table 2 data illustrate the central traits of Hungarian financing problems. For example, in Sweden ⅔ of R+D expenditures derive from enterprises, but in Hungary the 2003 ratio was only 30.7% (Hungarian Central Statistical Office).

If one examines R+D expenditure sector by sector, one sees that the ratio for enterprises never attained 50%. As for the resources, the government's remains stable at 55-60%, while for the enterprises it is 30-35%. Within the EU-27, this ratio compares poorly. All EU members intend to reduce their government contribution.

Table 2

Distribution of R+D expenditures, 2003

percentage

Country	Entrepreneurial sector	Government	Other national sources	Foreign Countries
EU-25	**55.5**	**34.7**	**2.2**	**7.6**
OECD	**61.6**	**30.5**	**4.9**	
Hungary	***30.7***	***58.0***	***0.6***	***10.7***
USA	63.1	31.2	5.7	
Japan	74.5	17.7	7.5	0.3
Sweden	65.0	23.5	4.3	7.3
Poland	30.3	62.7	2.4	4.6

Source: Havas and Nyíri, 2007

Although not major, sensible changes still occurred over the last couple of years in Hungary.

Table 3

Distribution of R+D expenditures by financial sources

Title	1998	1999	2000	2001	2002	2003	2004	2005	2006
Enterprises	36.1	38.5	37.8	34.8	29.7	30.7	37.1	39.4	43.3
State budget	56.2	53.2	49.5	53.6	58.5	58.0	51.8	49.4	44.8
Other domestic source	0.4	2.7	2.1	2.4	1.4	0.6	0.7	0.3	0.6
Foreign source	4.9	5.6	10.6	9.2	10.4	10.7	10.4	10.7	11.3

Source: Hungarian Central Statistical Office's Issue of Research and Development, 2006

Improving R+D and the innovation processes will only happen through the expansion of domestic resources and the risk taking ability of the entrepreneurial sector. But this solution is more difficult, more time-consuming, and longer.

It would serve the R+D sector well if the ratio for entrepreneurial expenditures were higher, meaning the business sector's R+D activity is not satisfactory and is poorly structured. According to related data, 80% of entrepreneurial sector R+D expenditures occur at foreign-owned enterprises. However, in Sweden and the Czech Republic it is only 40% and in Japan a mere 5%.

From more than 20 thousand milliard (billion) HUF of net revenue, the domestic entrepreneurial sector (representing the higher ratio per headcount, revenue and generated income) spends 10 milliard HUF on R+D which only counts for 0.05% of the net revenue.

Such a polarization of the Hungarian economy (the discrepancy between the R+D activities of enterprises with domestic or foreign owners) can be considered as a barrier to competitiveness and permanent growth.

According to OECD Analysis results (Kleinheincz, 2005), it is evident that most enterprises have limited scope for innovation. Most of the enterprises are not involved in innovation activities, and innovative enterprises have different innovation levels. There are four different innovation levels:

- The **static** enterprise never or rarely undertakes innovation; however, potentially, it has a steady position on the given conditions.
- The **innovative** enterprise undertakes continual innovation activities in a steady competitive market, related to steady technological conditions.
- The **learner** enterprise has the ability to adapt to its changing environment.
- The **renewing/reforming** enterprise is able to transform itself into another market or create a new market using its essential technological capabilities.

In Hungary circa 500-600 companies undertake innovation activities, and 100-150 out of these are SMEs. According to the Hungarian Innovation Association (HIA), the success of the domestic development policy depends on the number of the enterprises with R+D activities expanding by ten. In this regard, the SMEs represent the greatest potential.

"However the enterprises are the main areas for technological innovation, but it is clear that their activities are not separated and not independent from their environment. The enterprises share information and there is a mutual learning process in their relationships – while they supply to and order from each other.

There is an interaction between the enterprises and a number of institutions taking part in innovation activities. They get in connection with universities or other R+D institutions, consulting agencies, state organizations or authorities." (Kleinheincz, 2005).

Innovation must be one of the riskiest things a company can do, and business strategies are sensitive to the company's ability to take risks. Most Hungarian companies only wish to survive and this, unfortunately, has been true for a long time. There is a widespread view that it is very risky to start a business based on innovation because of the volatile political and economic situation. Taxation laws tend to fluctuate and there is no long-term guarantee that subsidies will remain in place.

However, what's more important is companies' (improving but still weak) financial muscle. Their ability to accumulate capital was limited by overspending in the budget and the relatively strong Hungarian Forint (HUF). There are few medium sized companies with growth potential and large capital.

The internal demand market, which could encourage the R+D sector, is weak. Companies' inability to adopt scientific results is a problem, but in some cases the scientific results are not marketable either.

There is a need to find a solution to these problems since other nations' fast growth has often been thanks to their ability to adopt more productive technologies.

A number of studies prove that economic growth did not derive from a growing need for capital, but depended on how fast the given country could adopt the domestic or foreign technologies.

Technological diffusion can answer questions related to economic growth that capital-intensive explanations cannot. One of the main resources of these processes can be the adaptation of foreign innovations. According to published data, more than 40% of US economic growth originates from foreign innovations (Borsi, 2004).

Characteristics of Hungarian agriculture's social and economic situation

In previous decades, the Hungarian agro-food sector and agriculture, which is my particular field of research, have often proven that they are promising areas when it comes to innovation. According to Szántó (1990) 'innovation made Hungarian agriculture known and recognized internationally'. Between 1960 and 1980 Hungarian agriculture significantly differed from industry as it had its own values and system approach. This paradigm created dynamic development among countries with the same political system.

Unfortunately, the agricultural paradigm's initial excellent results were accompanied by deteriorating economic conditions, of which costs exceeded the local optimum and later the Hungarian economy fell into crisis, blocking agricultural development. However, this does not diminish the value of Hungarian agricultural innovation (at least in the mentioned period). Looking back, we can say that the golden age was in 1970s, after which Hungarian agriculture had to function in an increasingly tough business environment.

In the late 80s agriculture's problems culminated with the unexpected regime change. New problems had a serious impact on the system of innovation.

Cooperation between innovation oriented groups is weak. Previous mechanisms have disappeared, and the new ones not yet functioning. It is disconcerting that those involved in innovation are in survival mode, and lack the energy to cooperate and seek innovative partners. Moreover, most often the will for coordination is missing, which constitutes a huge problem as Hungarian agriculture's previous success was based not only on the industry and trade but also on the he R&D sector.

It is a mistake to think that organizations engaged in education, research, breeding, development, production, industry and trade related activities can continually keep working separately toward putative or real business interests. Those in the agro-food sector have recently discovered this.

Regime change deeply restructured the national economy, including agriculture. It is not always valid to link changes in agriculture to current and historical events, but the 1989 regime change definitely impacted on the sector. According to Jávorka (1995) the transformation was more significant in agriculture than in industry or infrastructure.

No other sectors in Hungary faced more changes in companies' property, structure, or in their philosophy of production. Moreover, during the last decade there was palpable hostility toward the agricultural sector, and it was often stated that Hungary did not need such extensive agricultural production due to EU restrictions. Probably this attitude stemmed from the fact that agricultural ceased being viewed as a model sector whose example should be followed.

The agricultural research network is unfortunately scattered here and there, and efforts at integration have not proven successful. The still existing research centres are struggling and in survival mode ("to be or not to be"). In this situation these centres are not only unable to publicise new findings but also cannot fulfill their role in terms of international technology interface either. Today the situation is bleak when compared to the past when the network of educational and research institutes played an important part in economic activity and development of the sector. Innovation should also be inspired from the users, but this is only visible at the big farm level. Small producers' precarious circumstances mean they are unable to engage in innovation activities.

Short-term thinking has become the prevalent strategy. Unfortunately, this tendency runs counter to innovation. It is noteworthy that small organizations play an important role in agricultural production, and it is disturbing that the food industry lacks a national strategy; thus, those involved in this field do not have any future vision. Developing a complicated system like an agro-food enterprise is most difficult if one doesn't know where one is and where one wants to go.

International cooperation regarding Hungarian innovation has some unusual aspects. In the early 70s adaptation and integration of foreign technologies provided a basis for progress in Hungarian agriculture, but after this period a situation emerged where the major food industry branches (sugar, vegetable oil, tobacco and sweet industry) were bought by foreign investors.

Partly due to this food trade has come under the influence of foreign supermarket chains. As the foreign owners have invested mainly in processing, packaging, and trading, they are now able to coordinate the output of key supermarket chains. They thus have a significant effect on the performance of the whole innovation system, which they can alter, without assuming the role of a regular company.

Agricultural trends influencing innovative performance

To plan innovative projects we need to identify trends in agriculture which are crucial to the projects' success. There is a wealth of experience showing that it is unwise to apply analogies stemming from industry to the agricultural sector as doing this can have deleterious effects. For example, there are traditional **factors** which dramatically influence the success and outcome of agricultural development. Without mentioning each of them, here is an overview of the various factors.

It is an old truth that agriculture is an endless **struggle** between people and the forces of nature. Farming is a success if people can triumph against the natural elements or harness them over the long term. To achieve this people must recognize the natural *trends* that determine the difference between this branch of the national economy and the others.

Due to natural factors the following can be considered basic "*agricultural characteristics*":

- Because of its dependence on nature, farming **cannot be isolated** from natural conditions.
- Natural conditions are **objective**; their effects cannot be altered by technical-technological progress, even to a limited extent.

Natural conditions, including climate, soil conditions, and natural geography basically dictate what kind of farming can be carried out in a given area. To this extent, these factors fundamentally determine the value of a given field (or area). Therefore, the **basic elements** of organizing and planning in agriculture constitute the precise enumeration of natural conditions**.**

Among natural conditions the followings are **determining**:
a) climate, weather conditions,
b) soil conditions,
c) field conditions and
d) water conditions.

ad a). Climatic conditions can be observed in weather changes. From an agricultural standpoint, weather has "two faces" as, at the same time, it harbours opportunities and conditions. It is thus not surprising that there are numerous sayings describing the relationship between weather and agriculture.

In terms of weather's *measurable effects* the followings can be underlined:
- temperature (the different seasons and year by year);
- the quantity and distribution annual and seasonal precipitation;
- heat units;
- relative humidity;
- the intensity, frequency and direction of winds;
- hail and fog.

The above factors' effects are observable in**:**
- crops,
- the quality and quantity of products,
- the fluctuation in the quality and quantity of production,
- the animal breeding trends,
- the organization of production and
- farming profitability.

Since the weather is objective, it is important to keep abreast of **local** weather conditions and to pay continual attention to forecast services' data and information. However, it is also useful to keep track of one's own experience and findings as weather is repetitive.

In farming a reliable weather *forecast* is vital as unexpected bad weather can ruin a farmer's plans.

ad b). Concerning crop distribution in a given area, **soil** is a major determining factor. The "quality" of soil primarily depends on its composition, nutrition-content and the soil's characteristics. To evaluate soil one can utilize various mechanical, physical and chemical tools.

Combining the quality of production sources and the soils' natural features, one can talk about soil's *economic productiveness,* which is presented in the real volume of yield.

Soil productiveness – as with other production sources – is purely *potential,* but harnessing this potential depends on several factors.

ad c). Field conditions refer to the natural location of the soil, showing how far the soil is above sea-level and the quality of the soil surface (flat, sloped, mountainous).

The soils' surface influences cultivation methods, and determines machinery and how it can be used. Hungarian soil is generally flat or rolling and this means crop production predominates while in the mountainous areas pasture-based animal breeding is prevalent.

The area surrounding agricultural land can have a negative or positive impact on the value of a given field as mountains, forests, larger rivers, and lakes are usually advantageous.

ad d). Water conditions refer to water-absorption ability. This depends on the proximity of flowing water, their runoff, and the level of ground water etc.

These factors impact on crop production, but also may impact significantly on, for example, the creation of animal breeding farms, which require a lot of water.

Based on the above it is clear that farmers must recognise that nature is in full command, and that they must deal with the effects of natural factors.

Other points to consider:

- Agriculture's main activities are crop production, animal breeding and horticulture, and crop production especially requires working outside and being **exposed to the elements, which sorely tests the individual farmer.** This holds true even if modern machinery such as a tractor's enclosed driving compartment makes life somewhat easier for the farmer.
- Agriculture means working with living organisms and **live materials,** and their limited lifespan means agriculture is **time sensitive,** linked to a biological-agro-technical optimal period. It is highly recommended to keep in mind these periods as, otherwise, successful farming is less likely. It is important to remember that live materials behave similarly to humans. If they are hungry, they want to eat. If they are thirsty, they want to drink. If they are cold, they put on warmer clothes. If they are hot, they shed some clothes. **One of the basic elements of successful farming** is understanding life-cycles of live materials and organisms. It is also essential to understand which human human activities help them.
- Most agricultural activities are dispersed in different farm areas**,** and they often require a change of location. An important organizational task is harmonizing farm labour in different farm field locations with the necessary machinery and workforce. It is also necessary to to meet the social needs of workers and – if required – to organize transport to and from the workplace. A major problem may be the condition of rural roads.
- In agriculture, time is an erratic factor as there are periods when the working day is long, and periods when it isn't, meaning autumn to spring. Weather also influences farm work and it is frustrating when a time sensitive activity such as the harvest is disrupted by rain or bad weather.
- In agriculture another problem is **checking the quality** of completed work. Often after a job is completed, the quality of the work can either not be checked or perhaps only in a haphazard manner. This holds true for sowing or plant protection work where mistakes are only uncovered after the fact and cannot be rectified.
- There are marked differences between the major branches of agriculture. In **crop production and horticulture** crucial factors are the need for large amounts of land, dependence on weather conditions, and the existence of busy and slack seasons. But **animal breeding** entails continual and repetitious tasks so there are no days off.

The basic nature of agriculture *cannot be separated from space and time*, and the above list can be expanded if one focuses on a specific enterprise. Therefore, concrete development projects require that the factors listed above be considered in terms of **space and time.**

Results and discussion

Logical innovation model

Frequently during my research I had to create logical **models** representing typical phenomena of a process or a solution. In doing so I wished to illustrate the situation as well as to include the major characteristics of an innovation related problem, its internal and external relations, and to describe the area in which they could be functional. In this regard, this paper deals with the classical model of agro-food innovation and one possible model of adaptive innovation.

To create the simplified model of agro-food innovation, some basic principles are required. Some of them are the following:

- There are several similarities between agricultural innovation and other types of production innovation. For example, basic and applied research need to be part of the agricultural innovative process. However, due to the complexity of agricultural production, the innovation processes of three independent areas are integrated in agricultural innovation. These innovation processes are related to biological, chemical, and technical conditions.
  - **Biological** conditions are related to raw materials and species of agricultural production. Primarily they require a genetic focus. Obviously to produce and sustain modern species is a complex task.
  - **Chemical** innovations are related to the production of agricultural chemicals, fertilisers, medicines for animals, and plastics. The agro-food sector is considered as a good market for the big chemical companies. In these fields innovation competition is very heavy and new products and technologies are developed dynamically.
  - **Technical** innovations are connected with agricultural machinery, buildings, automotive solutions and energy management. These areas are highly varied and require numerous types of innovative processes. There are different technical tasks in various areas of agriculture. In plant production, horticulture and animal husbandry there are varied technical challenges.
- Given the sector's unique nature, the tasks are different for basic and applied research and development.
- Following the R+D stage, the critical question is how to transform the R+D results into agricultural production. During this transformation process "technical development" plays a key role as it must ensure that the results from the former innovation phases, human resources, and ecological elements, are all considered during the transformation.

I prepared and used the *general model of agricultural innovation* (Figure 1). This model clearly demonstrates the related work needed to be done. It shows that innovation fragments can be systematized under two umbrellas: marketing and knowledge. Marketing is important of innovation success is decided in the market. The whole innovation process should be geared to market success. Knowledge combines previous experience and recent information within the entire process.

The functional logical model (Figure 1) is an appropriate instrument for
- Reviewing systematised processes related to agricultural innovation
- Introducing the relation between the part processes
- Analysing the status of agricultural innovation
- Defining what to do in the area of development

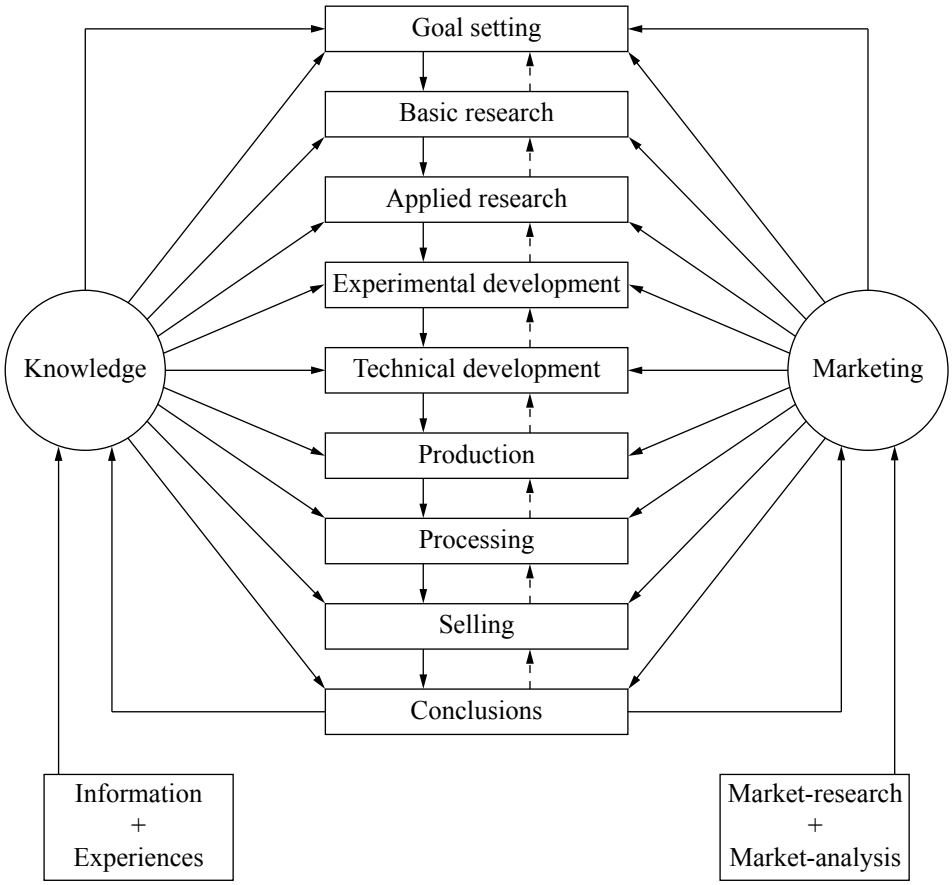

Figure 1: The simplified model of the agro-food sector's innovation

One can conclude Hungarian agriculture was successful as long as the innovators could perform their activities in a harmonized way as represented by the model.

However, the situation has radically changed. In theory the old practice should work, but the SME's (mainly private farms who play an important role in agricultural success or failure) do not enjoy the necessary conditions to follow the model. The other problem is that the previous harmony between those involved has changed.

In order to improve agricultural efficiency, agricultural innovation, agricultural research, and technical development need to be overhauled, and one must determine which sector to devote attention to in order to improve efficiency. Financial reality does not allow for improving every area.

Hungary is endowed with specific agro-eco potential when it comes to agricultural production. Circumstances dictate prudence and the country should opt for straightforward planning. Rash action could seriously damage the entire Hungarian agro-food sector and damage the nation's reputation. Recent successes should serve as a model, and Hungary's limited resources need to be concentrated in those areas which have encountered competitive success. Sometimes it is harder to improve a "normal" activity than to catch up to the others by entering unfamiliar ground.

The era of the *great leap forward* is long gone.

One possible model of adaptive innovation

There are a couple potential methods for dividing innovative solutions. One of them distinguishes between the original and the adaptive innovation. The original innovation is a result of the organization's own investment, R+D activities, and co-workers' activities, while the adaptive innovation is built on results already developed by others. (Consisting of an idea, an invention, know-how, a plan-documentation etc...)

I am not aware of any publication that details how many Hungarian enterprises have undertaken original or adaptive innovation activities. Relying on the above mentioned HIA-estimations and on my experience, it is safe to declare that the domestic companies' capacity for innovation is very worrisome. Moreover, for the agro-food sector it is even worse.

Reviving agricultural innovation was this paper's initial objective. In this vein, my focus was on adaptive innovation as I feel that the role of the previously ignored SME's should be reconsidered within the context of the entire domestic innovation strategy.

There should be no illusion about these organizations' ability to finance R+D's in the long run. Instead, their adaptive skills should be improved, but even in the short run this presents a challenge. Success requires challenges in both quality and quantity in the area of education, extension and research.

There are numerous factors influencing the processes of adaptive innovation. In my model I highlighted two of them (**Figure 2**). "External support" includes all external factors which impact on an enterprise. Social-political-economical changes could either strengthen or weaken innovation. Competitive pressure could mobilize dormant energy and lead to a future "escape hatch."

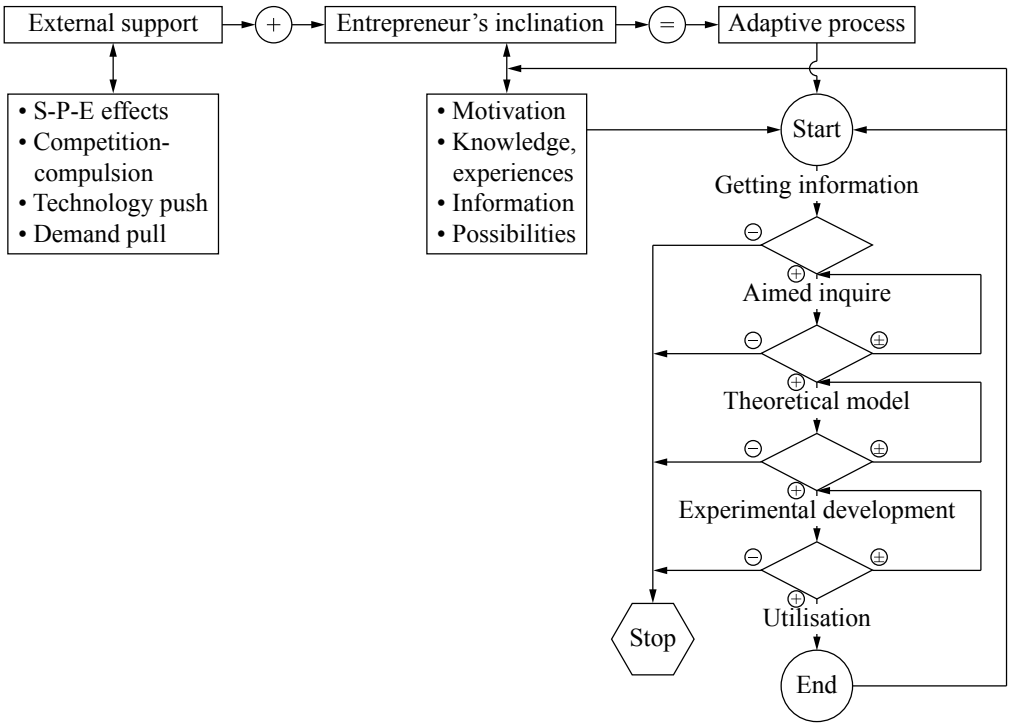

Figure 2: The adaptive innovation model

Producer-distributor organizations striving for agricultural development sense a technological impetus since their livelihood depends on how well they flog their products and services to users/customers. In this regard, supply-side pressure predominates in Hungary. The 'demand pull' represents buyers' demands and desires, as well as customers and processors of agricultural products. For organizations producing for the market, satisfying these needs is an obvious precondition for competition.

A fundamental question involves the entrepreneur's personality, his/her openness to new things, and his/her awareness that progress is vital because, without it, the organization will descend down a slippery slope.

Adequate motivation is essential, regardless of whether it stems from external pressure or a company's internal resources. Entrepreneurial knowledge and experience are most helpful. Figure 1 indicates the role of knowledge which constitutes the main model's integrating component. In our dynamic world we may frequently encounter confusion due to outdated information. Entrepreneurs require the relevant information at the right time and in optimal quantity and quality.

One of the advisory system's long-standing problems is that the **A**gricultural **K**nowledge and **I**nformation **S**ystem (**AKIS**) is still not operating at an appropriate professional standard, which represents a necessary precondition for an extensive system serving professional objectives.

Entrepreneurs' behaviour is also influenced by how capable an organization is. For agricultural enterprises the ecological environment is vitally important as it determines agriculture's potential. Other relevant factors are an enterprise's technological background, production culture, financial status, and networks.

An enterprise with sufficient external backing can initiate the adaptation process, subsequently leading to a complete or partial product or process renewal based on the principle of "considered progress". The model illustrates the adaptation process steps in a systemized order. The first essential phase, which entails acquiring knowledge, opens the door to stimuli enabling the entrepreneur to start adaptive innovation.

The ideas and information flowing from innovation can come from the enterprises' internal or external environment.

Important **internal** factors:

- management – in small enterprises it means a few people or only the entrepreneur,
- marketing – it functions mostly with very simple instruments,
- production – this is the area where the theory is tested
- company motivation factors – only in special cases can it have positive effects and this occurs with an appropriate number of employees,
- brainstorming team – in agriculture this possibility exists only theoretically,
- internal monitoring of technological development – a good system for monitoring, recording data, and collecting experience could help a lot to define the areas that need to be developed, and to select and adopt the adequate technological innovation.

Important **external** factors:

- state information, governmental or international programs supporting innovation
- exhibitions, fairs, conferences and professional meetings
- attaining technology inherent in machinery
- participation in training courses

- cooperation with:
  - customers,
  - suppliers,
  - outside experts and consultants,
  - other companies,
  - universities,
  - research institutes,
- reviewing the scientific literature
- studying the patents
- continually analysing competitors
- being up-to-date regarding law and standards.

Just like in the other phases of the process, the entrepreneur has to consider and evaluate the usefulness of new knowledge. If the idea is worth improving, then comes the "targeted direction" phase during which additional information and professional details are obtained and discussed. At this point the idea can still be rejected.

Here the often significant time factor aspect emerges in the innovation processes, and excess speculation is disadvantageous. The next step is to create a 'mental model' related to the concept. During this phase the entrepreneur mentally assembles and "acts out" the prospective innovation.

Taking one minor step at a time, the next phase is the 'small sample' phase during which the idea is practically tested as an experiment or development.

Despite preparations, problems can crop up resulting in the rejection of the idea. However, if the results are positive, then the next step could be complete acceptance, bringing about substantive adaptation, and the application of a solution(s) which was developed somewhere else.

Conclusions

- For a long time Hungary's innovation performance has been beset with critical problems, and this also applies to the agro-food sector, and to agricultural production as part of the agro-food chain. A permanent lack of innovation weakens Hungary's competitiveness and harms the sector's domestic and international prestige.

- The 2007-2013 period entails new challenges. In this period the Hungarian economy must develop more dynamically to avoid widening the gap between itself and its competitors. It is not an exaggeration to say that if Hungary is not able to capitalize on this period, it will face competitive disadvantages that could drive Hungarian agriculture into a critical situation. It could have unforeseeable effects on the whole economy

- The innovation processes need to be improved in order to to develop more intensively. A lot remains to be done both at the micro and macro levels. This paper, which deals with some of the currently necessary tasks related to Hungarian agricultural innovation, does not accept the application of the model based on R+D. Instead it opts for the more practical model of adaptive innovation, particularly useful for the SMEs.

- To improve the current situation ideas and mechanisms are needed which support those ideas which would improve the competitiveness of domestic enterprises and that of the national economy.

- We have to improve the standard of education as knowledge-intensive development can provide future opportunities. To improve adaptations, there should be more emphasis on gaining professional knowledge.
- Clearly one has to analyse: how to increase the pool of capital available for innovation and the entrepreneur's share of it.

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