FEASIBILITY STUDY OF THE PATENT SYSTEM EFFECTIVENESS ON FOOD SECURITY

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Abstract: The patent system is responsible for solving the technical and industrial problems through innovation. To determine the effect of the patent system on food security, the mechanisms and functioning of the patent system should be known in promoting innovation. By examining the elements of food security, we can examine the mechanism impact of patents on the basic elements of food security, particularly the availability, access and stability. Implementation of new processes and products, in particular, new varieties and improved farming are the key factor in increasing performance and improving agriculture and the food production. The patents by strengthening the knowledge-based economy and industrial growth caused by it could lead to the increasing per capita income and stability in accessing to adequate food.

Key words: patent, food security, agriculture, industry

1 Introduction

Lack of food security is considered the basic problems of each community. Fixing any of the problems of society by the government requires the approach and policies that define the legislative and operational framework. Determining these policies in the field of food security depends on the food security factors and indicators. It means the factors that will help to persons to distance from the vulnerability and the risk lack of food insecurity or factors that lead the ordinary people toward the vulnerability and the risk lack of food insecurity (Stamoulis & Zezza, 2003).

A patent is a tool that with the support of certain forms of innovation, in various industrial fields, in the form of granting exclusive monopoly business, seeks to achieve the economic goals and the progress of science and technology. The question is, achieving these economic and technology goals helps food security factors in what areas. Assuming the acceptance of the strengthening possibility of some food security factors, through the patent system, how does it realize and how the legislators of this country can use the patent system, to strengthen food security.

To answer these questions, we first need to identify the common elements of food security and the patent system and then evaluate the influence way among them. Study the concept and nature of food security shows that numerous factors affect directly or indirectly on food security that among them, agriculture and the economy have deeply relation with the patent system. Agricultural production, according to the nutritional needs of society plays a major role in food security and the patent system support the production of new varieties could provide the beginning of transformation necessary in this area. It can also strengthen the relation between industry and university and attract foreign investment, in the field of knowledge-based industries, and strengthen the knowledge-based economy.

1.1 The concept and logic of patent system

A patent is a legal entity that was formed with the advent of Industry and Technology, and legal systems regulate it in order to support the development of new technologies. Patents, according to what has been detected in the contemporary period in legal systems is the statutory monopoly with respect to certain business practices, such as production, storage, distribution and sale of commodities, including patents in the case of patent conditions for a limited period (World Intellectual Property Organization, 1997). If the invention was not about a certain product, and it has presented a new process to solve a technical problem, supporting it, include supporting for any product or product resulting from the process.

Accordingly, the results of each patent system should be a synergy encourage of science, wealth, and economic growth through two main strategies: 1. to reward investment in innovation by granting a monopoly; 2. early disclosure of initiatives information to accelerate the dissemination of science.

The patent will be taken into consideration with any basic, from the perspective of economists; it is an economic entity that interacts with other entities of economic system such as market with the right holder, the society and consumer. Each legal entity must be adjusted in such a way that could balance the interests of these factors in harmony with other institutions so that the least waste will be achieved. In particular, the resources are not available freely and in unlimited amounts. In economic analysis, the creator is evaluated as the producer and the community and consumer are classified of intellectual effect in the consumer class. Therefore, the benefit of an intellectual phenomenon depends on the amount of production and consumption. Due to this, people who think and have capital try to keep their attention focused to satisfy consumer demand and try to provide more consumer satisfaction and welfare. To clarify that with regulating any legal rule, whether resources are allocated to its most efficient use, the criteria of cost - benefit is used (Coleman, 1980). In this field, two fundamental questions about legal rules will be answered: What is the impact of legal rules on the behavior of economic factors? In addition, whether such impacts of legal rules are socially desirable (Kaplow & Shavell, 1999), and in fact, the legal economy analysis means applying the economic efficiency standards about the legal norms (Schafer & Ott, 2004).

The result of applying the above criteria to the patent system is that, since the creation of monopolies needs high cost, we should calculate the net social benefit surplus maximization of knowledge and information to the cost of producing them. Because of this insight, the following questions will emerge 1. Whether due to the monopoly, right amount of information and knowledge will be created at the appropriate time? 2. Whether the created knowledge and information can be used in the industry to provide the maximum social benefits for producers and consumers of goods and services? 3. Whether the ambient condition for creating new knowledge, is in such a way that it reduces its production of social costs to its minimum amount (David, 1993).

The patent institution from this perspective is a policy making institution that uses the efficient sole means for maximizing benefits and minimizing transaction costs. In any area such as food security, we must separately match the approach and above methodology to evaluate the effect and the effectiveness of the patent system. In the debate, namely food security, we must examine the rules to patent, on increasing agricultural production and accessing to them on the one hand and strengthening the knowledge-based economy and factors such as employment and income levels.

1.2 The concept of food security

After an explanation and review the way of the patent system performance, it is the turn to the concept of food security and extracting its conceptual elements, so that to recognize the performance of the patent on each of these elements. The concept of food security, over the past five decades, has been changed according to the needs and complexities of the problem of hunger in the world and its differentiation with food shortages, poverty and hunger, is taken into consideration. As a result, these conceptual evolutions, the elements of food security,

and as a result, contributing factors to the lack of food security are studied in detail. Here, we investigate each of these two things, in legal literature, on food security.

2 Elements of food security

The concept of food security, in the 1950s, simply meant food availability in the economy and most of its discussions were about the National Food production. Green Revolution in the 1960s has improved the food security and in the 1970s, the concept of food security has entered the communities and international documents, and it was formalized (Babu & Gulati, 2005). Given the ambiguity of the concept of food security and its impact on policy, its debates about the definition has abundant prosperity, to the extent that some say, up to 200 definitions have been provided for it (Mukharjee, 2012; Willaarts, 2014).

Until the 1970s, the element of food shortages was more paid attention. World Food Conference, in 1974, with an emphasis on effective elements in food availability, defined the food security to "the availability of adequate supplies of food, at all times, in order to maintain and stable of food intake and eliminate fluctuations in production and prices (Clay, 2003).

In the second period of the evolution of the concept of food security, with emphasis on the balance between supply and demand, food availability was emphasized along with the availability of food. "In 1983, the World FAO also emphasized on the access to food and provided the definition, which aims to consider the balance between supply and demand in food security definition as: "to ensure that all people, at all times, have physical and economic access to staple needed foods.

In the third period, from these developments, the stability or sustainability of food security was considered. In addition to present the World Bank report on poverty and hunger 1986, it was emphasized on transient causes of food insecurity. In this report, the distinction between food insecurity, due to the structural problems of poverty and temporary food insecurity, resulting from natural or economic crises, were emphasized. Before that, in 1981, some writers with famine theory on the impact of production, labor, trade and transfer of resources were focused on access to food. World Commission on Environment and Development (WCED), in 1987, stated that, to sustain food security, three areas related to food security, meaning the economy, justice and the environment should be considered by knowledge and experience, simultaneously.

According to a recent definition, food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food to meet essential needs and food preferences for an active and healthy life. In fact, in the fourth period, with the emphasis on education and nutritional value, it was paid attention to the point that the lack of food security is not necessarily associated with hunger, but quality of food and the way to consume it had been considered and any abuse feeding, even if not accompanied by hunger, destroys food security.

Therefore, the forming elements of food security are including availability, access, stability and benefit. Now, to identify the patent mechanism influence way on these elements, the factors contributing to the strengthening or weakening of any of these elements will be taken into consideration.

3 Factors affecting the food security

The purpose of factors affecting the elements of food security is something that, though, may not have direct contact with the food, but for any reason, they affcet on the production, distribution and consumption of food (fgure 1). Naturally, each of the food security elements (availability, access, stability and utilization) is under the effect of external factors such as market conditions, globalization, macroeconomic approach, training and policies in the health field. It is clear that these factors are outside a simple process of the food supply and policy and decision-making about them cannot cope with an institution or ministry (agriculture) (Stamoulis & Zezza, 2003).

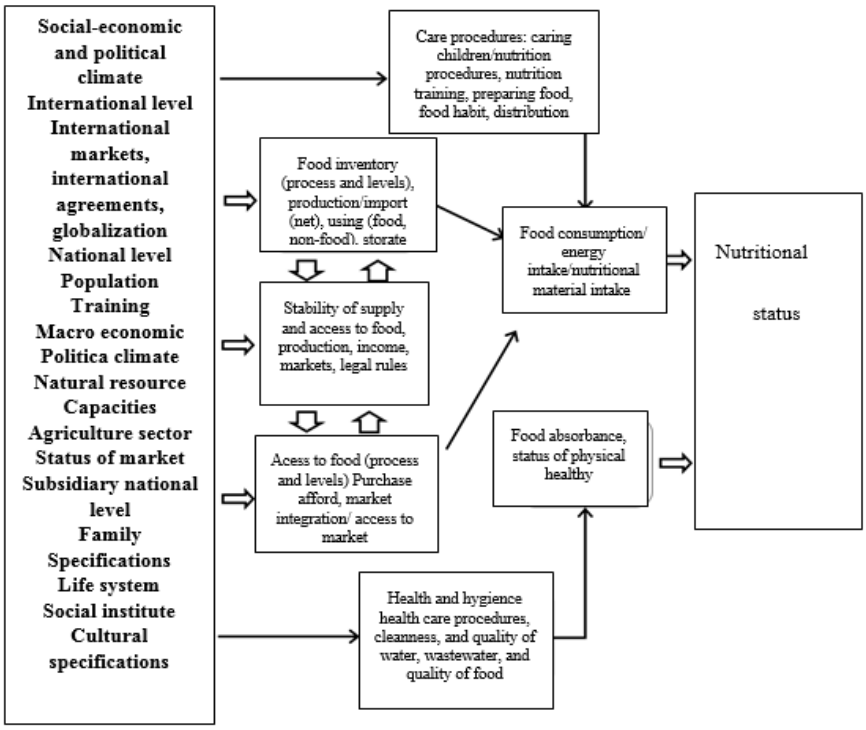

Figure 1: external factors affecting food security

According to the two-level approach, vulnerability and its management must be discussed (Chambers & Conway, 1992). Policymakers of the countries and relevant international institutions have tried to present more programs that are comprehensive, about the problem of food insecurity with respect both levels. FAO World in 2002 presented a plan to help the Food Security National Strategy for countries. The plan seeks to explain the member states focus on the issue of hunger, food security and agricultural and rural development to the multidimensional nature of food security. According to the multidimensional nature as well as both levels of food insecurity, any planning and policy in the field of food, security should be done with the participation of the custodians of the agricultural sector, trade, economy and social welfare. So that it had adequate integrity and required political commitment will be formed to fix the problems in this area and mobilizing resources will be formed in sufficient quantities (Stamoulis & Zezza, 2003). Strengthening sustainable agricultural and rural development, paying attention to the root causes of food insecurity such as productivity, public sector reform and decentralization, peace and security and reforming macroeconomic policies are the main axes of the FAO global plan (Stamoulis & Zezza, 2003).

Table (1) is based on the plan drawn by FAO. The first row in the table dedicates for rehabilitation of food system, especially for reforming food economy system, including in terms of the agricultural production, technology, diversity in the food processing, markets and consumption. The second line makes the options available to provide access to food for vulnerable individuals and groups (Clay, 2003).

Table 1: Policy levels to strengthen food security

Dual levels	Existence	Access and use	Stability
1. Rural development / Improving production	Improving the provision of food to vulnerable persons Improving food production, especially by small farmers in rural areas Investment in rural infrastructure Investing in rural markets The revival of the livestock sector Rehabilitation and conservation of resources Improving income, and other factors availability of food	Reconstruction of rural institutions Improve access with assets Guarantee access to land The revival of rural and financial systems Strengthening labor market Mechanisms to ensure food safety Social rehabilitation programs	Diversification of agriculture and workforce Food vulnerability monitoring Eliminating the structural causes of food insecurity Re-integration of refugees and the homeless The introduction of analysis and risk management Restoring access to savings mechanisms and credit system
2. direct and immediate access to food	Food aid Input assistance / seed Re-storage, livestock capital Restoring the ability of the market	Monetary exchange / Food Redistribution of assets Social rehabilitation programs Involvement in nutrition programs	Reconstruction of the social safety net Monitoring the effects of vulnerability and direct involvement making peace

The approaches presented by the World Food Conference in 1996 have considered the same things:

Encourage to sustainable production of food, reinforce the use and optimal allocation of public and private investment and rural development system, enabling vulnerable individuals, to ensure physical and economic access to food, ensure that agricultural trade and food policy are in order to strengthen food security and ensure the government's readiness to meet food needs in natural disasters. In the World Food Conference in 2002, it was also emphasizing the decisions of the summit in 1996, and the impact of factors such as political will, access to technology, erosion of natural resources, especially water and the effects of the rural economy and poverty reduction in rural areas. The Assembly also emphasizes on the strengthen role of trade and the use of biotechnology in removing poverty, hunger and a fair and sustainable maintaining of genetic resources.

Paying attention at the same time to both approaches is essential to solve the problem of food security. Policy, to ensure sustained economic growth, alongside structural problems and macroeconomic, structural reform and enough attention to non-food factors, can lead to solving problems about food security in the short and long term, in general and consistently.

4 Patents and food security

Attention to the economic basis of the invention support in these supporting systems of the patent system can act as an essential tool to help both the above objective. Then, after examining the possibility of supporting the plant innovation, in the patent system, we study the effect of the patent system, in both agriculture and industry and their implications for food security.

5 The impact of patents on agricultural strengthening

In a sustainable agriculture, the production should be noted that reduces the use of pesticides and chemical fertilizers and practices that were harmful to health and the environment, to meet the needs of food, health and protect the rights of future generations. This is emphasized on The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). Sustainable agriculture that is derived from the concept of sustainable development means attention to economic aspects, as well as other humanitarian and security needs in in the long term (Dutfield, 2006). Agricultural sustainability on the need to develop new technologies, which lead to improvements in food production and it has emphasized on less costs and negative side effects. In sustainable agriculture, no technology, or practice will be excluded such as transgenic technology or practices of organic farming based on non-scientific reasons. In addition, it is attempting to balance between the interests of traditional agricultural practices and formal systems of the seed supply (Chiarolla, 2011). Other pillars of sustainable agriculture are increasing agricultural productivity. According to some studies, the use of biotechnology and genetically modified plants create an average of $ 250 per hectare benefit. Gains from biotech crops, for Argentina, until 2005, was $ 20 billion, mainly due to the supporting approach of this country and acceptance of biotech crops, from day one, while with the countries technology owner, such as America and Canada. On the other hand, increase the income of farmers causes the increasing demand and strengthening commodity markets and services in the respective areas, and these conditions lead to an increase in employment and incomes and strengthen food security.

Another problem, related to sustainable agriculture is population growth and the consequent increase in food and agricultural needs and the shortage of agricultural land (Babu & Gulati, 2005). Among 51 billion hectares of land, 8.3 billion hectares were usable for agriculture, and 1.35 billion hectares of it is desirable for agricultural use, that almost all of the value is in use. Annually, 10 million hectares of these lands are released for various reasons. According to FAO statistics, there are less than 0.25 hectares of agricultural land per capita with right productivity.

This means that it is necessary, states plan in such a way that gains more products from less level of agricultural. To solve this problem, three approaches come to mind: an increase of fruitfulness, increasing the volume of crop and further land use. According to a study in 2000, 63 percent of shortages must be solved through enhanced product fruitfulness, 15 percent through enhanced crop culture and 22 percent by finding new agricultural lands. Regarding the fact that so the next Green Revolution of genetically modified varieties will be produced through technology. Given that, most fertile lands that can be used in this regard are in some countries in Africa and Latin America, for most countries, the use of the first option, ie an increase of fruitfulness, in particular through genetically improved varieties will be the main policy. Therefore, it is said that the next Green Revolution will be through genetically modified varieties production technology.

In addition, because many third world countries do not have the capacity to supply all their needs of agriculture through domestic production, they heavily influenced by developments in agriculture in developed countries. Because, developing countries are benefiting well from technology, especially the genetic modification technology and it heavily effects on the quality, productivity and cost of products. Some countries, such as Brazil, Argentina and India have been able to transform themselves and to be in charge with a large share of the global market with transferring technology and strengthening innovation in the field of agriculture.

Studies show that the use of transgenic technology leads to reduce costs, increase profitability and increase agricultural production. In addition, the economic impact study of this technology shows that the popular notion that the transgenic values will influx interests to large and multinational biotechnology corporations is not true; on the contrary, it can be in the interests of farmers and consumers. As it is specified in the table 2, farmers and countries that have used improved varieties of transgenic for cotton farming in developing countries, have experienced more fruitfulness, less cost for pesticides and higher net income.

Table 2: the performance of Bt cotton varieties than non-GM cotton (percent)

	Argentina	**China**	**India**	**Mexico**	**South Africa**
Fruitfulness	33	19	34	11	65
Profitability	31	340	69	12	299
The cost of pesticides	-47	-67	-41	-77	-58
The cost of seed	530	95	17	165	89

Therefore, farmers in third world countries can benefit from this technology, but access to appropriate technology in competitive terms, institutional arrangements, such as intellectual property rights, national research capacity, non-deterrent regulations in the field of safety and health, trade regulations and the efficient system of supplying sources has a fundamental importance in the distribution of benefits of this technology. To make use of new technologies, such as genetic modification technology, and help food security, food security policies should facilitate the access to new technologies related to food production and strengthen the research in the field, particularly with the aim of developing local required figures, that protection of innovation through intellectual property plays the most important role in this regard. Some researchers believe that if the system of intellectual property will be in order to strengthen food security, the current legislation should be reviewed and policies appropriate to national circumstances should be considered.

The patent system, it is possible that, in particular, innovation, in areas that need more urgent to innovate and focus on investment in that field will be felt, will be encouraged. For example, in the UK, because of the urgent need to innovate to solve environmental problems, in 2009, the plan "Green path" was run, which allow patent declaration, in this field will be resorded in a different process. The main objective of this project is to strengthen and encourage the development of low-carbon technologies, which is better for the environment, which, apart from the environmental benefits, it could guarantee the competitiveness of the British economy in the future world. In practice, the plan "Green path" provides creative active businesses in the field of green technologies, and the accelerating chance of acquiring the rights to inventions and based on those patent statements, quickly and in less than nine months from the date of demand, the result will be reache.

On the subject of debate, after careful study about the food security needs of each country, through the consideration of special privileges for producers of seed and plant varieties, we should attract the investments to meet those needs. For example, the Islamic Republic of Iran, strongly, faces with the shortages of water, that, in this context, the development of improved rice varieties, free from flooding and wheat, with low water requirements and cotton, with more than double fruitfulness are considered.

6 The impact of patents on strengthening the economy and industry

Enabling the transfer of technology from public universities and research institutions to industry is also national goals to help economic progress. Transfer of Technology here means the knowledge from the study and scientific research turning into products and valuable processes. The practical application of research that was done with macro governmental funds in universities and research centers depends on its results transfer to industry. This process normally will be elaborated through patent system, espacially appropriate disclosure of invention information and operating licenses. Technology transfer and encouraging operation licensing is desirable because, it enables small and startups companies to have the advantages of a monopoly in trade negotiations, regardless of market competition.

Major science and technology in developing countries will be produced at universities or public research centers and with a state budget that their results remain unused in many cases.

What leads to unused academic research in developing countries is the lack of relation between these researches and their commercial applications in the marketplace, because universities are unwilling to commercialize their research results on the one

hand and the private sector and companies are unwilling to use the research centers on the other. To make the relish, between academia and industry, policy makers should provide a framework that, while entering the private sector, in the field of research, place universities and public research centers in a direct relation to the trade market and encourage the technology transfer and exploitation of it. The role of the patent system policies, in filling this gap is essential in promoting selling and exploiting licenses of research results and other forms of technology transfer and joint research activities. Registering university and research centers results in the form of patent papers will lead them to useful, practical, and new research and send them to business companies for the issuance of exploitation licenses and subsequently, the technology transfer from university to industry will be more. In addition, it provides motivation and the perfect base for private companies to strengthen the investment in this area. Usually, companies cost 50 to 100 times more than the initial cost of operating license paid to the University for Technology Development. The government can determine the universities' budget with a measure of the success of public universities and research centers in the registration and commercialization of innovations by industry.

Now it must be recognized, the patent system, in general, has the above function. However, this function, in different fields, has the strength and weakness. The function of the support system in the field of agricultural biotechnology is palpable more than other areas, because biotechnology research and development is much more expensive than other areas, and drawing intellectual and financial investment in it, needs more support. This matter will be effective in two ways of internal investment in the required research on the country and attracting knowledge-based foreign investment in the economy, agriculture and industry in the country. As well as lawmakers and enforcers of the patent system careless about the element of informational disclosure of the invention has decreased the efficiency of the patent system in third world countries.

7 Result

In this paper, by extracting elements of food security and factors affecting it became clear that each of these elements in some way influenced by new technologies, especially the biotechnology and allocation of public and private funds. On the other hand, with studying the nature and logic of the patent system, it became clear, the patent system, to strengthen innovation, will act by creating incentive system and creating a link between investment and production of science and technology.

Given the above matters, this matter was reviewed that how the patent can have an impact on each of the elements and indicators of food security. Elements of food security include availability, access, stability and utilization, so, if it is detected, encourage of innovation and production of technology lead to an increase in production, facilitate access and stable the production and access, it can be said that the impact of patents is specified on food security.

Food existence, at the national and local level the most important food security element, though it is not sufficient element and necessarily it does not mean access for all people to food. It is clear that innovation and implementation of new processes and products, particularly new varieties and improved farming are the key factors in increasing yield and improving the quality and quantity of agricultural products. The patent system leads to an increase varieties adapted to local conditions, and may also lead to higher prices or reduced free availability of farmers to seed and influenced food intake. Due to the economic basis of the invention of the support system, the patent system can act as an essential tool to help these.

Increasing agricultural production helps food security by increasing the income of the rural and poor as well as through self-sufficiency in food production and price stability. Reduction of food prices in the local production of agricultural products reduces household food expenditures and creates employment for low-income classes' villages and small towns. Attention to technological innovation and commercialization strengthen have a key role in boosting agricultural production. For example, it may be imagined, the priority of food security requires the production of agricultural products, which have a role in providing essential food, take priority, but given the importance of commercialization, it must be said, essentially, we should not content to these matters and products that lead to more agricultural income and employment, also could be considered. If part of the population that lack food security could provide high yielding and modified varieties and the use of modern technologies, grow products that have faster and more commercial profitability, the hope to solve food insecurity, in their case, will be higher.

Sustainability in agriculture is other pillars of food security. Food production through the use of traditional varieties with low productivity, high water consumption, use of pesticides and chemical toxins ... that cause damage to other areas of human life such as health, biodiversity, and …, do not lead to solve sustainable food insecurity. Here, food security requires that, by supporting the development of new varieties that are resistant to pests and tolerant to drought, along with other forms of agriculture, such as agricultural mechanization, solving food needs will be coordinated by meeting other needs. Policy, based on this approach requires adequate information about the relation between food security and other areas in terms of physical infrastructure and social arrangements.

In another aspect, the patent, by strengthening the knowledge-based economy and industrial growth, because of it can lead to increase per capita income and stability in accessing adequate food. By strengthening the relation between industry and academia and attracting foreign investment in the field of knowledge-based products, Patent system can strengthen knowledge-based economy and employment and income, and increasing employment and per capita income has also helped to strengthen the element of access and stability.

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