



The Impact of Technological Changes on Small and Medium Enterprises (SMEs) in Turkish Agri-Food Industry

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Abstract: Food industry, as being one of the most important manufacturing industries, assists the nation to maintain a steady supply of food products. Turkish agri-food industry displayed a significant growth performance in the last few years. This study clarifies some factors influencing the growth of Turkish agri-food industry with the aim of identifying some technological changes and their impact within small-medium food enterprises in the last ten years. Information about these technological changes in Turkish food industry was realized through questionnaires and interviews. Some technological changes were determined as enlarged capacity of utilization and market share, application of Information and Communication Technologies (ICT), expansion of production lines, use of new packaging systems and participation of the work force in process improvement. It was observed that the number of food enterprises, especially small and medium, has gradually increased over the years and tackled with some problems of processing issues, technological expansion varieties, some technological changes and the factors responsible for technological changes in agri-food industries, and also, proposes how to increase the financial base of the small-medium food enterprises.

Key Words: Technological Changes; Small-Medium Enterprises; Food Industry; Turkey

Türk Tarıma Dayalı Gıda Sanayisinde Teknolojik Değişimlerin Küçük ve Orta Büyüklükteki İşletmeler (KOBİ) Üzerine Etkileri

Özet: Gıda sanayi, üretim sektörlerinin en önemlilerinden biri olarak, ülkelerin düzenli bir gıda arzı sağlamasına destekte bulunur. Türkiye tarıma dayalı gıda sanayisi son yıllarda önemli bir büyüme performansı göstermiştir. Bu çalışma Türkiye tarıma dayalı gıda sanayisinin büyümesini etkileyen bazı faktörleri, Küçük ve orta büyüklükteki işletmelerde son on yılda meydana gelen bazı teknolojik değişimleri tanımlamak ve bunların KOBİ'ler üzerine etkisini tanımlamak amacıyla, açıklar. Türkiye gıda sanayisinde meydana gelen bu teknolojik değişimler hakkında bilgi anketler ve görüşmeler yoluyla elde edilmiştir. Bazı teknolojik değişimler, genişletilmiş kapasiteden yararlanılması ve Pazar payının artırılması bilgi ve iletişim teknolojilerinin uygulanması, üretim hatlarının genişletilmesi, yeni paketleme sistemlerinin kullanılması ve süreç geliştirmeye iş gücünün katılması olarak belirlenmiştir.

Gör÷lmüştür ki gıda işletmelerinin sayısı özellikle küçük ve orta büyüklükteki işletmelerde son yıllarda gitgide artmış ve bu işletmeler, işleme konularında ve teknolojik genişleme çeşitlerinin seçiminde bazı problemlerle karşılaşmışlardır. Bu çalışmada tarıma dayalı gıda sanayisindeki bazı teknolojik değişimler ve bu teknolojik değişimlere neden olan faktörler belirlenip KOBİ'lerin finansal yapılarını nasıl geliştirebileceklerine dair önerilerde bulunulur.

Anahtar Kelimeler: Teknolojik Değişimler; Küçük ve Orta Büyüklükteki İşletmeler; Gıda Sanayi; Türkiye

Introduction

Turkey has gained a place among the 20 largest economies in the world with a gross domestic product (GDP) of almost USD 300 billion. Turkey's economic growth rate is increased through implementation of more liberal foreign trade policies and diversification of its exports seeing a shift from agricultural to industrial products over the last few years. The economic and employment contribution of the agri-food processing sector to the national economy is significant due to source and labor utilization (Cetin, 1994; Oktay and Güney, 2002). In parallel to the increase in product innovations in more recent years the number of agri-food manufacturing enterprises, in particular small and medium-sized enterprises (SMEs), has increased, which might reduce national dependence on imported foods, save foreign currency and encourage the growth of auxiliary companies (Kırım, 1990; Sariaslan, 1996).

The food and agriculture industry is the world's largest and most competitive manufacturing industry in which technological innovation is vital in order to improve competitiveness in global market along with maintaining food safety, health, and environmental challenges (Cetin et al., 1996). However, the rapid change in technology and the wide range of technologies available on the market entail difficulties in deciding efficient technology for the needs of agri-food manufacturers (Lanteigne and Laforest, 2007).

Since domestic agri-food industry has a significant effect on rural and economic development, providing a technology support structure in the shape of a sustainable network between agri-food entrepreneurs, local authorities and transnational partners should be encouraged. The main features to form an effective network depend on competences of the enterprises and can be classified as right level of technology, the appropriate quantity and quality of agricultural output, adequate infrastructure and facilities, and appropriate marketing structures and strategies.

Technology, a key component in strategic development, is inevitable in the industrial development process (Thomas and Sparkes, 2000; Earle, 1997). The technological development is the driving force on enterprises to invest on novel technologies more than their capacities (Kehinde et al., 2002). Improved ability of food enterprises to gain access to available knowledge and experiences will lead to increased competences of the enterprises and to present new opportunities for meeting rapidly changing demands of the food consumers (Fearne, 1994). Satisfaction of customers is mandatory for any manufacturing industry which wants to be competitive in the market (Trotman, 1982). The technical bases to improve the ability to gain access to knowledge are the Internet and information and communication technologies (ICTs). By adopting available novel technologies enterprises,

especially SMEs, can enhance their market share for both global and local markets, as rapid progress in technology constrains them to restructure their manufacturing process.

The purpose of this paper is to identify and analyze the impact of technological changes on competences of Turkish agri-food SMEs. The significance of this research primarily lies in the fact that the results can throw fresh light on developing strategies and measures to investigate in and reduction of entrepreneurial restraints to implement and use novel technologies. There are few studies providing empirical evidence in the Turkish context about the effect of technology implementation both on industry and on individual food SMEs.

Material and Methods

The empirical insights regarding the technological changes in agri-food industries are evaluated by questionnaires made by field studies as well as face-to-face interviews. These data are collected and evaluated from selected agri-food firms. The questionnaire was designed to measure the advantages and effects of technological changes and to identify the restraints in production, such as marketing, skilled operators, raw materials procurement, quality of raw materials and environment, in food SMEs.

Content analysis, a common method for investigating the written documents such as Web pages and has been extensively used in marketing, advertising, and information system literature, is conducted to classify the food SMEs (Babbie 2001, Liao et al. 2006). The SMEs were classified as i) fruit and vegetable processing industry, ii) grain mill processing industry, iii) poultry processing industry, iv) seafood processing industry, and vi) olive and olive oil processing industry. The selected food industry firms exist in the provinces of Marmara region. Since most of the existent sub categories in food industry in Marmara region are existent in this study, it is thought that the study represents the regions' food industry fairly well. For this study, totally 150 food industry firms were interviewed and the distribution among sub categories is as follows; fruit-vegetable processing industry (61), grain mill industry (40), poultry industry (12), Sea food (9), Olive and olive oil industry (28). SMEs in Turkey are defined as companies that have less than 250 employees. According to this study, the size of enterprises and the employee numbers have no effect on technological changes. In addition to this, information about the effect of technological changes on market share could not be obtained because enterprises were unwilling to answer this knowledge in their surveys.

Questionnaires are designed to measure the technological changes that have been implemented over the last ten years within these agri-food processing groups, including the adoption of new technologies, use of ICT, the number of new products/processes developed, impact of technological change on output, sources of technology change and economic consequences of technology innovation. The questionnaire consisted of five range scaled questions typically rated from 1 to 5 (1 being "Not at all" /5 being "Extremely important"), as well as, closed-ended and a multi-response questions.

Results and Discussion

SMEs have an important role in Turkish economy in sense of labour efficiency, and are characterized by diversity of their activities. It is a necessity for food processors or promoters to implement technological innovations in order to have a significant

competitive advantage in national as well as global market. The struggle with technology, lack of the necessary skills and knowledge as well as economic problems may result in reduction in marketing power.

The restraints in raw material quality and marketing are found as the major problems of agri-food SMEs (Table 1).

Even though grain mill and fruit-vegetable SMEs have these restraints in common, they are less affected by scarcity of skilled operators and environmental issues. Similar impact has been mentioned previously by researchers (Cetin et al., 2003(a)). The problems in raw material supply and quality as well as strategies of processing and marketing are the significant reasons of low productivity in food industry (Badescua and Garce's-Ayerbe, 2009).

On the other hand, the impact of environmental issues on olive-olive oil and poultry SMEs are colossal than other sub-groups. The lowest importance degrees given to environmental issues and scarcity of skilled operators by grain mill processing SMEs whereas poultry SMEs are facing the problems of raw material quality and supply.

Table 1. Problems Commonly Experienced with Processing Issues in Agri-food Industry

Problems	Agri-Food Industry Sub-groups					Mean
	Fruit-Vegetable processing Industry	Grain mill Products	Poultry Industry	Sea food Industry	Olive and olive oil Industry	
Skilled operators	2.15	1.96	3.6	3.25	3.45	2.56
Raw materials procurement	3.24	3.42	3.15	4.17	4.06	3.97
Quality of raw materials	3.98	4.33	3.24	3.9	4.02	4.15
Marketing	4.25	3.92	4.12	3.7	3.72	4.02
Environmental issues	2.5	2.14	3.4	3.05	3.54	2.75

Mean value of ranking (1 lowest-5 highest)

The technological needs of agri-food SMEs should be investigated with respect to the ability to innovate, qualification, organizational structures and procedures including methods development for improvement. Table 2 reveals that expansion of production lines; expanded capacity utilization, expanded market shares and use of ICT as a marketing tool have been the major concern for all industry sub-groups for technological change. (Cetin et al., 2004).

The active involvement of the management staff and production labor in the production process has contributed to the technological change observed. Employment of labor was ranked lowest for all SMEs, which may be the most the reflection of employing efficient labor. Introduction of new production lines was given the lowest value than the other technological expansions, meaning that SMEs are unwilling to adopt new process lines because of possible inadequate financial resources and inefficient utilization of existing lines. Labor employment, expansion of production lines and expanded market shares were

in the first place for fruit-vegetable-processing industry, as 3.94, 4.74 and 4.76, respectively, whereas poultry, seafood and fruit-vegetable processing industries choose the use of ICT as a marketing tool for technological expansion than other agri-food SMEs.

Table 2. Areas of Technological Expansion in Agri-Food Industry

Expansion Variable	Agri-Food Industry Sub-groups					Mean
	Fruit-Vegetable processing Industry	Grain mill Products	Poultry Industry	Sea food Industry	Olive and olive oil Industry	
Labor employed	3.94	2.96	2.85	3.89	3.15	3.22
Production lines	4.74	4.18	4.35	4.55	4.05	4.43
Capacity utilization	4.48	4.28	4.53	4.15	3.9	4.26
New product lines introduced	4.13	4.05	3.82	4.2	3.88	3.57
Market shares	4.76	4.17	3.84	3.76	4.33	4.05
Use of ICT as a marketing tool	4.26	3.73	4.29	4.32	4.02	4.17
Increased financial base	4.07	3.16	3.2	4.18	3.45	3.34

Mean value of ranking (1 lowest-5 highest)

The implication of ICT implementations in SMEs is majoring on research and development which result in innovation and improved firm competences. Table 3 shows some technological changes that have been made between 1998 and 2007 in agri-food industry sub-groups. For all examined agri-food SMEs process improvement is mentioned as the most important technological development, and followed by new packaging systems, thereby, enabling to have a larger market share by increased safe, palatable and high quality product demand. The tendency to adopt ICT for food industry is a peremptory necessity because of the rapid growth in computer systems, networks and online services. Use of ICT and novel computer-aided manufacturing equipment are given less importance in grain mill industry. Because of their small and flexible structure, SMEs adapt faster to the changes of the economy than larger enterprises. Despite of having flexibility in the economy, the most necessary element is financing so as to enlarge and continue their existence. Because of financial insufficiency, some SMEs, such as in grain mill industry, do not have developed technologies; they have to intensively employ labor instead with conventional processes.

For process improvement, introduction of new generation machines, new packaging systems and using ICT within broad food industry sub-groups fruit-vegetable processing and poultry industries have the highest values of change. The revolution in information technology and other technological communications changed the way people conduct business and these play an important role on globalization of international trade (Santarelli and D'Altri, 2003; Wymer and Regan, 2005). The spread of IT usage result in increased utilization of e-commerce in every industrial sector (Sang-Bae, 2001; Lu et al. 2001). The sellers and buyers can trade without seeing each other through the internet; thus, the firms can decrease their costs, and can increase the possibility of reaching wider crowds and promotion options (Shaw, 2000; Lal, 2005).

Table 3. Some Technological Changes Made over the Last 10 Years

Types of Technological Change	Agri-Food Industry Sub-groups					Mean
	Fruit-Vegetable processing Industry	Grain mill Products	Poultry Industry	Sea food Industry	Olive and olive oil Industry	
Process improvement	4.16	3.14	4.35	4.42	3.35	3.77
New packaging system	3.73	2.95	3.8	3.26	3.42	3.11
New computer aided manufacturing equipment	2.33	1.62	2.24	2.01	1.68	1.85
Increased automation	2.79	2.11	2.83	2.05	1.96	2.34
Introduction of new generation machines	3.72	2.71	3.6	2.65	3.04	2.98
Use of Information and Communication Technologies (ICT)	3.29	1.95	3.41	2.92	2.34	2.61

Mean value of ranking (1 lowest-5 highest)

The consequences some factors on technological changes in product and process improvement are examined in Table 4. Although poultry industry takes part in the first place in some technological changes as technological push, competitive pressure, improvement product quality, process development and anticipated increase in product demand, it has an insufficient capacity for existing equipment. Fruit-vegetable processing industry has the highest market saturation and the desire to improve long term stability values as 3.53 and 4.61, respectively, while the grain mill SMEs displayed the lowest values as 2.92 and 3.75. The consequence of having higher market potential has a positive impact on competitive pressure in all agri-food SMEs (Cetin et al., 2003(b)).

Table 4. Factors Responsible for Technological Changes in Product/Process Development

Product Development	Agri-Food Industry Sub-groups					Mean
	Fruit-Vegetable processing Industry	Grain mill Products	Poultry Industry	Sea food Industry	Olive and olive oil Industry	
Technological push	4.07	2.76	4.15	3.86	3.05	3.15
Greater financial base	3.44	2.81	3.05	3.08	2.73	2.97
Market saturation	3.53	2.92	3.1	3.47	3.01	3.22
Desire to improve long-term stability	4.61	3.75	4.43	4.1	3.83	4.15
Existence of large potential markets	4.54	4.07	4.13	4.02	4.62	4.24
Competitive pressure	3.2	3.87	4.62	4.56	3.12	4.47
To improve product quality	4.35	3.78	4.42	3.92	4.02	4.13
Process development	3.98	4.36	4.7	3.75	3.76	4.43
Anticipated increase in product demand	4.07	3.89	4.18	3.17	3.4	3.62
Inadequate capacity of existing equipment	3.77	2.87	3.96	2.98	3.43	3.61
High maintenance cost	2.76	2.53	2.05	1.94	2.35	2.24

Mean value of ranking (1 lowest-5 highest)

The number of new products and processes developed are shown in Table 5. Despite the fact that fruit-vegetable SMEs implement new processes and develop new products, grain mill SMEs are reluctant for product and process innovations. Seafood SMEs that have high marketing potential have consequent values to fruit-vegetable SMEs for novel process and product development with 20% and 17.7%, respectively. SMEs, like functioning in grain mill industry, that can not fulfill the finance and marketing functions properly, do not take innovation of process technology into consideration because of financial problems.

Table 5. Number of new products/processes developed

	Agri-Food Industry Sub-groups					Total
	Fruit-Vegetable processing Industry	Grain mill Products	Poultry Industry	Sea food Industry	Olive and olive oil Industry	
Number of changes in processes developed	12	2	4	5	2	25
(%)	48	8	16	20	8	100
Number of new products developed	34	11	20	17	14	96
(%)	35.42	11.46	20.83	17.7	14.59	100

The impact of technological changes on output of agri-food industries are evaluated in Table 6. Technological changes have positive impact on quality improvement, consumer preference on the product, conservation of raw materials, cost reduction, increase in the volume of output, labor utilization efficiency, reduction in energy consumption and improvement in facility layout. Grain mill SMEs has lower impact of technological changes than other industry sub-groups because of having inadequate novel computer-aided manufacturing equipment, ineffective use of ICT, poor introduction of new generation machines and non-increased automation.

Conclusions

The paper focuses on how sustainable growth of Turkish agri-food companies in the global market can be accomplished through the technological changes and evaluates the forms of promotional marketing facilities undertaken by agri-food SMEs in Turkey. The influential factors on the growth of the Turkish agri-food industries are evaluated and the suggestions to accelerate the growth while contributing to the development of the national economy are made.

In spite of a strong agricultural base and being a good producer of food products in the world, Turkish agri-food processing industry is far from tapping its full potential because of a low rate of technological progress and increasing inefficiencies of the firms. It is necessary to encourage imports so as to ensure faster technological progress in the food industry. However, the technological possibilities depend on the mode of organization and various economic factors. Therefore, the other types of changes are to be made together with technological changes in order to substantially reduce the inefficiency.

Table 6. Impact of Technological Changes on Output of Companies

Impact	Agri-Food Industry Sub-groups					Mean
	Vegetable-Fruit processing Industry	Grain mill products	Poultry Industry	Sea-food Industry	Olive and olive-oil Industry	
Quality improvement	4.46	3.98	4.67	4.39	4.05	4.35
Consumer preference on the product	4.53	4.07	4.61	4.25	4.23	4.49
Conservation of raw materials	4.43	3.78	4.01	4.21	3.86	3.98
Cost reduction	4.35	3.46	4.42	4.11	3.77	4.08
Increase in the volume of output/economies of scale	4.61	3.94	4.56	4.24	4.05	4.37
Personnel utilization efficiency	4.25	3.9	4.07	4.11	3.95	4.1
Reduction in energy consumption	4.41	3.92	4.3	4.45	3.97	4.23
Improvement in facility layout	3.99	3.5	3.97	3.85	3.61	3.64

Mean value of ranking (1 lowest-5 highest)

Turkish agri-food industries have the chance of increasing competitiveness related with constituting an effective, productive and appropriate work environment. The improvement in the work environment, providing information security and technology can increase the competitiveness in international arena.

Technological changes assist firms in establishing new markets and determining selling capacity. Adoption of communication technologies together with low cost and security as marketing strategy, enterprises can directly get more profit with an increase in selling capacity.

By using Internet there will be a significant increase in job opportunities; selling products will become easy, advertisement, promotion, and support before and after selling will be used more effectively; to come into contact with more customers by automatic information distributor system; business productivity analyses and planning will be done more easily. However, the technological changes to utilize ICT in Turkey were not able to reach the importance it deserves, in the last ten years. Especially the firms that want to have a competitive advantage in today's markets should make the necessary investment to optimize ICT usage. As a result, the enterprises lack of enough knowledge on the use of information technologies. Some industries are also having difficulty in finding and employing qualified workers on information technologies. It is important for enterprises to utilize information technologies that are widely used in recent years in order to increase their quality levels, and to have a place in national and international competition. It is needed to train qualified employees that will work in food industry enterprises.

In order to maintain technologic knowledge, the industries should spend conscious effort; spend time, labor and money. Industries that have efficient technologic knowledge can benefit from the advantages of establishment of new institutions, being aware of

technological alternatives, improving their product quality, increasing the firm's productivity level and increasing also their success in global market.

The chance of increasing competitiveness of Turkish food industry firms' within the global information economy is parallel to the formation of an appropriate, efficient and productive working environment, however, the reflection is negative on product quality. Deficiency in product quality and technology innovation decreases the selling power of SMEs, and results in difficulty in exportation and competing with the larger firms in international market.

The agri-food enterprises in Turkey are mainly small and medium enterprises, which limits the usage of modern technologies due to financial issues and technologic knowledge. The conclusion obtained from the results of the current evaluation of SMEs show that technological changes is a driving force of competitive pressure, and thereby, implementation of novel technologies to create and increase competitive strengths and to sustain these strengths is crucial for SMEs.

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