A STRATEGIC FRAMEWORK FOR ENHANCING PRODUCTIVITY AND COMPETITIVENESS IN AGRI-BIOTECH SECTOR OF PUNJAB

A Thesis submitted

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DECLARATION

I hereby declare that this thesis entitled "*A STRATEGIC FRAMEWORK FOR ENHANCING PRODUCTIVITY AND COMPETITIVENESS IN AGRI-BIOTECH SECTOR OF PUNJAB*" is an original work done by me for the award of the degree of Doctor of Philosophy in Management. I also declare that this thesis or any part of it has not been submitted by me for the award of any degree, diploma, title or recognition before.

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CERTIFICATE

Certified that the thesis entitled "**A STRATEGIC FRAMEWORK FOR ENHANCING PRODUCTIVITY AND COMPETITIVENESS IN AGRI-BIOTECH SECTOR OF PUNJAB**" which is being submitted by Mr. Sandeep Singh, in fulfillment of the requirements for award of the Degree of Doctor of Philosophy in Management, Thapar University, Patiala, is a record of candidate's own independent and original research work, carried out by him under our supervision and guidance. The matter embodied in this thesis has not been submitted in part or full to any other University or Institute for the award of any degree.

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CONTENTS

ABSTRACT

Agri-Biotechnology is an emerging area with a lot of scope for research. The research in Agri-Biotech sector is mostly on cropping areas .The present study covers empirical research on selected Agri-Biotech firms of Punjab. The sample has been chosen from the state of Punjab covering Dairy Products, Food Processing and Chemical: Fertilizer /Pesticides/ Distillery.

The objective of the study was to determine productivity trends in Agri-Biotech sector, to identify the factors affecting productivity and competitiveness and to design a strategic framework for enhancing productivity and competitiveness in Agri-Biotech sector.

Secondary data was used for finding out labour productivity, capital productivity and total factor productivity. Results indicate that low capital productivity and total factor productivity and high labour productivity as well as high capital labour ratio. Inter industry difference shows chemical sector performing better than food and beverage sector.

The findings of the study included the identification of the factors affecting productivity and competitiveness. On the basis of factor analysis the study identified key factors influencing productivity. These include: Internal and External Environment; Cost Efficiency; Production Planning and Control; Technological Advancement. The analysis was also done on the basis of size of the firm, viz. small, medium and large and also on the basis of nature of industry. The results of ANOVA highlight a significant difference on the basis of size viz. small, medium and large for factors influencing productivity. ANOVA results depict difference evident on the basis of nature of industry, viz. Dairy Products, Food Processing and Chemical: Fertilizer /Pesticides/ Distillery for factors influencing productivity.

Next step was to identify the key factors influencing competitiveness using factor analysis. These include: Threat of new competition; Threat of substitute products or services; Bargaining power of suppliers; Intensity of competitive rivalry; Bargaining power of customers; Rivalry among existing firms. The study also tried to evaluate the findings on the basis of evident literature. The analysis was also done on the basis of size of the firm, viz. small, medium and large and also on the basis of nature of industry. The study uses ANOVA for highlighting the difference on the basis of size of the

firm factors influencing competitiveness. The findings highlight a significant difference on the basis of size for factors influencing competitiveness. ANOVA was also used for highlighting the difference on the basis of nature of industry factors influencing competitiveness. The results depict difference evident on the basis of nature of industry, viz. Dairy Products, Food Processing and Chemical: Fertilizer /Pesticides/ Distillery for factors influencing competitiveness.

Finally structural equation modeling was used to a strategic framework for enhancing productivity and competitiveness in Agri-Biotech sector of Punjab. The dependent variables were market share and investment on research and development. The independent variables were competitive factors and productivity factors. The results indicate that from Research and Development (R&D) expenditure perspective productivity factors are important, while from the market share perspective competitive factors are highly important. The study also highlights low level of IPRs in the state especially patents. Thus there is a need to focus on these perspectives to enhance productivity and competitiveness in Agri- Biotech sector.

The findings of this study have significant policy implications for the Agri-Biotech sector of Punjab. The Agri-Biotech sector of Punjab is using higher inputs, but still the performance in terms of productivity is low and needs to be improved. This sector is using more of capital input, as capital labour ratio is higher.

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LIST OF ABREVIATIONS

ANOVA	Analysis of variance
AVE	Average variance extracted
CR	Composite reliability
CSO	Central Statistical Organization
DF	Degree of freedom
ERP	Enterprise resource planning
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GSDP	Gross State Domestic Product
IP	Intellectual Property
IPRS	Intellectual Property Rights
IT	Information technology
R&D	Research and Development
SCM	Supply chain management
SCMIS	Supply chain management information system
SEM	Structural equation modeling
TFP	Total Factor Productivity
TFPG	Total Factor Productivity Growth
TRIPS	Trade Related Aspects of Intellectual Property Rights
WTO	World Trade Organization

CHAPTER-1

INTRODUCTION

This chapter presents the theme and lends a brief background on the contextual area of research on the designated topic, 'A Strategic Framework for Enhancing Productivity and Competitiveness in Agri-Biotech Sector of Punjab.' It introduces the research problem. Section 1.1 covers the introduction of the topic, setting the scene for research. Punjab Economy has been depicted in Section 1.2. The rationale for the study has been portrayed in Section 1.3. In Section 1.4, the objectives of the study have been highlighted. Section 1.5 divulges the organization and the layout of the thesis. Second chapter presents the literature review which comprises of the different studies on productivity and competitiveness. Third chapter introduces the design of research with methodology. Fourth chapter is focused on the analysis of data and interpretation of responses to questions collected through the questionnaire. Fifth chapter covers the implications and significant findings of the study. It also highlights the recommendations regarding the proposed model of the study. It covered the critical evaluation of the research work, revisiting the research objectives, indicative of exactness, diligence, contributions. It draws comparisons with similar works. Finally it enlists the future research areas.

1.1 Introduction

Biotech sector has gained global visibility and has emerged as an important significant sector next to information technology. It has transformed every sector in the economy starting with agriculture, food, pharmaceuticals, health care, industrial processing and environmental sustainability which are being directed towards rising investment opportunities in India as well as in other countries.

Biotechnology is an innovative branch and many new drugs are manufactured and discovered due to its contribution. Biotechnology medicines existent in the market are

manufactured at lesser prices and in an easier manner. In order to treat diseases in human beings the first genetically engineered products which were designed were medicines. The application of biotechnology in the modern world has increased and the sector has contributed in growth in a great manner. Earlier the diseases which were untreatable now have become treatable due to thorough knowledge of science, which has helped in the development of new medicines. Agri-Biotechnology is an emerging area with a lot of scope for research. The research in Agri-Biotech sector is mostly on cropping areas, and limited research has been done on factors influencing productivity and competitiveness in Agri-Biotech sector, especially on designing a framework for enhancing productivity and competitiveness in Agri-Biotech sector.

There is emergence of new and innovative advanced technologies, scientific discoveries and inventions and it is pertinent to study these in relation to Agri-Biotech sector. Thus, there is a pressing need for the studying productivity and competitiveness in relation to Agri-Biotech sector. According to Kumar (1985) the determinants of production influence the price of commodities. This necessitates a "paradigm shift" to warrant a healthy environment for the well-being of the present and future generations. There must prevail a sense of responsibility, so that a cleaner and "Safer Earth Planet" is handed over to the coming generations. This will lead to sharing a pollution free environment by all nations with equal share of resources that are accessible on earth. In the changing business environment innovation and IPRs (Intellectual Property Rights) are gaining increasing importance, as they are a source of creation of wealth and nation’s well-being. The competitiveness of firms has been improved due to the involvement in cooperative research and development. More emphasis has been laid on the protection of IPRs (Intellectual Property Rights) by increasing the budget for the development of new technology.

It is important to understand changes that have occurred at global level to have a deeper understanding of the impact it may have on the way businesses are being conducted. India had been a member of the General Agreement on Tariffs and Trade (GATT). It has been a member of World Trade Organization (WTO). WTO marks transition in how business is conducted in the world and India has been no exception. It governs the

multilateral trade between its members. It has the responsibility to implement Trade Related Aspects of Intellectual Property Rights (TRIPS) and General agreement on tariffs and trade (GATT) in services. The agreement on trade related aspects of intellectual property rights is an international treaty by WTO, which sets down minimum standards for most forms of intellectual property regulations within all member countries. It sets the minimum standards of protection to be adopted by member countries in respect of patents, copyrights, trademarks, trade secrets, industrial designs, geographical indications and integrated circuits.

At global level the issue of controversy is the relationship between international trade and intellectual property protection. In order to prevent the imitation of the innovations by others Intellectual Property Rights (IPRs) play an important role. Many implications of the trade are covered by TRIPS agreement under WTO. It helps in the development of technology and formulation of new strategies to become competitive.

A transitional phase of the Indian economy is going on. Liberalization, privatization and globalization have led to industry restructuring. The progress in science and technology has accelerated because of economic integration. Ever since the beginning of industrial era, several efforts have been initiated for the improvement and enhancement of manufacturing productivity, (Grunberg 2003). In the field of performance improvement, Adam Smith (1996) was the first known practitioner. Advances in technology have created new opportunities for businesses. Technology plays a vital role in the development of any economy. Modern industry is driven by technology, and lack of access to technology can lead to stunted economic growth. Technology played an important role in the rapid economic growth observed in the late twentieth century in Korea, Taiwan, and Singapore. The World is changing fast and the world of business is changing even faster. In the new millennium, business corporations will have to deal with entirely new challenges to meet customer demands, move from competition to collaborative reconfiguration, dovetail supplier and subcontractor processes to the corporate goals and empower employees to be able to meet and surpass customer expectations. With increasing global competitiveness companies are taking more effective and innovative steps to improve overall productivity, quality and efficiency.

1.2 Punjab Economy

Punjab is one of the developing states of India. Growth in economy has accelerated and per capita income has risen as compared to other states. Punjab won best performance award in state of states 2013-14 (India Today, 2014). It provides the best infrastructure in comparison to the other states and has GDP (Gross Domestic Product) value. This includes road, rail, air and river transport links that are extensive throughout the region. Punjab has also one of the lowest poverty rate in India at 6.16% (1999-2000 figures), and has won the best state performance award, based on statistical data compiled by the Indian Government. In 2012, the state was one of the highest receiver of overall remittances to India which stood at $66.13 billion, after Kerala, Tamil Nadu and Uttar Pradesh. Dera Bassi, Jalandhar, Amritsar, Ludhiana, Patiala, Bathinda, Batala, Khanna, Faridkot, Rajpura, Mohali, Mandi Gobindgarh, Ropar, Firozpur, sangrur, Malerkotla and Moga are major financial and industrialized cities. A big share of state's GDP comes from these cities.

Punjab (the five rivers region) is one of the most fertile regions on earth. The region is ideal for growing wheat crop. Rice, sugar cane, fruits and vegetables are also grown. Indian Punjab is called the "Granary of India" or "India's bread-basket." Many records mistakenly mention that it produces 43% of India's wheat, but that is actually its contribution to the national pool. It produces 17% of India's wheat, and 11% of India's rice (2013 data). The total area of Punjab is just 1.4% of total area of India, but it produces roughly 12% of the cereals produced in the country. The largest grown crop is wheat. Other important crops are rice, cotton, sugarcane, pearl millet, maize, barley and fruits. The principal crops of Punjab are barley, wheat, rice, maize and sugarcane. Among the fodder crops are bajra and jowar. In the category of fruits, it produces abundant stock of kinnow. The main sources of irrigation are canals and tube wells. The rabi or the spring harvest consists of wheat, gram, barley, potatoes and winter vegetables. The Kharif or the autumn harvest consists of rice, maize, sugarcane, cotton and pulses. Agriculture sector is the largest contributor to the gross state domestic product (GSDP) of Punjab. According to 2013-14 data, the contribution of agriculture and allied industries in GSDP at factor cost is 28.13%.

The state has essentially an agrarian economy with a lower industrial output as compared to other states of India. A prominent feature of the industrial scenario of the Punjab is its small sized industrial units. There are nearly 194,000 small scale industrial units in the state in addition to 586 large and medium units. Derabassi, Ludhiana is an important centre for industry. In the 1980s there was a chance of a Hero Honda and Maruti Suzuki plant to be set up in Ludhiana but due to some circumstances of terrorism it was cancelled.

According to the 2008 Global Hunger Index, Punjab has the lowest level of hunger in India. Less than one-fourth of children below the age of five are underweight. Thus based on these parameters the state of Punjab was selected.

The planned development strategy is responsible for this. However there were some problems like war with Pakistan, otherwise the growth would have been faster. Since independence the economy of Punjab has developed impressively. Different activities of productivity were organised by farmers and industrialists. They were given full support by the government. The government policies maintain a balance between growth rate and prosperity.

Due to concentrated efforts many trained workers were developed, which improved the manufacturing sector in Punjab. During 1950 incentives were proposed to entrepreneurs. Investment in power was given the topmost priority by the government in five year plans. All the resources were channelized with proper planning. The demand for agro processing, agro-input, and machine goods were increased due to improved output in agriculture. In 1960 agricultural implements, bicycles, and foundry products were manufactured in Punjab and small-scale industries were developed.

Different cities were becoming industrial centres in Punjab. Ludhiana was ahead of Amritsar for the manufacture of consumer goods, as well as engineering products in 1960. Products of iron were under production in the rolling mills of Gobindgarh. The agricultural output was increased with green revolution and it provided an improvement in the industrial activity of Punjab. Hence, the economy of the state was growing with high outputs and consumption rates. Industry in Punjab developed under competition restricting policies, which included reservation of certain product lines, high import

duties and promotional measures. As a result the industry lagged behind in modernization and technological upgrade. But, New Economic Policy (NEP) of 1991 based on three planks of liberalisation, privatisation and globalisation, along with signing of the WTO and introduction of Trade related Intellectual Property rights (TRIPS) set in a new era of competition and technology up-gradation, thus manufacturing of Punjab also had to respond to these changes. The present research tries to identify how Agri-Biotech firms have responded to the stronger Intellectual Property Regime (IPR) regime and competitive environment.

Apart from farming, the global era has opened many new opportunities in Agri-Biotech sector to earn more and generate employment for different sections of society. The global era along with new developments in technology and discoveries in science forces the Industries to become more competitive. The globalised scenario through the development and growth of industries leads to growth in the economy and changes in the society. In the future pollution control, food processing, management of waste will become easier due to new technologies. United States has led the world in commercial development of Agri-Biotech sector, because of its strong research base and ability of financing the new innovative ideas. During the last few years the revenue generated through this sector has rapidly increased. The productivity of agricultural sector of U.S. was boosted as enforcement of intellectual property rights in the world was improving. What is prevalent scenario of IPRs in Agri-Biotech sector in India needs to be examined?

Actual boost came with green revolution which brought unprecedented growth in agricultural output. This was followed by an increase in manufacturing and selling of dairy products due to high incremental stock of milk as a result of white revolution. During this transitional phase came the concept of the combinational activities of agriculture and dairy farming which led to growth of economy. New developments and scientific assistance enhanced the fruits of the activities in Agri-Biotech sector and thus lead to its popularity and increased attention for research in this area.

A National Innovation policy has already been put in place to unleash full innovative potential. It is responsible for knowledge diffusion, competition between firms, innovators at the basic level and technology support at earlier stages. In order to implement the innovative programs, it is essential for private sector to join hands with the institutes encouraging R&D activities. The government should fund the innovators and incentives must be provided for their work. The firms are focussing on IPR strategies so as to become more competitive.

Punjab Government has taken many steps for promoting R & D in relation to biotechnology. Due to the presence of firm base of agriculture opportunity lies in the development for biotechnology in Punjab.

On the path of development the government is setting up a biotechnology park near Chandigarh. It is being set up with an estimate of US$ 22 million. Punjab State Council for Science and Technology and Beckons Industries Ltd are setting it up as a public-private partnership. It will provide the facilities of validation, pilot testing and will act as an incubator of biotech for research and development. Small and Medium Enterprises (SMEs) will be attracted towards this and thus would be contributing to this sector for R &D improvement.

Dr Morepen, Ranbaxy, Panacea Biotech are some other companies which are interested in this park as for widening their business the role of single window agency will be played by the government.

1.3 Rationale for the Study

There is a need to understand what changes are occurring in Agri-Biotech sector and how Agri-Biotech sector of Punjab is responding to the new changes that have happened especially in view of adoption of WTO by India. The present study considered only dairy products, food processing and chemical firms for analysing the trends in Agri-Biotech sector of Punjab. In terms of milk availability after Haryana and Gujarat, comes Punjab. Due to this reason dairy products were included in the present study. AMUL opened its first milk plant at Batala in 2015. Different plants are situated at Verka (Amristar district), Ludhiana, Mohali, Jalandhar, Patiala, Hoshiarpur,

Gurdaspur, Ferozepur, Sangrur, Bhatinda, Faridkot, Nabha, Moga, Kot Kapura and Hamira. Moga plant is the biggest plant in the state. It has an estimated capacity of processing 435 thousand litres of milk.

Food Processing Sector plays a major role in driving improvements by filling the gap between 'farm and shelf'. Due to the large availability of vegetables and food grains the food processing industry has improved in Punjab. The third sector considered for analysis is chemical sector covering fertilizers, pesticides and distillery. Bio-fertilizers and bio-pharmacy sector is also growing at a fast pace. Between 1950 to1980 developing countries were given an important place in Intellectual Property (IP) system internationally. Process patents over product patents were favored by India. So it helped to manufacture imported products in local firms after the process demonstration (Penrose, 1951). Again this favors the importance of covering Chemical firms including Bio-Fertilizers and Bio-Pharmacy and hence they were included in the scope of the present study.

There is a need to determine productivity trends in Agri-Biotech sector and it is equally important to identify the factors affecting productivity. There is also a need to identify the factors affecting competitiveness. Focusing on productivity and competitiveness is the need of the hour for creating intellectual capital. In order to enhance productivity and to gain an edge over other firms, many firms implement IPR strategies which improve competitiveness as well. After examining these, the research focuses on designing a strategic framework for enhancing productivity and competitiveness in Agri-Biotech sector.

1.4 Purpose of the study

The study was carried out with the purpose to design a strategic framework for enhancing productivity and competitiveness in Agri-Biotech sector. To accomplish this it was essential to investigate:

R_1: What are the trends in productivity in Agri-Biotech sector?

R_2: Which factors affect productivity in Agri-Biotech sector?

R_2: Which factors affect competitiveness in Agri-Biotech sector?

1.5 Organization of the Thesis

Chapter 1 – Introduction

The chapter provides a brief outlook of research work. It defines the research problem, presents the rationale and purpose of the study. This study has been conducted for designing a strategic framework for enhancing productivity and competitiveness in Agri-Biotech sector of Punjab. This chapter also presents the structure of the thesis.

Chapter 2 - Review of Literature

The chapter presents the literature review. The papers reviewed from different sources helped in understanding the various concepts. It gave a brief of research findings related to the factors affecting productivity and competitiveness. The review helped to lend the emphasis and direction to present research learnings from the findings, scope and limitations of earlier studies conducted by different researchers. Clearer insight could be gained through the objectives fulfilled and benefits reaped by earlier researchers. The review helped in the identification of the gaps in earlier works, to lay down the present research objectives and to choose the right strategies for pursuing research.

Chapter 3 - Research Design and Methodology

It introduces the design of research with methodology. The research objectives have been chalked out clearly along with formulation of hypotheses. It mainly focuses on the research design, sampling design, sources of collection of data, details of questionnaire, reliability and validity test. This chapter also highlights the research methods used to prove the hypotheses of the study. It also presents the conceptual model of the study.

Chapter 4 - Data Analysis and Interpretation

The chapter is focused on the analysis of data and interpretation of responses to questions collected through the questionnaire. The study used secondary data to assess the growth of Agri-Biotech sector and to analyse partial and total factor productivity of

this sector. ANOVA, Factor Analysis, Multiple Regression was used to analyze the data. ANOVA was used in the survey based analysis for finding the relation between size and age of the organization with factors influencing productivity and competitiveness of firms in Agri-Biotech sector. Factor analysis and regression models were used for finding the important predictors of productivity. Finally structural equation modeling was used to design a strategic framework for enhancing productivity and competitiveness in Agri-Biotech sector. Initially the factors affecting productivity and competitiveness were identified and after that a strategic framework for enhancing productivity and competitiveness was designed.

Chapter 5 - Conclusion

This chapter covers the learnings, implications and significant findings of the study. It also highlights the recommendations regarding the proposed model of the study. It covered the critical evaluation of the research work, revisiting the research objectives, indicative of exactness, diligence, contributions. It draws comparisons with similar works. Finally it enlists the future research areas.

Summing Up

An attempt has been made for proposing a strategic framework for enhancing productivity and competitiveness in Agri-Biotech sector. A brief outline of research has been drawn, focusing on research to identify the factors affecting productivity and competitiveness and highlighting the research components and the need for research in this direction. Following the introduction, the next chapter focuses on review of literature covering research studies on productivity and competitiveness.

CHAPTER-2

REVIEW OF LITERATURE

Agri-Biotech sector is facing many challenges due to globalisation. A lot of economic importance is given to design and operation of Agri-Biotech systems. Firm performance remains unpredictable in spite of the considerable literature on productivity improvement, and as such there is no widespread agreement on how to gauge the best performance. An in depth analysis of earlier studies will throw light on issues and concerns related to productivity performance and also on competiveness. In view of this the present chapter reviews the insights provided by eminent researchers who have worked on these areas.

The literature review has been categorised under the different headings:

2.1 Studies on productivity

2.2 Studies on competitiveness

2.3 Studies on Productivity, Competitiveness and Firm Performance

2.1) Studies on productivity

Productivity involves the competence and efficiency with which inputs are converted into output. When the costs are decreased and resources are used efficiently growth in productivity is witnessed. This enables a firm, to reduce the prices of its products to increase its profit margins by minimising the inputs and maximising the output. However, according to Hitt and Brynjolfsson (1996) profitability does not mean productivity at all times and vice versa. To analyse the economic growth nationally and internationally productivity is viewed as the most significant aspect.

Lee et al. (2007) makes a comparison of Indian and Chinese manufacturing in terms of labour productivity and output for the period 1980 to 2002. The results indicate that Chinese manufacturing outperformed Indian manufacturing in terms of growth in labour productivity and value added. Further results for analysing impact of trade reforms on productivity highlight that majority of the industries experienced total factor productivity regression in pre-reform period, as total factor productivity growth was 0.53, in comparison growth of 0.69 in post-reform period.

There are numerous studies covering productivity in Indian manufacturing sector as a whole. A brief overview of literature is essential to highlight the issues related to trends in productivity. From 1946 to 1964 Banerji (1975) examined index of partial productivity of labour, index of capital and total productivity for manufacturing sector. Technical progress was not evident. An increase was observed in labour productivity. Mehta (1980) studied only the large scale sector. The results established that the efficiency of the industrial sector was declining.

Several studies focus on enhancing productivity through investment in human especially through training and development and on capital infrastructure, particularly through investments in new technology. These studies considered partial productivity only, however partial productivity indices failed to compute and measure technical advancement. This lead to the emergence of the index of Total factor Productivity (TFP) [Ahluwalia (1991), Goldar (1985), Srivastava (1996)]. Ahluwalia (1991) exhaustively studied the period 1959 to 1985 and reported deceleration in total factor productivity of the manufacturing sector during sixties and seventies. There was a turn-around reported in the first half of eighties and productivity growth showed acceleration. Growth of value addition in majority of the manufacturing industries was the major reason for enhancement and increase of total factor productivity. Another major contribution was made by Goldar (1986). He reported that progress in technology contributes only marginally to growth output. From 1951 to 1979 the growth rate was 1.27 per cent per annum annually. Srivastava (1996) highlighted that total factor productivity growth (TFPG) during (1980 to 1984) was negative, while for the period

1985 to 1988, it was in the range of 0.10 per cent to 2.00 per cent per annum. This study reported acceleration in TFPG rates in 1987.

There are diverse results and no unanimity and consensus on TFPG which is mainly due to methodology adopted and differences in measurement of capital and labour issues.

Few researchers' [Goldar, 1986, 2000; Rao, 1996; Gangopadhyaya and Wadhwa,1998; and Trivedi et.al., 2000] reported that in 80s there was an increase in TFP in Indian manufacturing sector. Das (2003) suggested a deceleration in post-1991 reform period in TFP. The results were reverberated by Kiran and Kaur (2007), and TFP for the entire period for manufacturing in India during 1980-81 to 2002-03 was 1.24 per cent per annum. In depth analysis for sub-periods indicated a drop of TFPG from 1.53 in to 0.44 per cent from pre to post-liberalisation phase. From 1992-93 onwards era liberalisation phase was mainly associated with lower TFP growth. Another important finding of the study was that dismal performance on capital productivity, as it was very low for entire manufacturing sector in India during this period and there was a pressing need to improve efficiency of capital to augment total factor productivity.

In contrast to numerous studies at all India level, very few have been conducted on productivity of Punjab manufacturing sector. TFP along with partial productivity for the state was calculated by Singh (1987) during 1967-68 to 1981-82. The study depicts deceleration in productivity. Some sector specific studies were conducted. Growth with structure of hosiery of Punjab industry during 1975-81 was analysed by Bhardwaj (1990). In domestic and international markets the demand for hosiery products was increasing. Many problems were solved by the small scale units.

Singh (2004) investigated the growth in productivity in Punjab manufacturing sector during 1983 to 1999 due to the impact of economic reforms. The capital intensity was soaring high, which suggested capital deepening. The findings also suggested an increase in labour productivity. Moreover, the rate of growth for labour productivity was higher during post-reform. In contrast capital productivity revealed a deceleration in the study period. One positive aspect in post-reform was that for capital productivity rate of growth was affirmative. During pre-reform it was pessimistic. These conclusions

indicated that capital input efficiency was low in the pre-reform era. In contrast during the time of post-reform it showed an improvement. The estimates of average annual rates of growth of capital intensity also revealed an increase in this stage. The comparative analysis of average annual growth of Kendrick, Solow and Translog indices suggested that the overall factor use efficiency in the manufacturing sector of Punjab decelerated during the post-reform phase, which reflected technological retrogression in Punjab. Few studies that have been done on Punjab manufacturing covered the entire manufacturing sector and as such specific study on Agri-Biotech sector has not been undertaken earlier, hence there is a need for conducting such study.

There are several studies covering inter-industry differences in productivity, very few focused on factors influencing productivity, some cover productivity and technology nexus, other researchers wrap up relation of productivity, innovation and intellectual property rights (IPRs). Many important ones have been considered to throw more light on related literature.

Khamba and Singh (2001) considered technology adoption and adaptation as the most critical elements for a firm's performance. Sethi et al. (2007) highlighted several significant factors through which manufacturing firms have competition in technical capability and flexibility. To achieve flexibility and gaining edge over others, human beings constitute an essential and important factor. Their training, skill and technical expertise are necessary for firms. Thus, an important aspect of productivity is investment on human resource development. Labour productivity and capital productivity both constitute productivity (Arif et al. 2006). Organizations are successful which adequately supervise their technological resources besides their employees (Hollbeche, 1998). Creativity, novelty and innovative skills of human resources can improve by providing them suitable credit and award for their creative work (Koning, 1998).

Singh (1995) analysed the effect of HRM practices on organizational performance in Jordan within the financial services industry through the study of managers and also by considering the reports of the companies annually included in the study. The purpose was to investigate the HR practices that are most closely associated with healthier and

improved organizational performance. Majority of respondents accepted that it was not training alone, but the extrinsic incentives that resulted in better outcome. Belwal (2014) highlighted the importance of training needs of employees and opined to consider and focus on them for convalescing productivity. Ramayah (2009) further paid attention to this issue and opined that effectiveness depends upon Human Resource (HR) roles and HR contributions. Thus, investment on humans cannot be ignored and labour productivity improves with investment on humans.

Technological advancements with new infrastructure especially IT, telecommunication, and practices with strategic thinking are essential to create an environment which is hyper competitive (Sheel, 2002). However, Bartelsmann, van Leeuwen and Nieuwenhuijsen (1996) reported a contradictory result, in terms of the importance of new technology for productivity growth in Netherlands. Along with focus on technology, there was an emphasis on enhancing commercial value through investment on IPRs. In product form i.e. tangible, it becomes valuable but intellectual property is intangible as an idea.

IP is not the product itself, but idea and mental creation expressed and conceptualised as products (Idris, 2002). This view is not new and Scherer (1983) emphasized on propensity to patent across sectors or firms. These thoughts were supported by Ulku (2004), as he suggested that innovation (as proxied by patent applications) is important for Gross Domestic Product (GDP) per capita and also for enhancing TFP. Cornish and Lewelyn (2003) emphasized IP for illustrating different types of intangible property. IP comprises of patent, trade mark and copyright.

Similar thoughts have been expressed and accepted by researchers at global level as well. Wang and Tsai (2003) studied a sample of 136 large Taiwanese firms for the period 1994-2000 and established R&D investment as a significant determinant of TFP growth. Maskus (2000) discussed two different views of IP. First are the natural-rights that considered ownership as creator's natural right for mental creations. Second one is the public-rights view. This view considered free accessibility to information to be vital and important for cultural growth as well as social well-being. The information should

be in public domain. Thus, there are still inconsistencies, and there is a need for more focused study covering thorough examination and detailed analysis. Moreover the results differ across countries. There have been many studies which focused to use patents as innovation indicators. Some shortcomings are related to the measurement of patent data and outcomes of innovation (Griliches 1990). According to Singh (2008) structural change leads to employment implications. Employment has an important relation with the changes that need to be made in the structural format.

The productivity and efficiency of biotech industry in Taiwan was evaluated with Mamlquist models and data envelopment analysis. During 1998-2001 panel data set was utilized which comprised of thirty one biotech firms which were in the list. TFP increased during 1998-2000 and in 2001 it decreased.

The technical efficiencies of chemical and food related firms were low. This was revealed by Mamlquist indices. Changes in technology were responsible for TFP changes in biotech. More efforts were in efficiency improvement (Mei-Fang Chen et al., 2005). The results by Darwish & Singh (2013) provided strong support for the involvement of human resource functions into the business. Financial performance is enhanced by corporate strategy. Tehseen & Ramayah (2015) highlighted that the influence of entrepreneurial competencies on success of SMEs business is moderated by external integration. For gaining competitive advantage the management of relationships with their customers and suppliers is necessary for entrepreneurs. They learn about new innovations and customer preferences.

Not only investment in new technology is important, implementation of new software such as supply chain management and enterprise resource planning are also vital for improving firm productivity and performance. According to Seth, Kiran and Goyal (2015) for industry practitioners critical success factors will be acting as a guide for the Supply chain management information system implementation.

2.2) Studies on competitiveness

According to Lall (2001), competitiveness analysis describes the concept of competitiveness; explains the way it is calculated and identification of the important factors that influence it. It underlines the interactions among the factors and their influence the competitiveness. Industrial competitiveness could be attained by relating sustainable growth and relative efficiency. Production efficiency, cost and quality improvement has been related with competitiveness. Buckley et al. (1988) opined that competitiveness of the industry helped in providing better services and quality products at lower costs. Beck (1990) considered that structural change can be managed with competitiveness.

There is plethora of literature associating competitiveness with financial performance, basically focusing on return on shares and returns on investment. Bobillo et al. (2006) focused on sales, net profit margin as measures for gauging financial performance. Bains (1986) advocated profitability as a means for enhancing competitiveness. Some researchers focus on non-financial indicators, viz. market share and customer satisfaction for measuring competitiveness. Fischer and Schornberg (2007) considered market share as a useful indicator and pointer to improved competitiveness. Porter's contribution to competiveness cannot be overlooked. He in fact has heightened the debate about competitiveness and provided extensive depth and dynamism to literature on competitiveness.

Porter (2008) defined competitiveness at the organizational level as reflected in lower costs or differentiated products for commanding premium prices. Porter's competitive strategies include: three forces from 'horizontal' competition. These are: the threat of substitute products or services, the threat of established rivals, and the threat of new entrants. He also includes two forces from 'vertical' competition, viz. the bargaining power of suppliers and the bargaining power of buyers (customers). The present study has considered Porter's five forces in devising a construct of Competitiveness.

There is wide literature focusing on IPRs especially after adoption of TRIPS and WTO as in information technology Indian strength has been proved (Kavida et al. 2008). There is a need to cover the new improvements in intellectual property rights in Agri-Biotech sector. Davis (2004) explored the changing role and importance of IPRs. He traced these developments in the intellectual property scenario which comprise of:

i) the growing prominence and importance as sources of competitive advantage for assets which are intangible,; ii) activities of business to be globalized; iii) digital technologies advancements iv) IPR scope along with power to be governed by legal framework changes. He examined the implications of these trends for firm strategy by considering the 'overall value', coupled with the efficiency and effectiveness of patents for firms.

A change in this scenario occurred in 1980 due to the initiatives of the U.S. Government. David (1993) viewed it as "course of action which is direct, unilateral." Studies related with competitiveness have used different parameters, but many studies advocate IPRs as emerging strategies for competitiveness to be enhanced. With more IPRs companies take an edge over others.

Innovation is important for both corporate and start-up ventures. An important factor is that with a good deal of luck and effort, entrepreneurial ventures evolve into sustainable, growing, profitable businesses (e.g., corporations). The success of new business can be measured by how is it selling its products or services and managing more people. This necessitates the organizational structure and business processes to grant internal control and external accountability. With the growth of the start-up, its innovation process slows down and it becomes victim to the very problems that generated its strengths and advantages. Success leads to innovative friction and no winner is ever secure (Engel, 2007). This, calls for a need to continuously review its competitive strategies.

2.3 Studies on Productivity, Competitiveness and firm performance

It is important to study whether investments in research and development (R&D) innovation can be used for measuring firm performance (Parcharidis, 2006). R&D investment generates profits after a time gap (Griliches, 1979; Lev, & Zarowin, 1999); Jefferson et al. 2006), thus it becomes impertinent to sustain at a certain level (Hall 2002). According to Jefferson (2006) the returns to industrial R&D are three to four times greater than the returns to fixed production assets. According to (Drucker, 2005), the main function of a business is innovation to earn profits. Thus, to gain a competitive advantage, more resources should to be spent on the R&D investment. Earlier studies on returns from R & D expenditure for developed and advanced countries point out that the private rates of return on R & D are quite high in the range of 20 to 50 %. This reflected that R & D investment influences efficiency and growth in productivity. Shifts in the production function are defined as Hicks Neutral if they leave marginal rates of substitution untouched, but simply amplification or decline the output attainable from any given inputs (Solow 1957).

Empirical evidence is available regarding the improvement in productivity through investment in R & D (Odagiri, 1985; Martino, 1983; Morton, 1971; Zaltman, 1973). Innovative production is due to knowledge generating inputs, mostly R&D (Griliches and Mairess, 1984). Large scale firms invest a lot on R& D and around ninety percent of all private R&D expenditures in the United States are undertaken by 400 of the largest corporation (Scherer, 1991)**.**

Many researchers consider that there is a causal relationship between market share and performance. A few researchers have suggested that if market share is an asset, then competition for it should be just fierce enough to reduce the net long-term returns to zero (Schendel and Patton 1978; Rumelt and Wensley 198 1; Spence 1981). Majocchi and Zucchella (2003) examined the relationship between performance and internationalization. The researchers' opined that export intensity and the number of international agreements are not the determinants of performance, but it is influenced by the ability of firms to gain access to specific markets.

According to Scherer (1984, 2005) for large firms, market share may be more effective in determining the firm's performance and success than the legal monopoly granted by patent. While on the other hand patent protection is more relevant for fostering innovative investments for small and new technology-based ventures. Thus, there may be a difference of opinion amongst the researchers about what can be considered as a measure of performance.

Competition plays a much more effective role in nurturing innovation than intellectual property (Sherer, 1984). But through patent rights for 20 years, competition is reduced. Pfister and Deffains (2005) oppose the view that exclusion of competition enhances the profitability of investments. Empirical findings seem to suggest that stronger patent protection intensity decreases foreign direct investments, mostly in high GDP countries or countries with a low R and D. IPRs give exclusive rights of distribution markets and adversely affect the productive processes and industry organization and even are against consumers' welfare (Ramello, 2003, 2005; Ghosh, 2005; Hoekman and Nicita, 2011). Businesses that are capable of coping with different facets of competitiveness possess higher probability of expansion in today's highly competitive environment (Singh, Garg and Deshmukh, 2007).

Large scale firms crossed the boundaries for expansion and the increased due to internationalisation, but SMEs are still protected by regional and national boundaries (Ruzzier, Hisrich and Antoncic, 2006). Only a few SMEs paid enhanced attention to developing competitive strategies in the face of globalization. This perception now is changing with globalisation gaining momentum and even SMEs have to garner competitive strategies to perform better and to survive (Ruzzier et al., 2006). Thus, there is a need to focus on competitive strategies, especially in a volatile market environment. The fundamental competitive strategies of Porter (1980; 1985) viz. cost leadership, differentiation and focus may be needed, but not enough as globalization deepens its roots.

There is a grave need to investigate the competitive strategies required in view of globalisation. Research on strategic planning attempts to examine the reason "Why" some businesses perform better than others (Porter, 1990). There are other studies like

that of Schendel and Hofer (1979) focusing "How" businesses should compete in a given industry sector. Competitive strategy as cost leadership, differentiation and niche market are a source of deriving competitive advantage as advocated by Porter (1980). The emphasis on Resource Based View (RBV) focuses on business studies examining the internal resources to decide its strengths to outperform its competitors (Barney, 1991).

Evans and Lindsay (1997) suggested that businesses with multi-functional competencies have enhanced opportunity to survival and grow. It is thus becoming more and more apparent and evident that adoption of strategies aiming at cost reduction, improving quality and innovation assists firms to face competition more effectively in both domestic as well as global markets (Jonsson and Devonish, 2009).

Globalization is a premeditated option to facilitate a business to expand and acquire global finance, diminish cost overheads, diversify and acquire and attain technological expertise and access new markets (Demirbag and Tatoglu, 2008). Narain et al. (2004) supported that in order to be competitive these days, additional investment on innovative R&D is obligatory along with the employment of technical manpower and advanced technology in the firms of India. There is long-run relationship between expenditure on R&D and variables of trade. A causal link exists between performance of the firm and R&D expenditure (Salim 2009).

The satisfaction of the customers can be measured by the quality of products provided by the firms. Firms use different factors for judging the quality of products. Ruzzier et al., 2006 opines that managing innovation, global impact and change management are important for competing at global level. Parnell (2006) is of the view that there is a need for devising competitive strategy for gaining sectoral competitive advantage as it directly impacts success of a firm.

Productivity theories focus on supply side dimensions shifting focus from partial productivity to total factor productivity. In partial productivity it could be capital deepening or investing on training and development. Hassan et al. (2006) and Hollbeche (1998) focussed on human resource factor. Koning (1998) also reverberated

the thoughts, but there has to be recognition and reward of employee's creativity and innovation skills. Studies on total factor productivity relate with technical progress.

On the other hand Brynjolfsson (1993) laid emphasis on productivity paradox and observed remarkable advances in computer power are associated with relatively slow growth of productivity for the economy as a whole as well as for individual firms. The concept is also referred to as the Solow computer paradox (1987) as Solow observed that the computer age is everywhere except in the productivity statistics. The productivity paradox has attracted the attention of researchers as technology now created productivity gains as those that happened in early 1970s. Gordon (2000) questioned the actual productivity of such technological developments and opined that technology may be associated with diminishing returns.

Although widely accepted that office automation may play an important role in boosting labour productivity and total factor productivity, however, the growth accounting statistics didn't confirm this, as from the early 1970s to 1990s there was a massive slow-down in growth even though machines were becoming ubiquitous. This could be due to other factors influencing productivity. Thus, there is a need to examine this in greater detail. There may be other variables in countries' economies that were changing simultaneously. Growth accounting separates out the improvement in output using the same capital and labour resources as input by calculating growth in total factor productivity. As productivity is the basic economic measure of a technology's contribution, with pointers of productivity paradox, CEOs and line managers have started questioning the vast investments in computers and advanced technologies. Although as pointed earlier there are success stories of positive association of investments in computers and advanced technologies, there are failures as well.

Findings of Siegel and Griliches (1991) suggested a positive correlation between an industry's investment in computers and its multifactor productivity growth in the 1980s in United States manufacturing sector. They used industry and establishment data from a variety of sources to examine several possible biases in conventional productivity

estimates. Study by Barua, Kriebel & Mukhopadhyay (1991) suggested that IT improved intermediate outputs, if not necessarily total output. Roach (1991) reported that productivity deceleration is generally concentrated in the service sector, in contrast to earlier studies suggesting positive relation (Siegel and Griliches, 1991 & Barua, Kriebel & Mukhopadhyay, 1991). Moreover the low measured productivity of IT may be because of measuring issues related with output. Denison (1989) has pointed out that productivity and output statistics may be quite unreliable. Majority of economists agree with the evidence presented by Gordon and Baily (1989), and Noyelle (1990) that the problems of measuring output are awful in service industries, owning the majority of IT capital. The present study is covers the manufacturing sector, the Agri-Biotech sector to be precise. The measurement of output and input has been explained in detail in Chapter 3.

Table 2.1: Factors Influencing Productivity

Factors Influencing Productivity	**Supportive Literature**
1. Adoption of new technology	Sethi et al. 2007; Khamba & Singh (2001); Zhu et al. 2006; Baldwin and Diverty (1995)
2. In-house R&D Expertise	Odagiri (1991); Scherer (1982, 1983)
3. Capital Intensity	Alinaitwe et al. (2007); Terlechky (1974), Scherer (1982, 1983) and Griliches (1984); Odagiri (1991); Cuneo and Mainsesse (1984)
4. Planning and viability study	Alinaitwe et al. (2007)
5. Consequential changes in related products/ processes	Alinaitwe et al. (2007); Bresnahan and Trajtenberg (1995)
6. Attitude of employees towards technology adoption	Alinaitwi, Mwakali, and Hansson 2007
7. Education and training of employees	Lim et al. (1995); Bartel (1992) ; Barret and O'Connell (1999); Sabourin (1995)
8. Participation of engineers in technology adoption	Alinaitwi et al. (2007)
9. Availability of Professional Consultants	Lim et al. (1995); Lim et al. (1995) : Ailabouni et al. (2007)
10. Material Supplies	Alinaitwi et al. (2007)

11. Cost of new technology	Lim et al. (1995); Rosenberg (1982),
12. Opportunities created due to globalization lead to new technology adoption	Mayer (2001) ; Mayer (2001; Cameron, Proudman and Redding (1999); Friedman (2005) ; Zakeri et al. (1996); Fernandes (2003)
13. Threats caused due by globalization forced to go for new technology.	Mussa,(2000)
14. Availability of better technology due to globalization attracted to go for it	Coe and Helpman (1995); Coe et al. (1997) and Keller (1998).
15. Govt regulations (environmental related etc) lead to new technology adoption	Larson, (2003); Reed, et al.(2005).
16. Cost of training	Lim et al. (1995)
17. Increased maintenance expenses	Zakeri et al. (1996);
18. Skill of Production managers	Alinaitwe et al. (2007); Lim et al. (1995); Ailabouni et al. (2007)
19. Compatibility of equipment	Alinaitwe et al. (2007); Zakeri et al. (1996)
20. Availability of finance	Zakeri et al. (1996); Zakeri et al. (1996)

According to Alinaitwe et al. (2007) factors affecting labour productivity include: unskilled and incompetent supervisors, deficient skills of the workers, poor communication, equipment scarcity, meagre ways to construct, rework, work stoppage due to rejection, breakdown of machinery.

Kaming et al. (1997) in a study on craftsmen in Indonesia concluded that factors affecting productivity are: interference in work, absenteeism; scarcity of materials, rework, Deficiency of equipment and tools. According to Zakeri et al. (1996) construction sector in Iran was affected by: material scarcity, rough weather along with poor sites, tool scarcity, designing, inappropriate planning, repetition. Study by Lim et al. (1995) covering Singapore construction also identified the factors that influence productivity. These are: worker hiring problems, increasing labour turnover, remaining absent; and language problems.

Ailabouni et al. (2007) studied the factors influencing productivity of manpower in the UAE construction industry. These include: dividing the time aptly between family and work, supervisor's leadership qualities, education of technology, on time payment or irregularities in it, job security, and transparency and management accountability.

Researchers focusing on Competitive factors focused on many dimensions. The concept of 'barriers to new competition' was introduced by Bain (1956) and he advocated that barriers to competition decreased the efficient allocation of resources. Geroski *et al*. (1990) highlighted behaviour as a noteworthy predictor of market performance and market structure. Baldwin and Diverty (1995) opine that plant size and plant growth are closely related with technology use. Stigler (1968) focused on costs asymmetry between incumbents and potential entrants. According to Friedman (2005) Globalization has a positive influence on business organization and practice. The firm has economies of scale if and only if it has increasing returns to scale, has diseconomies of scale if and only if it has decreasing returns to scale (Gelles and Mitchell, 1996). Productivity was improved in U.S. firms due to the training of employees Bartel (1992). Barret and O'Connell (1999) corroborated the importance of training for productivity for Irish firms. Employees are trained by the companies so that they develop the skills essential for technology adoption (Sabourin, 1995). Fernandes (2003) opined that trade liberalisation gains are higher for larger plants and in high concentration industries. Knowledge generation and information processing influenced productivity and competitiveness (Castells 2001). Bresnahan and Trajtenberg (1995) believe that new technologies need changes in complementary technologies and thus take time to implement.

Hines (2013) highlighted the effect of the threat of substitutes offered in the market and this is one of the Porter's five forces as well. The consumer choices have been changing under the influence of the new marketing strategies and due to psychological changes. These lead to the new similarities and the attraction effects (Burton et.al, 1987). The preferences of the customers have inclined towards more of self controlled scenario with non-linear pricing strategies (Esteban et.al, 2007). The changing and shifting of

the preferences and the availability of the substitutes has lead to enhanced product differentiation. Shang (2009) opined that in order to gain marketing competitiveness it is important and in fact indispensable to redesign the distribution network in an efficient and effective manner. To gain an edge over the substitute products in the market, it is pertinent to develop and enhance new networks with new middlemen, as these could lead to attain and accomplish new business horizons (Jallat et.al, 2001).

Globalisation has shrunk the world and it has become much easier to transport the products from one part to the other. But according to Ghemawat (2001) the hard reality of global expansion is that the distance still matters in supplying the products from one place to another. The method of transportation, the distance to be travelled all are vital for the availability of the substitute products in the market for enhancing competitiveness. Kotler (et.al, 2009) opined that it is essential to understand the need of the customer and to provide the best quality products to suit their needs. Thus, in order gain competitive advantage, the quality of the substitute products should always be kept in mind. Undoubtedly the marketing plans are important, but the way how they are prepared, used and implemented are also equally significant (Mc Donald, 2011). Rainer et.al (2009) highlighted the role and importance of information systems. Information comprises of all the information about the level of quality of the substitute products available.

Kelly et al. (2000) related the effects on profitability in the manufacturing sector with increased buyer concentration. The consequence of being unimportant is enormous as it affects the margins of price cost in producer goods industries (Bradburd, 1982). Connor et al. (1996) in their study on U.S. food manufacturing industries acknowledged the countervailing power due to concentration change. The conception of retail brands and visual merchandising has gained significant importance as the bargaining power of buyers has increased (Shona et al.2003). The study by Jonathan (1999) covered the cell phone market of France and focussed on the influence of the switching costs on customer retention. The switching of the buyers will not take place if the product is of high quality and Rust et al. (1995) opines that the return of quality is achieved by

making service quality financially accountable. Chin-Oh Chang et al. (1993) covering pre sales housing system in Taiwan discussed the effect of forward pricing on the housing market and considered it critical to collect the information about the sellers and buyers reference point dynamics (Corina et al.2011). Kexin Zhao et al. (2015) pointed out the dissimilarity of transaction prices and the listing prices due to online price dispersion. The competition is getting stiffer, smarter and severer among the companies irrespective of their online or offline existence, and there is a need to update information about the consumers and preserve it for future reference.

The shopping behaviour of the rural consumers who had migrated to urban Africa has been observed by Anuradha (2011) and she highlighted that the consumers are price sensitive. Shrivastava et al. (2015) tried to understand the depth and the nature of price sensitive buying behaviour of the consumers. Undoubtedly this is important, but product uniqueness is an important driver of customer utility in mass customization (Franke, 2008). Leigh et al. (1984) conducted a theoretical analysis for visualizing the purchasing behaviour of industries.

The relationship of the switching costs with the competition dynamics was pointed out by Farell (1988). He focused on how to achieve a dynamic competition with switching costs. Oyeniyi et al. (2010) conducted a study in the mobile phone market of Nigeria to recognize the effect of switching costs on customers' loyalty. The study highlighted on the importance of maximization of profit as the main aim of the organizations. This was achieved through minimizing the cost of inputs (Ashley, 1961). Boland (1981) however criticized the neoclassical maximization. The utility of the product depends on the time of depreciation and hours of working. Jeffrey (2007) analysed the impact and the incentives of cooperative forward integration in oligopolistic markets.

From the competitive perspective, the management of the human resources of the organization and the advertisement strategies are relevant, especially in a scenario where the competitors are looking for a sole opportunity to become a market leader. The nature of relation should be smooth among the employees and the employers. Gitelman

(1984) discussed the ways the labour problems were confronted by the American employers and stressed that it is important to understand the type of threat a union can pose to help counter the movement (Discon, 2010). Rachana et al. (2014) conducted a study in Hidustan Unilever Limited to identify the role of advertising expenses on FMCG (Fast Moving Consumer Goods) sector. The preferences of the consumers for brands are influenced by advertisements (Ayanwale et al. 2005). There may be a change in the strategies in order to face the new competitive environment (Subramanian, 2010). Bailey (1992) pointed out that in airline industry there was a development of the 'hub-and spoke-system' leading to tough competition among the existing competitors, and declining prices. The competitive strategies could help in availing off opportunities in the firm's environment with its strengths and neutralizing the threats by avoiding the weaknesses (Barney, 2007). For competitive advantage, Porter's "five forces model" (Porter, 1985) are of paramount importance. Undoubtedly, it has been supported by empirical evidences as highlighted in literature.

Table 2.2: Factors Influencing Competitiveness

Factors Influencing Competitiveness	**Supportive Literature**
1. Barrier to entry	Porter (1998), Scherer, 1988; Bunch and Smiley, 1992; Bain (1956)
2. Competitor products with patents	Mascus (2000); Porter (1998)
3. Profitability of industry	Bain (1956); Lall, (2001); Buckley et al. 1988; (Tangen, 2003)
4. Economies to scale	Porter (1998); Caves, (1982)
5. Buyers propensity to substitute	Porter (1998); Hines,(2013)
6. Product differentiation	Porter (1998);Burton, et al.(1987); Esteban et al.(2007)
7. Substitute products in market	Porter (1998); Shang.et al.(2009); Ghemawat, et al.(2001); Jallat, et al.(2001)
8. Quality of substitute products	Kotler, et al.(2009); Rainer,. et al.(2009);McDonald, et al. (2011)
9. Buyer concentration	Porter (1998); Kelly, et al.(2000); Bradburd, Ralph.(1982); Connor, et al.(1996)
10. Bargaining power of buyers	Porter (1998); Kilne, et al.(2007); Shona, et al.(2003)

11. Buyer switching cost	Porter (1998); Jonathan Lee et al.(1999); Rust, . et al (1995)
12. Buyer information available	Chin-Oh Chang et al.(1993); Kexin Zhao et al.(2015); Paraschio, et al.(2011)
13. Buyers price sensitivity	Shrivastava, et al.(2015); Anuradha Devdas,.(2011)
14. Product uniqueness	Porter (1998); Lall, (2001); Franke, et al.(2008); Leigh, et al.(1984)
15. Supplier switching cost relative to firm switching cost	Oyeniyi, et al.(2010); Farell, et al.(1988)
16. Degree of depreciation of inputs	Ashley, (1961); Boland, (1981)
17. Supplier concentration to firm concentration ratio	Farell, et al.(1988); Rust, et al (1995)
18. Existence of labour unions	Discon,(2010); Gitelman,(1984)
19. Ability for forward integration	Royer (2007); Jallat. et al.(2001)
20. Competitive advantage through innovation	Geroski (1991); Beck (1990),
21. Competitive strategy	Lall, (2001)
22. Customization	Porter (1998); Lall, (2001)
23. Level of advertising expenses	Ayanwale, et al.(2005); Rachana, et al.(2014)
24. Competition b/w online & offline companies	Kexin Zhao et al.(2015); Shang,.et al.(2009)

Market share is the key indicator of market competitiveness of how well a firm is performing against its competitors. It may not be the only indicator and R&D expenditure is also taken as another dependent variable. These two taken together are used for gauging business performance.

Competitiveness is the capability of firm to do better than other similar firms in terms of sales, market shares, or profitability (Lall, 2001). Beck (1990), states that competitiveness can be interpreted as the ability of firms to manage and cope up with the structural change. Accordingly Geroski (1991) stated that the impact of innovations is more on growth of productivity for its users than on its producers.

Guellec and Potterie (2001) viewed the relations of growth in TFP and R&D in the long-run at the cumulative level for sixteen Organisation for Economic Co-operation and Development (OECD) countries in the period 1980- 98. R& D leads to new goods as well as services, increased quality output, processes of production which are new. On the other hand public research leads to generation and increase in basic and scientific knowledge. All were important for TFP growth, and the principal effect was by foreign-sourced R&D. This was followed by domestic business research and public research.

Proudman and Redding (1999) covered eleven industries for U.K. and found that productivity of industry and innovation rate are enhanced by R&D. Griffith, Redding and Van Reenen (2004) covered thirteen manufacturing industries in 12 OECD countries for the period 1970-92, found a relation between R&D and TFP. The study by Wang and Tsai (2003) also supports that R&D investment was a significant determinant of TFP growth. This study covered 136 large Taiwanese firms for the period 1994-2000.

On the contrary Comin (2006) seriously questions the impact of R&D on TFP growth calibrates a model to assess the importance of R&D for TFP growth and finds that less than 3-5 tenths of one percentage point of TFP growth can be attributed to R&D. The impact was low, but R&D did contribute to growth. Thus, based on literature it can be inferred that R&D can be taken as an indicator of firm performance.

2.3 Gaps in earlier studies

Majority of the earlier studies on productivity and competitiveness are based on manufacturing sector as a whole. Literature on performance of Biotech sector is mostly related with the seasonal crops, fertilizers and seeds, and in fact the productivity aspect of Agri-Biotech sector has been inadequately studied. With globalisation, firms have to be technologically savvy, highly productive and quality conscious for surviving in the competitive world. Thus, there is a need for conducting a study to cover the productivity and competitiveness especially in the Agri-Biotech sector, which is one of the growing sectors of Indian economy. Equally important in this productive environment are

Intellectual property rights in Agri-Biotech sector for enhancing competitiveness. The present study examines the trends in partial productivities as well as total factor productivity. In this study, the focus is on the empirical measurement of (a) capital productivity (b) labour productivity and (c) total factor productivity. Partial factor productivity measures the ratio of output to one of the inputs setting aside interdependence of use of other output. Labour productivity (V/L) is the ratio of value added to total no of persons employed. Capital Productivity (V/K) is the ratio of value added to gross fixed capital. The present study also plans to identify the factors which affect productivity and competitiveness of the Agri-Biotech sector of Punjab through a survey based analysis. Finally it aims to design a strategic framework relating productivity and competitiveness with firm performance in Agri-Biotech sector. Such aspects of Agri-Biotech sector have not been covered earlier. Hence, the present study attempts to examine these issues and aspects and design a strategic model for enhancing productivity and competitiveness in Agri-Biotech sector.

Summing Up

This Chapter summarises the literature on productivity, competitiveness and firm performance. Based on literature the scale items for productivity and competitiveness have also been explained with relevant literature support. Also presented are gaps in earlier studies and the focus of the study to cover these gaps. The next chapter focuses on Research design and Methodology to cover these gaps identified in literature and to lend scientific direction to research.

CHAPTER-3

RESEARCH DESIGN AND METHODOLOGY

This chapter covers different methods of research adopted in present study to examine the factors affecting productivity and competitiveness and finally to design strategic framework for enhancing productivity and competitiveness in Agri-Biotech sector. Section 3.1 outlines the objectives of the study followed by hypotheses of the study in Section 3.2. The next section, Section 3.3 covers the different phases of research. Section 3.4, the research design covers the details of sample size, the selection criteria used, overviews the data collection process and presents the details of the questionnaire. Section 3.5 discusses the research methods used to analyse the data for achieving the research objectives. Finally, Section 3.6 outlines the research framework.

3.1 Objectives of the Study

The initial step of every research process is to define the objectives of the study. Review of literature helped in identifying the research gaps and indicated a need for pursuing research in Agri-Biotech sector for identifying the factors affecting productivity and competitiveness. The following objectives have been defined for the present study:

O1: To determine productivity trends in Agri-Biotech sector.

O2: To identify the factors affecting productivity.

O3: To identify the factors affecting competitiveness.

O4: To design a strategic framework for enhancing productivity and competitiveness in Agri-Biotech sector.

3.2 Research Hypotheses

For achieving the above objectives the following hypotheses have been framed:

H_{1a}: There is a significant difference in the means of size of firm on the basis of productivity factors.

H_{1b}: There is a significant difference in the means of nature of industry on the basis of Productivity factors.

H_{2a}: There is a significant difference in the means of size of the firms on the basis of competitive factors.

H_{2b}: There is a significant difference in the means of nature of industry on the basis of Competitive factors.

H_3: There is a relation amongst Market share and factors influencing Productivity.

H_4: There is a relation amongst Market share and factors influencing Competitiveness.

H_5: There is a relation amongst R&D Expenditure and factors influencing Productivity.

H_6: There is a relation amongst R&D Expenditure and factors influencing Competitiveness.

3.3 Phases of Research

The entire research activity was carried out in following phases:

Phase I: Understanding the existing trends

Phase I of the study explored the existing status of productivity and competitiveness in Agri-Biotech sector of Punjab. Observations based on review suggested that there was sparse literature regarding trends productivity and competitiveness in Agri-Biotech sector of Punjab. The objectives were framed after review of literature and hypotheses were set for further analysis.

Phase II: Finding the factors affecting productivity and competitiveness

Phase II of this research, attempted to identify the factors affecting productivity and

competitiveness in Agri-Biotech sector of Punjab. Extensive literature was re-examined to finalise the key variables of both productivity and competitiveness. The complete emphasis of this phase was on drafting the questionnaire for uncovering the information related to productivity trends, intellectual property rights, nature, type and quality of substitutes, competitive strategies, cost structure and technology initiatives.

Phase III: Choice of suitable research methods and techniques for analysis of data

In the present study descriptive research design was used. Both primary and secondary data were used for the study. Primary data was collected through a self structured questionnaire. For secondary data annual survey of industries data was used. Besides this, for data analysis ANOVA, Factor Analysis, structural Equation Modeling (SEM) was used. ANOVA was used in the survey based analysis for finding the relation between nature and size of the firm with factors influencing productivity and competitiveness in Agri-Biotech sector. Factor analysis was used for finding the important predictors of productivity.

Phase IV: *Designing a strategic framework for enhancing the productivity and competitiveness in Agri-Biotech sector*

In the last phase of the study structural equation modelling (SEM) through STATA was used to design a strategic framework for enhancing productivity and competitiveness in Agri-Biotech sector of Punjab.

3.4 Research Design

This section covers the research design, sampling design, sources of data collection, provides details of the questionnaire. It also covers the validity and reliability of the questionnaire. The current study used a descriptive research design. Descriptive research design can be conducted in three ways i.e. observational, case study and survey based analysis. This research revolved around a clearly defined problem for studying the factors affecting the productivity and competitiveness in Agri-Biotech sector through survey based analysis.

3.4.1 Justification and rationale for selecting the research area and study region

- Punjab characterizes a rich growing state with an agrarian economy.
- Punjab had begun to undergo fast urbanization under the influence of developmental compulsions. This was a consequence of the return of peace to the region and application of economic stimulus in the form of the opening up of periphery, mega projects policies and the impetus of the government sector, private sector and the Non Resident Indians (NRI).
- The mega project policy level initiatives of the state government were undertaken through an empowered committee headed by the Chief Minister, to consider and determine a special package of incentives as well as facilitation by way of relaxation of rules and regulations and provision of legal, institutional and financial dispensation.
- The phenomenon of fast track urbanization, through private or government initiative, individually or in partnership, landed well as a potential rich research area for the study.

3.4.2 Sample size

Primary data have been used for the study. The data was collected from selected agri-biotech firms of Punjab by using a self structured questionnaire. Random stratified sampling technique has been used. The sample size consists of sixty nine (69) firms. The questionnaire has been divided into three major sections. Section 1 covered the profile of the firms; the second section covered competitiveness and third section pertains to productivity. Effort has been made to cover all three regions of Punjab, viz, Malwa, Majha and Doaba. The sectors included in the study were: Food Processing, Dairy products, Distilleries, Fertilizers and Pesticides.

3.4.3 Data Collection

Primary data was collected through a self structured questionnaire. It aimed to explore the productivity performances of agri-biotech industries of Punjab economy by using the survey of 69 firms. The questionnaire was drafted after the literature review. Revisions were incorporated in the questions. These were based on interactions with the

employees in the Agri-Biotech industry and academicians. Few questions were clubbed and others were deleted after getting inputs from academicians and managers. The validation through experts refined the questionnaire and data was collected from respondent firms.

3.4.4 Details of the Questionnaire

Details of Questionnaire are provided through table 3.1. The first section covers the general features of the company, survey respondent's name and designation. This section also asked about main product(s) of the firm, the details of certifications of the firm, number of employees and its collaboration with any foreign company (if any). It also covered details of the registered IPRs (patents, copyrights and trademarks).

The next section dealt with competitive environment. It covers barriers to entry, the details of substitute products, quality of substitute products, bargaining power of buyers, product uniqueness, competitive strategy, level of advertising expenses, competition b/w online & offline companies, in the coming years the competitive position of the company in the market, competitive strategy , customisation etc.

The last section focuses on productivity and its factors influencing productivity, covering from technology adoption to training and development.

Table 3.1: Details of the Questionnaire

S. No.	Gist of Questions	Response method	Basic Objective/ Purpose
General			
Profile of Respondent Firms			Characteristics of the Firm
1.	Name of the firm		
2.	Address of the firm		
3.	Survey respondent 's name and designation		
4.	Respondent's mail & contact no		
5.	Main product(s) of company		
6.	Certifications of company	Tick the right option	

		√	
7.	Number of employees	√	
8.	Collaboration with some foreign company ,if any	√	
9.	Has your firm obtained Trade Marks?	√	IPR Status
10.	Has your firm obtained Patents?	√	
11.	Has your firm obtained Copy Rights?	√	
		Please specify:	Firm Status
12.	Employee Training per year	√	
13.	Technical Expertise % of Total Employees	√	
14.	R & D as % of output	Likert scale	
15.	Role of growth of output	√	
16.	Status regarding Market Share	√	
	Factors Influencing Productivity		
	Factors	Likert Scale	Factors Influencing Productivity
17.	Adoption of new technology	√	
18.	In-house R&D Expertise	√	
19.	Capital Intensity	√	
20.	Planning and viability study	√	
21.	Consequential changes in related products/ processes	√	
22.	Attitude of employees towards technology adoption	√	
23.	Education and training of employees	√	
24.	Participation of engineers in	√	

	technology adoption		
25.	Availability of Professional Consultants	√	
26.	Material Supplies	√	
27.	Cost of new technology	√	
28.	Opportunities created due to globalization lead to new technology adoption	√	
29.	Threats caused due by globalization forced to go for new technology.	√	
30.	Availability of better technology due to globalization attracted to go for it	√	
31.	Govt regulations (environmental related etc) lead to new technology adoption	√	
32.	Cost of training	√	
33.	Increased maintenance expenses	√	
34.	Skill of Production managers	√	
35.	Compatibility of equipment	√	
36.	Availability of finance	√	
	Factors Influencing Competitiveness		
37.	Factors	Likert Scale	To assess Factors Influencing Competitiveness
38.	Barrier to entry	√	
39.	Competitor products with patents	√	
40.	Profitability of industry	√	
41.	Economies to scale	√	
42.	Buyers propensity to substitute	√	

43.	Product differentiation	√	
44.	Substitute products in market	√	
45.	Quality of substitute products	√	
46.	Buyer concentration	√	
47.	Bargaining power of buyers	√	
48.	Buyer switching cost	√	
49.	Buyer information available	√	
50.	Buyers price sensitivity	√	
51.	Product uniqueness	√	
52.	Supplier switching cost relative to firm switching cost	√	
53.	Degree of depreciation of inputs	√	
54.	Supplier concentration to firm concentration ratio	√	
55.	Existence of labour unions	√	
56.	Ability for forward integration	√	
57.	Competitive advantage through innovation	√	
58.	Competitive strategy	√	
59.	Customization	√	
60.	Level of advertising expenses	√	
61.	Competition b/w online & offline companies	√	
	Competitive Position:		
62.	Perception regarding the competitive position of the company in the market in next 5 years	Likert Scale	To assess Competitive Position

3.4.5 Reliability and Validity

The questionnaire was tested for validity and reliability. Validity is the property by which a questionnaire measures what it is supposed to measure. The questionnaire was validated by the academicians and managers. It possesses a good validation score (3.75

on a scale of 5). The changes suggested by experts were incorporated in the questionnaire. Some questions were deleted and at same time, some were rephrased. Reliability applies to a measure when similar results are obtained over time and across situations. Cronbach alpha is used to determine the reliability of the scales and results. The reliability of questionnaire good as Cronbach alpha is 0.756. Hence the questionnaire was found to be valid and reliable to be used for the present research study.

3.5 Research Methods

Data has been analyzed with the help of STATA/IC13. Completed questionnaires were checked and coded before the raw data was entered for analysis. A number of statistical techniques were applied to test and interpret the results of the data analysis. These include: Descriptive Statistics, ANOVA, Factor analysis and structured equation modelling (SEM) to test hypotheses of the study.

3.5.1 Productivity Measurement

The study focused on the measurement of output growth empirically, capital and labor, capital productivity, labor productivity and total factor productivity. Secondary data collected through Annual Survey of Industries (ASI) was analysed using Partial and total factor productivity (TFP) methods.

Partial factor productivity is the ratio of output to one of the inputs. There are two methods used for measuring productivity. In measuring output an important preference arises between value added and gross output. Strong preference is in favor of value added method (Griliches and Ringstad, 1971; Ahluwalia, 1991; Kiran and Kaur, 2008). Many studies in Indian context (Balakrishnan and Pushpangadan, 1994), Dholakia and Dholakia (1994), Gangopadhyaya and Wadhwa (1998), Trivedi, et al. (2000) and Goldar (2000) have considered gross value added as a measure of output while calculating total factor productivity. In the present study also value added method was used.

Ratio of value added to total no. of persons employed is defined as Labour productivity (V/L). For the measurement of labour three alternatives exist. These are: (a) man hours; (b) workers and (c) employees. Total number of hours worked is not a satisfactory measure if a mix of skilled and unskilled workers is employed in a production process, as is generally done for manufacturing sector. Denison (1961) disfavors taking man hours as a measure of labour input, as reduction in man hours per week leads to an increase in labour input per hour. Thus, measuring labour by the number of employees is more satisfactory. Therefore, the present study uses the total persons engaged data from the Annual Survey of Industries for labour input.

Capital Productivity (V/K) is the ratio of value added to gross fixed capital. The figures on fixed capital available in ASI are the book values of fixed assets. The use of un-deflated book value amounts is inaccurate. In the present study Perpetual inventory method (Balkrishnan, et al., 1994) was used. The capital stock was calculated as:

$$K_t = K_O + \sum_{t=1}^{T} I_t$$

Where I, is investment in year t. K_0 is capital stock for benchmark year, i.e. 2000-01. Investment figures are obtained using the formula: $I_t = (B_t - B_{t-1} + D_t)/R_t$

Where B is book value of fixed capital, D is depreciation. For R Wholesale prices index of Machinery (base 2000-01=100) is used.

For total factor productivity Translog index of total factor productivity has been used. Translog index is based on the Transcendental logarithmic production function characterized by constant returns to scale. Translog production function does not assume a Hicks neutral or constant rate of technological change.

Total Factor Productivity Growth (TFPG) was calculated as:

$$\text{Log TFP (t)} = \Delta \log V(t) - \left[\frac{S_1(t) + S_1(t-1)}{2} \Delta \log L(t) + \frac{1 - S_1(t) + 1 - S_1(t-1)}{2} \Delta \log K(t) \right]$$

Where V is value added, S_1 is share of labour, L is labour and K is capital stock. The returns to labour were measured by total of wages, salaries and benefits. The returns to capital were measured as value added minus returns to labour.

The study also used qualitative data collected through questionnaire for gauging the competitive and productivity scenario of Agri-Biotech sector. The methods used are explained in section 3.5.2 to 3.5.4.

3.5.2 The Analysis of Variance (ANOVA)

Analysis of variance (ANOVA) was used for studying cause and effect of one or more factors (independent variables) on a single dependent variable. In the present study, one-way ANOVA was used as for deeper analysis, it was essential to conduct ANOVA on the basis of nature of industry and also for size of the firms, to discover whether there is a significant difference on the basis of these regarding the competitive factors and factors influencing productivity, which were analysed through factor analysis.

3.5.3 Factor Analysis

Factor analysis attempted to recognize a set of dimensions that are not directly observable in a large set of variables. Factor analysis was used to summarize a majority of the information in a data set in terms of relatively fewer factors (Cooper and Schindler, 2006). Factor analysis was used for reducing the number of variables of productivity and competitiveness into smaller number of factors.

3.5.4 Structural Equation modeling (SEM)

Structural Equation Modelling (SEM), a multivariate analysis describing a family of statistical methods designed to test a conceptual or theoretical model was applied in the present research to study interrelationship among the market share, investment on research and development with productivity factors and competitive factors.

The next section (3.6) presents the conceptual framework of research

3.6 Conceptual Framework of Research

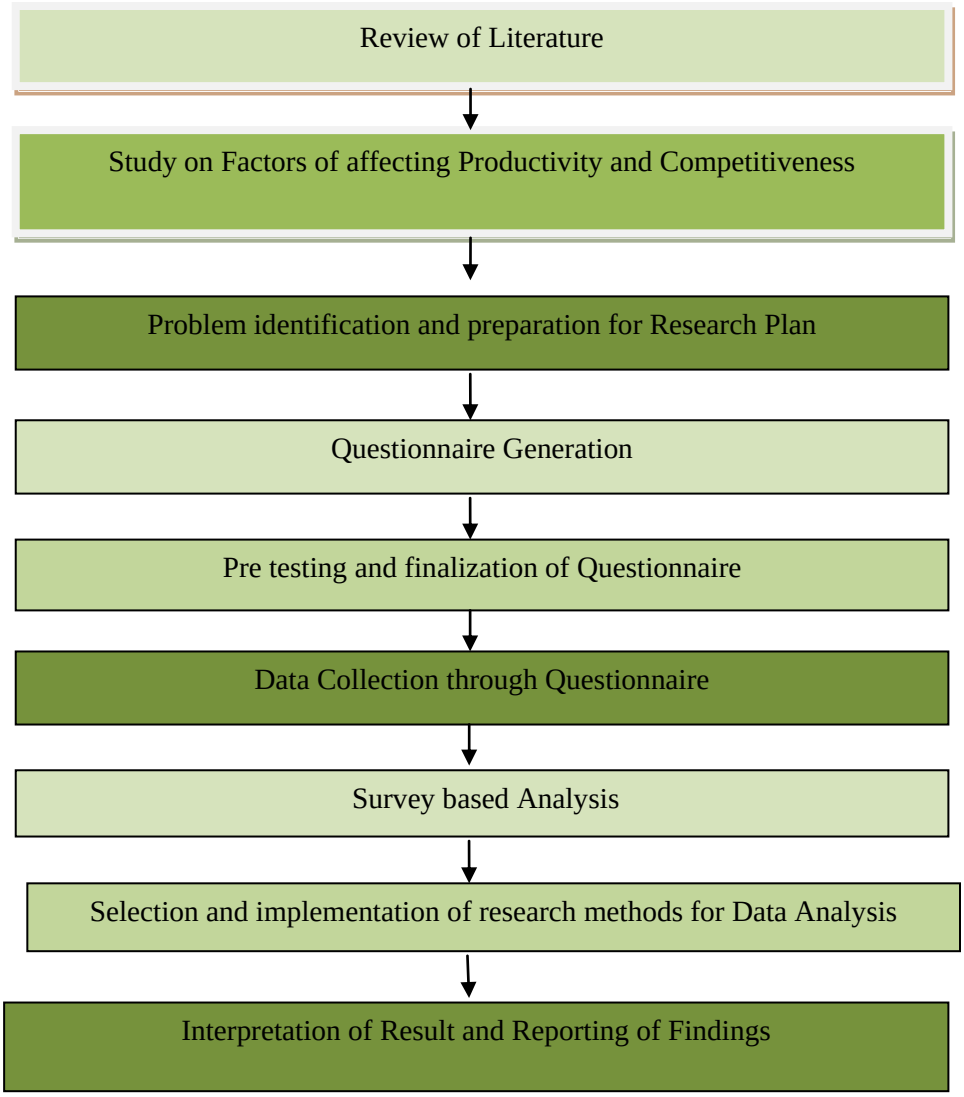

Figure 3.1 Conceptual Framework of Research

Summing Up

Selection of an appropriate research design comprises of one of the most significant aspects for achieving the targeted outcomes. This chapter has elaborated the details of step by step approach employed for carrying out the research in Agri-Biotech sector.

This chapter has presented a synopsis of the methodology used for analyses of qualitative as well secondary data. Methodology applied at different phases of this study has been explained. Finally, a brief overview of research methods used to test the hypotheses like ANOVA, Factor analysis, Structural Equation Modelling have also been specified. As this chapter highlights the conceptual framework and describes the design and methods of research, the next chapter presents the results collated through survey methods highlighted in the present chapter.

CHAPTER-4

DATA ANALYSIS AND INTERPRETATION

Section 4.1 of this chapter covers the productivity scenario of Agri-Biotech sector of India and Punjab. The details of partial productivity along with TFP of the Agri-Biotech sector of Punjab with India have been presented to understand differences in productivity scenario of Punjab with respect to rest of India. Section 4.2 deals with analysis and discussions of the responses gathered from the respondent firms by conducting the survey from the Agri-Biotech firms in Punjab. This section starts with the participative stake-holders' analysis and deals with analysis of the respondent profile with regard to nature and scale of the firm. Factor Analysis was conducted to analyze the productivity and competitive factors influencing the performance of firms. The section also deals with detailed ANOVA analysis to study the differences in attitude of respondents on the basis of nature and scale of firms with respect to competitive and productivity factors. Finally the last section 4.3 focuses on development of framework for enhancing competitiveness and productivity in Agri-Biotech industry of Punjab. Structural Equation Modelling (SEM) was used to depict the relation among productivity factors, competitive factors and performance of firms.

4.1: Productivity of Agri-Biotech sector of Punjab and India

Punjab is well placed to promote Agri-Biotech sector as a major driver for industrial growth. The state has a long and established history of agricultural research and development and Agri-Biotech sector is emerging as sunrise industry of Punjab.

The state of Punjab contributes 21.5 per cent to total production of wheat in India so it becomes the second largest producer. 14.5 million tonnes of wheat was produced in 2002-03. Moreover in terms of rice production Punjab is ranked fourth as it contributes 9.0 percent to total production. 8 million tonnes of rice was produced in 2002-03 in punjab.

A look at growth rates of Punjab and India is depicted in table 4.1 to highlight the current scenario.

Table 4.1: Growth Rate of GDP of India and Punjab as per price index (2004-05)

India			Punjab	
Year	**GDP (Rupee in Millions)**	**% Growth over previous year**	**GSDP (Rupee in Millions)**	**% Growth over previous year**
2001-02	19,72,6060	-	71,146	-
2002-03	20,48,2870	3.84	73,174	2.85
2003-04	22,22,7580	8.52	77,618	6.07
2004-05	29,71,4640	7.47	96,839	4.95
2005-06	32,53,0730	9.48	1,02,556	5.90
2006-07	35,64,3640	9.57	1,12,997	10.18
2007-08	38,96,6360	9.32	1,23,223	9.05
2008-09	41,58,6760	6.72	1,30,431	5.85
2009-10	45,16,0710	8.59	1,38,636	6.29
2010-11	49,18,5330	8.91	1,47,670	6.52
2011-12	52,47,5300	6.69	1,57,303	6.52
2012-13	54,82,1110	4.47	1,64,588	4.63
2013-14	57,41,7910	4.74	1,73,221	5.25
Annual Rate of Growth		**2.02*** **		**2.05*** **

*** p<0.001; GDP: Gross Domestic Product; GSDP: Gross State Domestic Product

Source: Central Statistical Organisation

Analysis of growth rates of India and Punjab depicts that Punjab is a growing state of Indian economy (Table 4.1). Highest growth rate was witnessed in 2006-07. Inter year rates of growth for India and Punjab shows variations, but there was a fall in the growth rate in 2008-09 in India to 6.72 and in Punjab to 5.85 % on year to year basis due to recessionary trends prevalent in the country. There were global recessionary trends and they had its repercussions in India as well. In the year 2002-03 the growth rate for India and Punjab was 3.84 and 2.85, whereas for the year 2013-14 the growth rate for India and Punjab was 4.74 and 5.25 respectively.

The annual production of food products in Punjab stood at 13070 million rupees in 2001-02. Between 1990-91 and 2001-02, the same increased by over 300 per cent. Punjab's share in India's output of food products stands at 3 per cent. The statistics clearly indicate a potential for further developing the state's agro processing industry.

The Government of Punjab has introduced policies to modernize infrastructure in agriculture sector in the state to promote agro-based industries. An outlay of 294.93 million rupees has been assigned to improve agriculture infrastructure and set up a cold chain infrastructure.

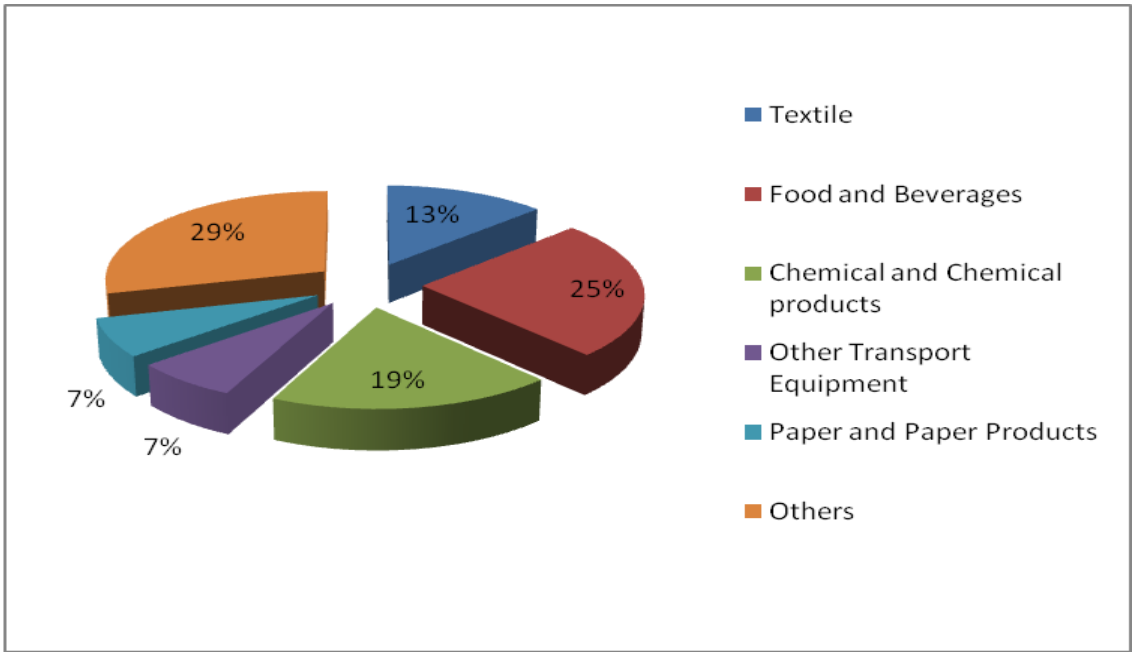

Figure 4.1: Principal Industries in Punjab

As shown in figure 4.1 food and beverage sector predominates in Punjab with 25 percent share. Chemical and chemical products sector is another emerging sector. The focus of the current study in on Agri-Biotech sector and further in this food and beverage sector and chemical and chemical products sector have been studied.

As in the current research all three sectors, viz. small, medium and large are included, it is essential to define them.

SMALL (S): Where the investment in plant and machinery is more than 2.5 million Rupees but does not exceed 50 million Rupees (B) Where the investment in Equipment is more than Ten Lakh Rupees but does not exceed Two Crores Rupees.
MEDIUM (M): Where the investment in plant and machinery is more than 50 Million Rupees but does not exceed 100 million Rupees (Original Purchase Value not depreciated)
LARGE (L): Where the investment in plant and machinery is more than 100 Million Rupees.

Punjab has a predominance of small-scale industry, thanks to the indomitable spirit and entrepreneurial skills of Punjabis. 0.2 million small scale industries and 600 large and medium scale industries functioning in the state involve fixed capital investment of Rs 54000 Million and Rs 20400 Million respectively.

Prominent players present in the agro processing industry in Punjab are Pepsi Foods and Nestle. Germany-based Metro Cash and Carry International have also signed a memorandum of understanding (MoU) with the Punjab Agro Industries Corporation for identifying and sourcing food products from the state. With 4.2 million hectares of sown area, 186 per cent cropping intensity and 100 per cent assured irrigation, Punjab is the granary of India. Apart from food grains, the state also has large quantity of fruits and vegetables available for processing.

The first objective of the research was:

O1: To determine productivity trends in Agri-Biotech sector

This was primarily achieved through secondary data collected through Annual Survey of Industries published by Central Statistical Organisation (CSO). Partial and total factor productivity was calculated based on methodology explained in chapter 3. In Agri-Biotech sector the industries covered under the secondary data from CSO included in the present study are: Food Products and Beverage (CSO Code 15); shown in table 4.2 and Chemical Industry (CSO Code 24) shown in table 4.4.

Table 4.2: Selected characteristics of Food and Beverage sector

S. No	Year	Factories (No.)	Fixed Capital (Rs in Millions)	Labour (No.)	Total Emoluments (Rs in Millions)	Total Output (Rs in Millions)	Depreciation (Rs in Millions)	Net Value Added (Rs in Millions)	Total Value added (Rs in Millions)
1	1998-99	10598	69533050	521218	5897740	133312520	5311820	33941700	19119240
2	1999-2000	10345	80870750	552446	7092200	151991540	7260750	35429260	19608360
3	2000-01	10669	85017210	543530	6966210	158392210	7166000	30401100	18787030
4	2001-02	10577	87762660	509812	7141210	153222990	7371110	29153520	19683440
5	2002-03	10395	80207520	512365	7554770	163574400	7358600	33117240	19988090
6	2003-04	10226	83672840	497586	8043500	180030780	7813180	35811920	19699480
7	2004-05	10747	82663900	536050	8927200	210914700	7551420	42735820	22148230
8	2005-06	10995	107943690	560863	10033700	241554010	9158700	48598680	27698600
9	2006-07	11065	118693930	593264	11642140	275374790	11748650	53339350	39720900
10	2007-08	11177	124202620	611022	12871930	301217610	11261770	61662900	40591280
11	2008-09	8456	116958430	420646	10358510	289396560	9881190	45920750	37069950
12	2009-10	8418	115295540	433737	10233250	279114580	11049610	53354080	43232030
13	2010-11	11202	124456790	467145	12540500	352290320	12117440	60014760	55543720
14	2011-12	11276	134642320	505122	14907800	449006810	12759970	73276400	68173860
15	2012-13	11426	148024070	463645	15512840	472968270	12685480	76664860	66349060
16	2013-14	11465	159425060	494253	18067850	513903380	13901810	79315360	71537840

Source: Central Statistical Organisation (CSO)

The data presented in table 4.2 was used for calculating labour productivity (LP); capital productivity (CP); capital intensity and total factor productivity (TFP). These productivity indices have been reported in table 4.3. Sixteen years data starting from 1998-99 to 2013-14 was considered for analysis.

Table 4.3: Productivity indices for Food and Beverage sector

S. No	Year	LP	CP	K/L	TFP	Growth(g)
1	1998-99	1.045	0.977	2.613	-	-
2	1999-2000	1.046	0.968	3.039	0.873	0.854
3	2000-01	1.044	0.965	3.127	0.835	0.832
4	2001-02	1.048	0.964	3.360	0.829	0.818
5	2002-03	1.049	0.958	3.730	0.807	0.797
6	2003-04	1.049	0.958	3.721	0.787	0.789
7	2004-05	1.053	0.959	3.919	0.791	0.816
8	2005-06	1.067	0.968	4.152	0.842	0.887
9	2006-07	1.089	0.976	5.027	0.932	0.936
10	2007-08	1.088	0.967	5.798	0.939	0.917
11	2008-09	1.085	0.961	6.011	0.895	0.887
12	2009-10	1.094	0.958	7.224	0.879	0.894
13	2010-11	1.109	0.963	8.442	0.910	0.940
14	2011-12	1.119	0.964	9.606	0.970	0.985
15	2012-13	1.122	0.957	11.109	0.999	1.028
16	2013-14	1.125	0.959	11.491	1.056	-

(LP): Labour productivity; (CP): Capital Productivity; (K/L): Capital/Labour; (TFP): Total factor productivity

Total factor productivity (TFP) growth lies in the range of 0.789 to 1.028 which is positive (Table 4.3) supporting that food and beverage sector is a growing sector. Partial productivity indices reflect that labour productivity is growing at a faster pace than capital productivity. There is an evidence of high capital/labour ratio. Capital/labour ratio increased from 2.613 in 1998-99 to 11.491 in 2013-14. Growth in TFP is a reflection of high capital intensity.

Table 4.4: Selected characteristics of manufacture of Chemicals and Chemical Products

S. No	Year	Factories (No.)	Fixed Capital (Rs in Millions)	Labour (No.)	Total Emoluments (Rs in Millions)	Total Output (Rs in Millions)	Depreciation (Rs in Millions)	Net Value Added (Rs in Millions)	Total Value added (Rs in Millions)
1	1998-99	10598	69533050	521218	5897740	133312520	5311820	33941700	19119240
2	1999-2000	10345	80870750	552446	7092200	151991540	7260750	35429260	19608360
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6	2003-04	10226	83672840	497586	8043500	180030780	7813180	35811920	19699480
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15	2012-13	11426	148024070	463645	15512840	472968270	12685480	76664860	66349060
16	2013-14	11465	159425060	494253	18067850	513903380	13901810	79315360	71537840

Source: Central Statistical Organisation (CSO)

The data for manufacture of Chemicals and Chemical Products CSO Code 24 has been shown in table 4.4. The data was used for calculating labour productivity (LP); Capital

Productivity (CP); Capital Intensity and Total factor productivity of this sector. These productivity indices of manufacture of Chemicals and Chemical Products CSO Code 24 have been reported in Table 4.5.

Table 4.5: Productivity indices of Chemicals and Chemical Products

S. No	Year	LP	CP	K/L	TFP	Growth(g)
1	1998-99	1.153	0.964	13.340	-	-
2	1999-2000	1.155	0.960	14.639	0.828	0.804
3	2000-01	1.146	0.949	15.642	0.779	0.755
4	2001-02	1.150	0.945	17.215	0.731	0.756
5	2002-03	1.157	0.957	15.654	0.782	0.821
6	2003-04	1.166	0.959	16.816	0.860	0.896
7	2004-05	1.170	0.969	15.421	0.931	0.936
8	2005-06	1.176	0.961	19.246	0.941	0.928
9	2006-07	1.180	0.963	20.007	0.915	0.942
10	2007-08	1.186	0.967	20.327	0.968	0.954
11	2008-09	1.200	0.955	27.804	0.939	0.926
12	2009-10	1.208	0.964	26.582	0.912	0.947
13	2010-11	1.210	0.967	26.642	0.982	1.029
14	2011-12	1.216	0.973	26.655	1.076	1.095
15	2012-13	1.227	0.969	31.926	1.115	1.119
16	2013-14	1.224	0.968	32.256	1.124	-

(LP): Labour productivity; (CP): Capital productivity; (K/L): Capital/Labour; (TFP): Total factor productivity

Result as shown through Table 4.5, highlight that TFP growth lies in the range of 0.755 to 1.19. TFP growth is positive. This supports that manufacture of Chemicals and Chemical Products CSO Code 24 is a growing sector. Partial productivity indices reflect that labour productivity is growing at a faster pace than capital productivity. There is evidence of high capital/labour ratio. Capital/labour ratio increased from 13.340 in 1998-99 to 32.256. Thus, growth in TFP is a reflection of high capital intensity in this sector. Productivity is broadly influenced by total output generated by the firm after

consuming different inputs in terms of labour and capital which measures total factor productivity. The study highlighted low capital productivity as compared to labour productivity and low total factor productivity. A comparative analysis depicts that Chemical and Chemical products have grown at a faster pace than Food products and Beverage sector in Punjab (Figure 4.2).

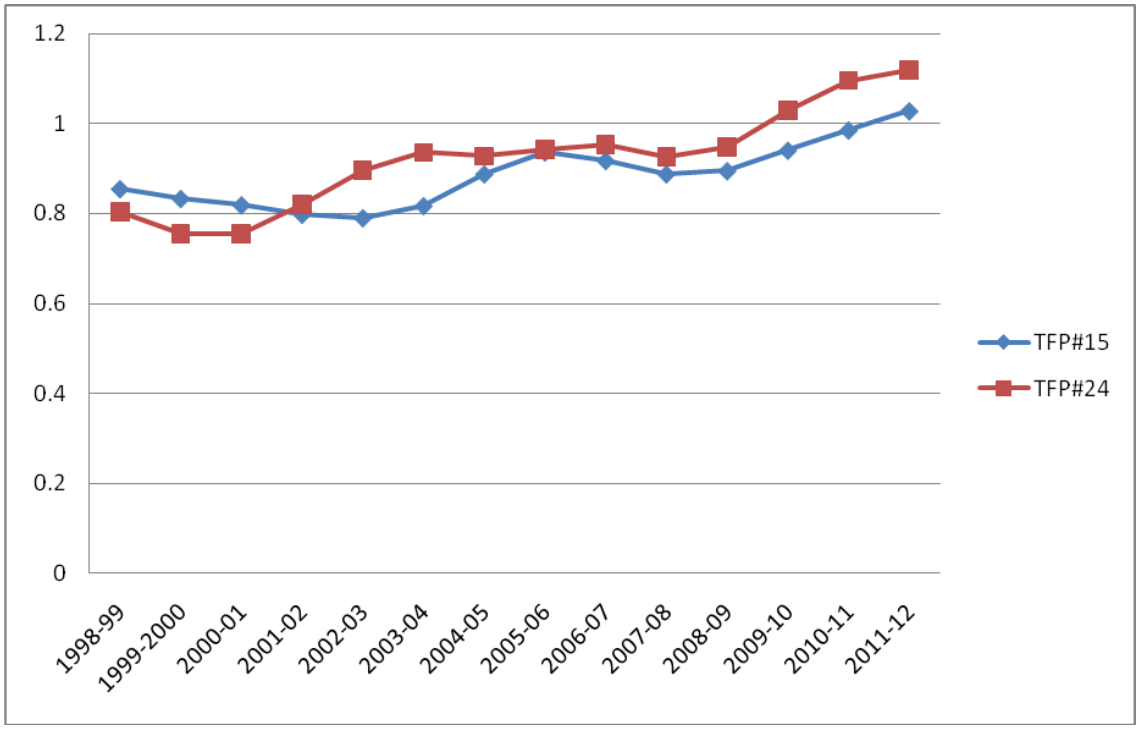


Figure 4.2: Total factor productivity growth of Food Products (CSO Code 15) and Chemical and Chemical products (CSO Code 24)

4.2 Survey based analysis of Agri-Biotech firms of Punjab

After assessing growth in terms of productivity, it became all the more relevant to understand the current picture of Agri-Biotech sector through a survey based analysis using self structured questionnaire by approaching respondent firms in this emerging sector. Secondary data helped in pointing out that this sector is growing sector and also that labour productivity, capital productivity and total factor productivity were positive. The indices also point out that there is high capital intensity in Chemical and Chemical products as compared to Food products and Beverage sector.

This section covers the survey based analysis of Agri-Biotech firms of Punjab. Section 4.2.1 gives details of the respondent firms. Section 4.2.2 covers the productivity factors. Section 4.2.3 covers the competitive factors.

4.2.1 Profile of respondent firms

Data was collected from 69 firms from the state Punjab in India. Break up of these firms has been depicted through figure 4.3. Among 69 firms 36 are in dairy products, 16 are in food processing and 17 are in chemical (fertilizer, pesticide, distillery).

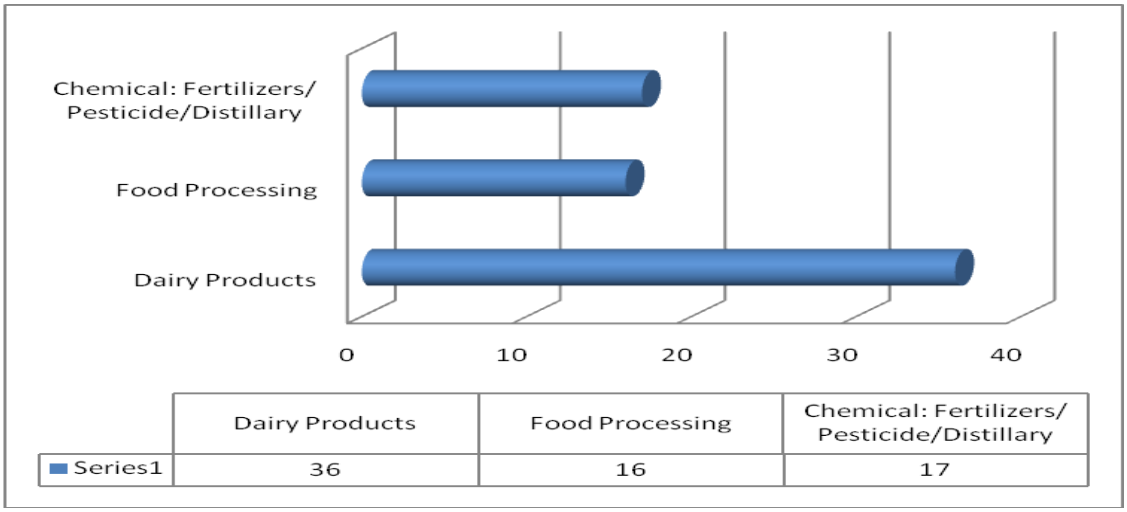


Figure 4.3: Nature of Industry

Size-wise analysis depicts that 34 are medium sized firms, 17 are large sized firms and18 are small sized firms (Figure 4.4).

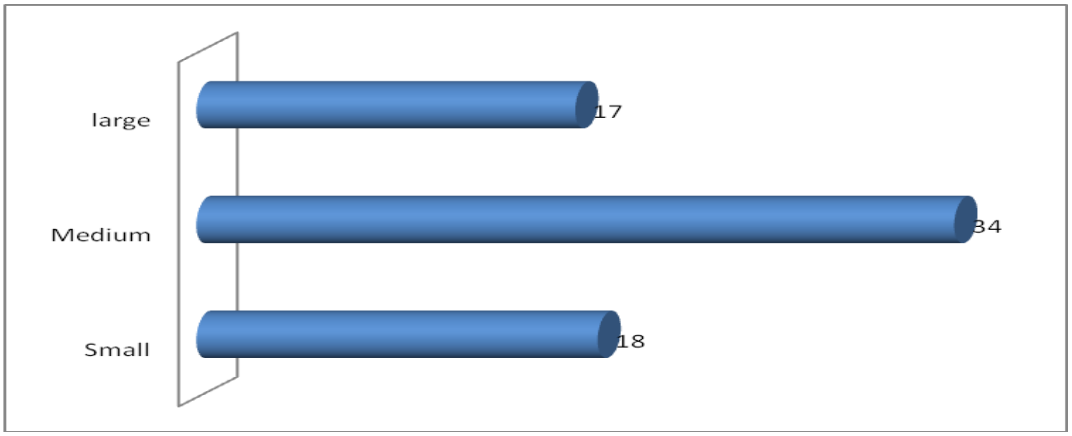


Figure 4.4: Plant Size

Analysis was done to find out the number of firms having ISO certifications. Majority (72%) of firms possessed the certifications as depicted in figure 4.5.

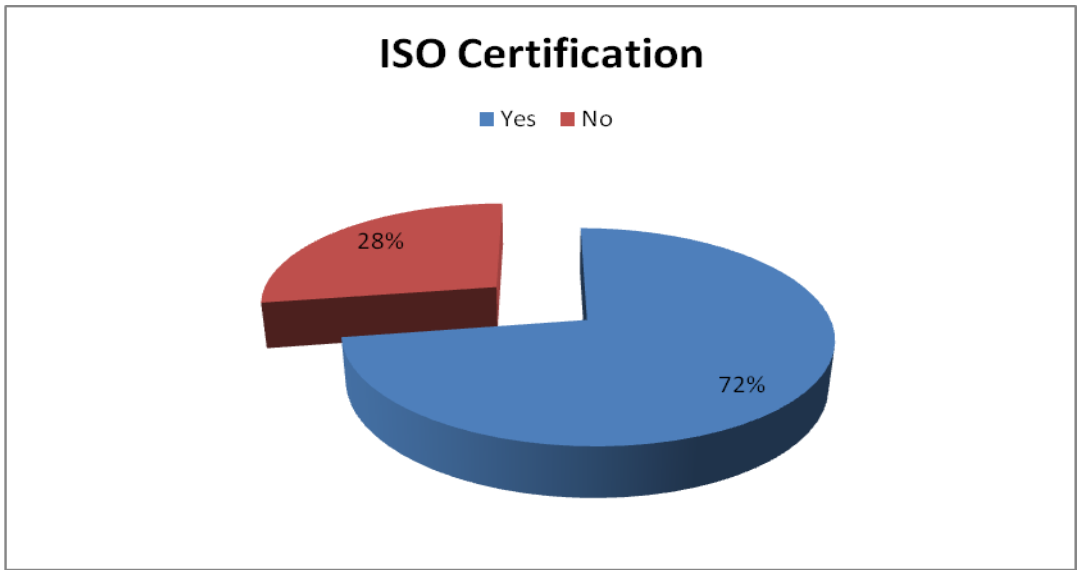


Figure 4.5: ISO Certification

Regarding status of IPRs the Agri-Biotech firms have low levels of IPR filings. Majority of firms 42 out of 69 have filed trademarks, followed by 24 firms who have filed copyrights and only 3 firms have filed patents (Figure 4.6).

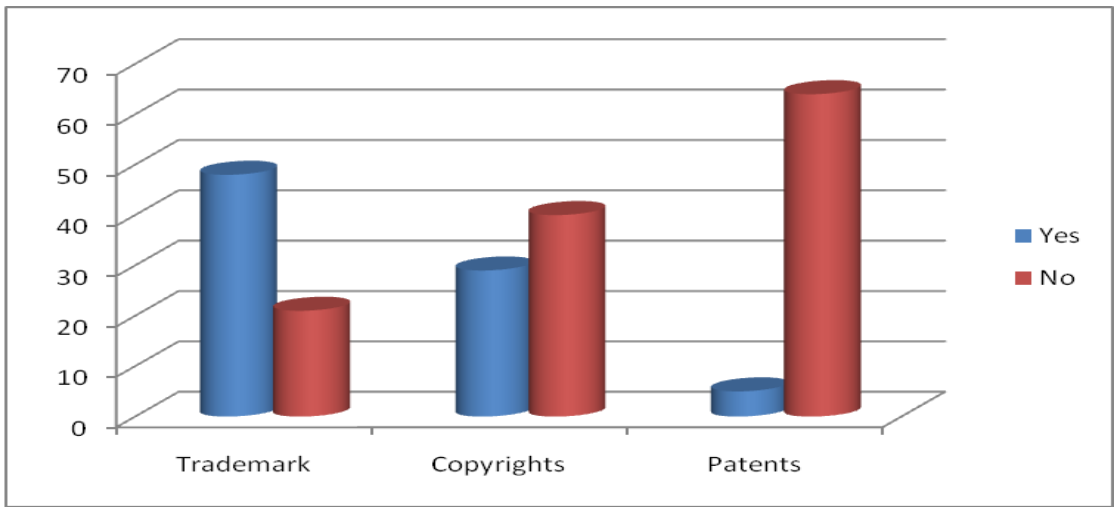


Figure 4.6: IPR scenario as analyzed among 69 firms

4.2.2 Factors affecting productivity

The next objective of the study was:

O2: To identify the factors affecting productivity

To identify the factors influencing productivity factor analysis was done (Table 4.6).

Factor analysis helped to classify twenty items into four productivity factors which are:

i. Internal and external environment; ii. Cost efficiency;

ii. Production planning and control; iv. Technological advancement

These four factors accounted for 90.669 percent of total variation. Internal and external environment emerged as one of the vital factor which accounted for 31.208 percent of total variation. Education and training and Govt regulations had comparatively high item loadings of 0.992 and 0.963 amongst items.

Availability of better technology; consequential changes due to globalization; trends of the past years for new technology had high item loadings of 0.718, 0.710, 0.709, whereas participation of engineers had lower loading of 0.556. This conveys that environment; both firm environment and external environment matters a lot and influences firm's decision making process. External factor of Govt. Regulation and internal factor of education and training had higher item loadings conveying their high importance. At the same time the results also convey that participation of engineers, included in internal factor needed more attention since this item had lower loading.

Cost component has major influence as the decision to acquire new technology involves financial liability. Not only this, once technology is acquired, it needs to be used efficiently to enhance cost efficiency. Thus, the second factor emerging from factor analysis is cost efficiency, which accounted for 24.6 percent of total variation. The items such as threats cost of training and education, lack of finance had item loading of 0.806, 0.961, 0.824 respectively, whereas alternate cost effective processes and economic viability study loaded negatively with 0.975 and 0.639 respectively which indicates that firms do not rely on these.

Table 4.6: Factor analysis for identification of factors affecting productivity

Factor Name	Items	Factor Loading	Eigen Value	% of Variance	C	AVE	Composite Reliability
1. Internal and External Environment	i. Trends of the past years for new technology	0.710	4.993	31.208	31.208	0.590	0.850
	ii. Consequential changes	0.709					
	iii. Education and training	0.992					
	iv. Participation of engineers	0.556					
	v. Selection of supplier of technology	0.620					
	vi. Availability of better technology due to globalization	0.718					
	vii. Govt regulations	0.963					
2. Cost Efficiency	i. Alternate processes cost effective	-0.975	3.936	24.600	55.808	0.733	0. 806
	ii. Economic viability study	-0.639					
	iii. Threats	0.806					
	iv. Cost of training and education	0.961					
	v. Lack of finance	0.824					
3. Production Planning and Control	i. Cost of new technology	-0.647	2.990	18.685	74.493	0.547	0.782
	ii. Opportunities due to globalization	0.756					
	iii. Increased maintenance expenses	-0.807					
4. Technological Advancement	i. Adopting new technology	-0.821	2.588	16.176	90.669	0.661	0.815
	ii. Attitude of employees towards adoption	-0.632					
	iii. Availability of Professional Consultants	0.623					
	iv. Production management skill deficiency	0.946					
	v. Problem of compatibility of equipment	0.973					

C: Cumulative; AVE: Average variance extracted

The next factor, viz. production planning and control gave 18.685 percent of total variation. The results clearly indicate that it is time for the firms to focus on production planning and control. The items such as opportunities due to globalization had high item

loading of 0.756, while cost of new technology and increased maintenance expenses loaded negatively with values of -0.647 and -0.807 respectively.

Technological advancement emerged as next factor with total variation of 16.176 percent. The items adopting new technology, attitude of employees towards adoption had inverse loadings of 0.821 and 0.632. This again showed the reluctant attitude of management to switch over to new technology and employees always resist change.

Production management skill deficiency had problem of compatibility of equipment and availability of professional consultants had higher loadings of 0.973 and 0.946. There is still dearth of professional consultants as the item availability of professional consultants had lower loadings of 0.623. This further underscores the fact that there is need for increased reliance on improving this scenario.

Overall results indicate that firms are still not geared up with enough competency to realise the potential opportunities that globalisation brings with it and there is lack of skill, training and expertise in Agri-Biotech sector. This also suggests reasons for low productivity indices of this sector when we consider total factor productivity growth.

Composite reliability of internal and external environment is 0.850; for cost efficiency it is 0.806; for production planning and control it is 0.782 and for technological advancement the value is 0.815. These values are acceptable as they are more than 0.70. The average variance extracted (AVE) is also greater than 0.50 therefore all these four factors were taken for further analysis.

The next step was to find out the relationship amongst plant size and factors influencing productivity and for this ANOVA was used for analysis (Table 4.7).

Table 4.7: ANOVA results for plant size and factors influencing productivity

		Sum of Squares	df	Mean Square	F	Sig.
P1-Internal and external environment	Between Groups	6.037	2	3.019	29.098	0.000***
	Within Groups	6.847	66	0.104		
	Total	12.884	68			
P2-Cost Efficiency	Between Groups	2.068	2	1.034	25.259	0.000***
	Within Groups	2.701	66	0.041		
	Total	4.769	68			
P3-Production Planning and control	Between Groups	6.064	2	3.032	24.565	0.000***
	Within Groups	8.146	66	0.123		
	Total	14.210	68			
P4-Technological advancement	Between Groups	0.219	2	0.109	0.371	0.691
	Within Groups	19.452	66	0.295		
	Total	19.671	68			

*** p<0.001; ** p<0.01; * p<0.05

df: Degree of freedom; F: F ratio; Sig: Significance

ANOVA results reflect that there is a significant difference in three of the four factors influencing productivity on the basis of plant size considered for analysis. These are: P1-Internal and external environment, P2-Cost efficiency and P3-Production planning and control. For P4-Technological advancement the results didn't reflect significant difference on the basis of plant size.

Post-hoc Tukey was conducted to have clarity on the differences. The results are shown through Table 4.8. In case of P1-Internal and external environment, there was a significant difference at all levels, between small and medium, medium and large and small and large firms. In case of other two factors, viz. P2-Cost Efficiency and P3-Production Planning and control also there was a significant difference in perception of all three categories of firms. Only in case of technological advancement, there was similarity of perception amongst all categories of firms. The results are significant for all but for technological advancement. Thus, the hypothesis H_{1a}: *there is a significant difference in the means of size of the firm on the basis of productivity factors* has been accepted.

Table 4.8: Tukey HSD results for productivity factors and firm size

Dependent Variable	(I) Size of the firm	(J) Size of the firm	Mean Difference (I-J)	Std. Error	Sig. (p)	95% Confidence Interval	
						Lower Bound	Upper Bound
P1-Internal and external environment	Small (1)	2	0.716	0.093	0.000***	0.491	0.941
		3	0.456	0.108	0.000***	0.194	0.717
	Medium (2)	1	-0.716	0.093	0.000***	-0.941	-0.491
		3	-0.2600	0.095	0.023*	-0.489	-0.030
	Large (3)	1	-0.456	0.108	0.000***	-0.717	-0.194
		2	0.260	0.095	0.023*	0.030	0.489
P2-Cost Efficiency	Small (1)	2	0.239	0.058	0.000***	0.097	0.380
		3	0.486	0.068	0.000***	0.322	0.650
	Medium (2)	1	-0.239	0.058	0.000***	-0.380	-0.097
		3	0.247	0.060	0.000***	0.103	0.391
	Large (3)	1	-0.486	0.068	0.000***	-0.650	-0.322
		2	-0.247	0.060	0.000***	-0.391	-0.103
P3;Production Planning and control	Small (1)	2	-0.240	0.102	0.050*	-0.486	0.005
		3	0.490	0.118	0.000***	0.206	0.775
	Medium (2)	1	0.240	0.102	0.050*	-0.005	0.486
		3	0.731	0.104	0.000***	0.481	0.981
	Large (3)	1	-0.490	0.118	0.000***	-0.775	-0.206
		2	-0.731	0.104	0.000***	-0.981	-0.481
P4-Technological advancement	Small (1)	2	0.015	0.158	0.995	-0.363	0.395
		3	-0.119	0.183	0.792	-0.559	0.320
	Medium (2)	1	-0.015	0.158	0.995	-0.395	0.363
		3	-0.135	0.161	0.680	-0.521	0.251
	Large (3)	1	0.119	0.183	0.792	-0.320	0.559
		2	0.135	0.161	0.680	-0.251	0.521

*** p<0.001; ** p<0.01; * p<0.05

Sig: Significance

After analysing data on the basis of scale of production, the analysis was also done on the basis of nature of the industry. There was a need to check whether a significant difference occurred on the basis of nature of industry for productivity factors. To find

out the relation between Nature of industry and factors influencing productivity ANOVA analysis was done and results are shown through Table 4.9.

Table 4.9: ANOVA results for nature of industry and factors influencing productivity

		Sum of Squares	Df	Mean Square	F	Sig.
P1-Internal and external environment	Between Groups	1.209	2	0.604	3.416	0.039*
	Within Groups	11.676	66	0.177		
	Total	12.884	68			
P2-Cost Efficiency	Between Groups	1.165	2	0.582	10.662	0.000***
	Within Groups	3.604	66	0.055		
	Total	4.769	68			
P3;Production Planning and control	Between Groups	6.846	2	3.423	30.677	0.000***
	Within Groups	7.364	66	0.112		
	Total	14.210	68			
P4-Technological advancement	Between Groups	7.065	2	3.532	18.493	0.000***
	Within Groups	12.606	66	0.191		
	Total	19.671	68			

*** p<0.001; ** p<0.01; * p<0.05

df: Degrees of freedom; F: F ratio; Sig: Significance

ANOVA results reflect that there is a significant difference in all four factors influencing productivity on the basis of nature of industry. These are: P1-Internal and external environment, P2-Cost Efficiency and P3-Production Planning and control and P4-Technological advancement.

Post hoc Tukey (Table 4.10) suggests that for P1-Internal and external environment, there is a significant difference in Group 1 (chemical: fertilizer, pesticide, distillery) and Group 2 (food processing), but not in group 1 and 3 (dairy products) and group 2 and 3. For cost efficiency viz. there was a significant difference in group 1 &3, as well as between group 2 &3. However there was similarity of perception in case of group 1 &2.

Table 4.10: Tukey HSD results for productivity factors and nature of industry

Dependent Variable	(I) VAR00019	(J) VAR00019	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
P1-Internal and external environment	Chemical (fertilizer, pesticide, distillery). (1)	2	0.272	0.126	0.037*	-0.031	0.575
		3	0.258	0.124	0.101	-0.039	0.555
	Food Processing (2)	1	-0.272	0.126	0.037*	-0.575	0.031
		3	-0.014	0.147	0.995	-0.365	0.338
	Dairy products (3)	1	-0.258	0.124	0.101	-0.555	0.039
		2	0.014	0.147	0.995	-0.338	0.365
P2-Cost Efficiency	Chemical (fertilizer, pesticide, distillery). (1)	2	-0.044	0.070	0.803	-0.213	0.124
		3	0.285	0.069	0.000***	0.120	0.450
	Food Processing (2)	1	0.044	0.070	0.803	-0.124	0.213
		3	0.329	0.081	0.000***	0.134	0.525
	Dairy products (3)	1	-0.285	0.069	0.000***	-0.450	-0.120
		2	-0.329	0.081	0.000***	-0.525	-0.134
P3-Production Planning and control	Chemical (fertilizer, pesticide, distillery). (1)	2	-0.096	0.100	0.605	-0.337	0.144
		3	0.696	0.098	0.000***	0.460	0.932
	Food Processing (2)	1	0.096	0.100	0.605	-0.144	0.337
		3	0.792	0.116	0.000***	0.513	1.071
	Dairy products (3)	1	-0.696	0.098	0.000***	-0.932	-0.460
		2	-0.792	0.116	0.000***	-1.071	-0.513
P4-Technological advancement	Chemical (fertilizer, pesticide, distillery). (1)	2	0.414	0.131	0.007**	0.099	0.729
		3	0.762	0.129	0.000***	0.454	1.071
	Food Processing (2)	1	-0.414	0.131	0.007**	-0.729	-0.099
		3	0.349	0.152	0.050*	-0.017	0.714
	Dairy products (3)	1	-0.762	0.129	0.000***	-1.071	-0.454
		2	-0.349	0.152	0.050*	-0.714	0.017
*** p<0.001; ** p<0.01; * p<0.05.							

Sig: Significance

In case of P3-Production Planning and control there was a significant difference in chemical (1) and dairy products (3), as well as between chemical (1) and food processing (2). Unlike in size for technological progress, there was a significant difference in case of all three groups. Thus, the next hypothesis H_{1b}*: There is a significant difference in the means of nature of industry on the basis of Productivity factors has been accepted.* Crépon, Duguet and Mairesse (1998), studied 4,000 manufacturing firms in France between 1986 and 1990 and found a relation among productivity and new and advanced technologies. The results in the present study are also comparable to the earlier studies, since all three categories of industries shared that there may exist a difference in productivity on the basis of technological progress.

4.2.3 Factors affecting competiveness

The next objective of the study is:

O3: To identify the factors affecting competitiveness

The related hypotheses are:

H_{2a}*: There is a significant difference in the means of size of the firms on the basis of competitive factors.*

H_{2b}*: There is a significant difference in the means of nature of industry on the basis of Competitive factors.*

The next step was to identify factors for competitiveness. This was done through factor analysis of twenty four questions pertaining to competition in the survey. On the basis of factor analysis these were reduced to six factors, viz.

i. Threat of new competition; ii. Threat of substitute products or services;

iii. Bargaining power of suppliers; iv. Intensity of competitive rivalry;

v. Bargaining power of customers (buyers); vi. Preparedness for change.

The total variation explained by these six factors influencing competitiveness is 96.208 percent.

Table 4.11: Factor analysis for identification of factors affecting Competitiveness

Factor Name	Items	Factor Loading	Eigen Value	% of Variance	C	AVE	CR
F1:Threat of new entrants	i. Economies of scale	0.891	5.113	20.452	20.452	0.636	0.836
	ii. Barriers to entry	0.821					
	iii. Importance of brand loyalties in purchase decision	0.663					
F2: Threat of substitutes/ services	i. Buyers' switching costs	0.930	4.989	19.958	40.410	0.663	0.906
	ii. Quality of substitutes	0.922					
	iii. Perceived level of product differentiation	0.787					
	iv. Number of substitutes available in the market	0.738					
	v. Buyers' propensity to substitute	0.660					
F3: Bargaining power of suppliers	i. Supplier switching costs	0.863	4.286	17.144	57.553	0.559	0.788
	ii. Supplier concentration	0.764					
	iii. Ability for forward vertical integration	0.591					
F4: Intensity of competitive rivalry	i. Online competition	0.951	4.227	16.906	74.459	0.673	0.910
	ii. Customization	0.938					
	iii. Competitive advantage through innovation	0.778					
	iv. Level of advertising expense	0.760					
	v. Strong competitive strategy	0.631					
F5:Bargaining power of customers (buyers)	i. Availability of Buyer information	0.886	2.808	11.231	85.690	0.566	0.864
	ii. Products uniqueness	0.813					
	iii. Influence of Buyers	0.769					
	iv. Buyer concentration	0.678					
	v. Buyer price sensitivity	0.575					
F6: Preparedness for change	i. Rapid adjustment to stocks	0.933	2.630	10.518	96.208	0.555	0.783
	ii. Sensitivity to market changes	0.636					
	iii. Workplace Flexibility	0.625					

C: Cumulative; AVE: Average variance extracted; CR: Composite Reliability

Threat of new competition emerged as a significant factor having three items. This explained 20.452 percent of total variation. The construct validity is quite good and is 0.836 and AVE is 0.636. Both these are in acceptable range. Moreover, two out of three items in this factor, viz. Economies of scale and Barriers to entry have high loadings of 0.821 to 0.891. The third item, viz. Importance of brand loyalties in purchase decision had lower loading of 0.663, but this is also not very small. Therefore all items of this factor were retained for further analysis.

The second factor viz. threat of substitutes/services accounted for 19.958 percent of variation. In this factor, two items, buyer switching costs and quality of substitutes had higher loadings. Buyers' propensity to substitute had lower loading compared with buyers switching costs. Perceived level of product differentiation has a slightly higher loading than the number of substitutes available in the market.

The next perceived factor is bargaining power of suppliers, which accounts for 17.144 percent of variation. This factor composed of three items. Supplier switching costs had item loading of 0.863 and supplier concentration had item loading of 0.764. In this factor ability to forward vertically integrate had lowest loading (0.591).

Intensity of competitive rivalry emerged next on priority explaining 16.906 percent of total variation. Online completion and customization had higher item loadings and emerged as two important items. This generation customers aspire for convenience and the results bear testimony to this. Competitive advantage through innovation; and level of advertising expense had lesser loadings, as compared to online competition and customization. Competitive strategy in this factor had a lower score of 0.631.

Bargaining power of customers was the next factor. This factor explained 11.231 percent of variation, had high construct validity of 0.864 and AVE is. 0.566. The AVE is also more than 0.50 and is in the acceptable range. Thus all items have been retained for further analysis. Buyer information availability had high item loading of 0.886, and products uniqueness also had good loading of 0.813, thereby highlighting the role of information sharing in the knowledge era we are living in today. Influence of buyers

had item loading of 0.769 and buyer concentration had a value of 0.678. The lowest loading was for buyer's price sensitivity. This highlights another important issue that buyers today are not only relying on price competitiveness, but on other qualitative variables as well. Firms have recognized and realised that the price may not be the only variable to be considered for assessing bargaining power of the buyers.

The sixth and last factor that emerged from factor analysis was preparedness for change accounting for 10.518 percent of variation. The construct reliability (CR) of this factor is 0.783 and AVE is 0.555. Thus, this factor also had acceptable values of CR and AVE.

Rapid adjustment to stocks loaded heavily with item loading of 0.933. Workplace flexibility has lower loading than Sensitivity to market changes. Preparedness for change in factors influencing competitiveness had lowest Eigen value, and explained low variation. This once again highlights the enhanced impetus to be given to preparedness for change.

After identifying factors influencing competitiveness, it was imperative to find out the factors extracted by other researchers who had worked on similar area. This was done to establish relation with earlier literature and also to help in providing a further direction to research. The results highlighted the importance of factors of competitiveness; their link to literature will help in validating these factors to proceed further with Structural equation modelling. Table 4.12 represents the Supportive Literature-Competitive Factor Matrix. Threat of new competitor, Intensity of competitive rivalry and bargaining power of customers (buyers) which emerged as important factors from the study had support through earlier literature. Preparedness for change is a recent and current factor and has less supportive evidence through empirical studies.

Table 4.12: Supportive literature-competitive factor matrix

	C1: Threat of new entrants	C2: Threat of substitutes/ services	C3: Bargaining power of suppliers	C4: Intensity of competitive rivalry	C5: Bargaining power of customers (buyers)	C6: Preparedness for change
Bhardwaj 1990; Ahluwalia 1991; Khamba, & Singh 2007	√			√	√	
Cornish 2003; Dutfield 2000; Sethi et al. 2007;		√	√		√	√
Lee 2003: Mascus 2000; Clemente 2006;	√		√	√		
Mehta 1990; Hassan et al. 2006;	√	√		√	√	√
Griliches 1990; Biber 2000; Porter, 1990		√	√		√	
Kaur & Kiran 2008; Lalitha 2004	√		√	√	√	
Kavida & Sivakoumar 2007; Porter, 1990		√				
Hollbeche, 1998; Mei-Fang et al.2007	√			√	√	

Proceeding further it was important to analyse these competitive factors on the basis of Size of the firms and competitive factors that emerged through factor analysis. This was done through ANOVA analysis. The related hypothesis is:

H_{2a}: There is a significant difference in the means of size of the firms on the basis of competitive factors.

ANOVA results as shown in table 4.13 highlight that the results are significant for F1: Threat of new competition, F2: Threat of substitute products or services, significant for F3: Bargaining power of suppliers, F5: Bargaining power of customers (buyers) and F6: Rivalry among existing firms.

Table 4.13: ANOVA results for size of firm and competitive factors

		Sum of Squares	df	Mean Square	F	Sig.
F1:Threat of new competition	Between Groups	1.988	2	0.994	6.544	0.003*
	Within Groups	10.027	66	0.152		
	Total	12.015	68			
F2:Threat of substitute products or services	Between Groups	0.270	2	0.135	4.031	0.022*
	Within Groups	2.215	66	0.034		
	Total	2.485	68			
F3:Bargaining power of suppliers	Between Groups	2.816	2	1.408	8.320	0.001***
	Within Groups	11.168	66	0.169		
	Total	13.984	68			
F4: Intensity of competitive rivalry	Between Groups	1.163	2	0.581	2.756	0.071
	Within Groups	13.924	66	0.211		
	Total	15.086	68			
F5: Bargaining power of customers (buyers)	Between Groups	20.001	2	10.000	136.111	0.000***
	Within Groups	4.849	66	0.073		
	Total	24.850	68			
F6: Preparedness for change	Between Groups	4.616	2	2.308	23.192	0.000***
	Within Groups	6.569	66	0.100		
	Total	11.185	68			

*** p<0.001; ** p<0.01; * p<0.05

df: Degree of freedom; F: F ratio; Sig: Significance

Results are not significant for F4: Intensity of competitive rivalry. As the p-values are significant for all but one factor, hence the next hypothesis, *H_{2a}: There is a significant difference in the means of size of the firms on the basis of competitive factors has been accepted.*

For deeper analysis, it was essential to conduct ANOVA on the basis of size of the firm and competitive factors, to find out whether there is a significant difference on the basis of these six competitive factors. Table 4.14 presents Post hoc Tukey for size of Firms and Competitive factors.

Table 4.14: Post hoc Tukey for size of the firm and competitive factors

Dependent Variable	(I) Size of the firm	(J) Size of the firm	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
F1:Threat of new competition	Small (1)	2	-0.364*	0.114	0.006	-0.637	-0.092
		3	-0.420*	0.132	0.006	-0.736	-0.104
	Medium (2)	1	0.364*	0.114	0.006	0.092	0.637
		3	-0.055	0.116	0.882	-0.333	0.222
	Large (3)	1	0.420*	0.132	0.006	0.104	0.736
		2	0.055	0.116	0.882	-0.222	0.333
F2:Threat of substitute products or services	Small (1)	2	0.069	0.053	0.395	-0.058	0.198
		3	0.174*	0.062	0.017	0.026	0.323
	Medium (2)	1	-0.069	0.053	0.395	-0.198	0.058
		3	0.104	0.054	0.140	-0.026	0.235
	Large (3)	1	-0.174*	0.062	0.017	-0.323	-0.026
		2	-0.104	0.054	0.140	-0.235	0.025
F3:Bargaining power of suppliers	Small (1)	2	-0.375*	0.120	0.007	-0.663	-0.088
		3	0.054	0.139	0.919	-0.278	0.388
	Medium (2)	1	0.375*	0.120	0.007	0.088	0.663
		3	0.430*	0.122	0.002	0.137	0.723
	Large (3)	1	-0.054	0.139	0.919	-0.388	0.278
		2	-0.430*	0.122	0.002	-0.723	-0.137
F4: Intensity of competitive rivalry	Small (1)	2	-0.299	0.133	0.073	-0.620	0.021
		3	-0.287	0.155	0.161	-0.660	0.084
	Medium (2)	1	0.299	0.133	0.073	-0.022	0.620
		3	0.011	0.136	0.996	-0.315	0.338
	Large (3)	1	0.287	0.155	0.161	-0.085	0.660
		2	-0.011	0.136	0.996	-0.339	0.315

F5: Bargaining power of customers (buyers F6: Preparedness for change	Small (1)	2	-0.903*	0.079	0.000	-1.093	-0.713
		3	-1.491*	0.091	0.000	-1.711	-1.271
	Medium (2)	1	0.903*	0.079	0.000	0.714	1.092
		3	-0.588*	0.080	0.000	-0.781	-0.395
	Large (3)	1	1.491*	0.091	0.000	1.272	1.711
		2	0.588*	0.080	0.000	0.395	0.781
F6: Preparedness for change	Small (1)	2	-0.341*	0.091	0.001	-0.562	-0.120
		3	-0.726*	0.106	0.000	-0.982	-0.470
	Medium (2)	1	0.341*	0.091	0.001	0.120	0.561
		3	-0.385*	0.093	0.000	-0.610	-0.160
	Large (3)	1	0.726*	0.106	0.000	0.470	0.982
		2	0.385*	0.093	0.000	0.160	0.610
*. The mean difference is significant at the 0.05 level.							

*** p<0.001; ** p<0.01; * p<0.05

Sig: Significance

The results indicate that except for one factor, viz. F4: Intensity of competitive rivalry, ANOVA results were significant for all other factors. Thus this highlights that there is a significant difference amongst firms regarding the competitive factors on the basis of size of the firm. *Thus, the hypothesis H_{2a}: There is a significant difference in the means of size of the firms on the basis of competitive factors* has been accepted.

Next step was to analyse on the basis of nature of industry. ANOVA results as shown through table 4.15 indicate that except for one factor, viz. F5: Bargaining power of customers (buyers) ANOVA results were significant for five out of six factors. Thus this highlights that there is a significant difference amongst firms regarding the competitive factors on the basis of nature of the industry. *Thus the hypothesis H_{2b}: There is a significant difference in the means of nature of industry on the basis of Competitive factors* has also been accepted.

Table: 4.15. ANOVA results for nature of industry and competitive factors

		Sum of Squares	df	Mean Square	F	Sig.
F1:Threat of new competition	Between Groups	6.331	2	3.165	36.748	0.000***
	Within Groups	5.685	66	0.086		
	Total	12.015	68			
F2:Threat of substitute products or services	Between Groups	0.879	2	0.440	18.074	0.000***
	Within Groups	1.606	66	0.024		
	Total	2.485	68			
F3:Bargaining power of suppliers	Between Groups	4.458	2	2.229	15.443	0.000***
	Within Groups	9.526	66	0.144		
	Total	13.984	68			
F4: Intensity of competitive rivalry	Between Groups	5.396	2	2.698	18.374	0.000***
	Within Groups	9.691	66	0.147		
	Total	15.086	68			
F5: Bargaining power of customers (buyers)	Between Groups	1.142	2	0.571	1.589	0.212
	Within Groups	23.708	66	0.359		
	Total	24.850	68			
F6: Preparedness for change	Between Groups	2.332	2	1.166	8.690	0.000***
	Within Groups	8.854	66	0.134		
	Total	11.185	68			

*** p<0.001; ** p<0.01; * p<0.05

df: Degrees of freedom; F: F ratio; Sig: Significance

Further for deeper analysis post hoc Tukey was performed. The results of the same are shown through table 4.16.

Results indicate that in case of F1: Threat of new competition, there was a significant difference in group 1 (chemical: fertilizers/pesticide/distillery) and group 2 (food processing) and also between group 1 (chemical: fertilizers/pesticide/distillery) and group 3 (dairy products), but not between group 2 and 3. For factor F2: Threat of substitute products or services; F3: Bargaining power of suppliers; F4: Intensity of competitive rivalry and F6: Preparedness for change difference existed amongst group 1 and Group 2 only. In case of F5: Bargaining power of customers (buyers) there was similarity of perception amongst all the groups.

Table 4.16: Tukey HSD results for nature of industry and competitive factors

Dependent Variable	(I) VAR00019	(J) VAR00019	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
F1:Threat of new competition	Chemical (fertilizer, pesticide, distillery). (1)	2	-0.476*	0.088	0.000***	-0.687	-0.264
		3	-0.692*	0.086	0.000***	-0.899	-0.485
	Food Processing (2)	1	0.476*	0.088	0.000***	0.264	0.687
		3	-0.216	0.102	0.094	-0.461	0.028
	Dairy products (3)	1	0.692*	0.086	0.000***	0.485	0.899
		2	0.216	0.102	0.094	-0.028	0.461
F2:Threat of substitute products or services	Chemical (fertilizer, pesticide, distillery). (1)	2	0.015	0.046	0.943	-0.097	0.127
		3	0.266*	0.045	0.000***	0.156	0.376
	Food Processing (2)	1	-0.015	0.046	0.943	-0.127	0.097
		3	0.251*	0.054	0.000***	0.120	0.381
	Dairy products (3)	1	-0.266*	0.045	0.000***	-0.376	-0.156
		2	-0.251*	0.054	0.000***	-0.381	-0.120
F3:Bargaining power of suppliers	Chemical (fertilizer, pesticide, distillery). (1)	2	-0.094	0.114	0.688	-0.368	0.179
		3	-0.612*	0.111	0.000***	-0.880	-0.344
	Food Processing (2)	1	0.094	0.114	0.688	-0.179	0.368
		3	-0.517*	0.132	0.001***	-0.835	-0.200
	Dairy products (3)	1	0.612*	0.111	0.000***	0.344	0.880
		2	0.517*	0.132	0.001***	0.200	0.835
F4: Intensity of competitive rivalry	Chemical (fertilizer, pesticide, distillery). (1)	2	-0.126	0.115	0.519	-0.402	0.149
		3	-0.677*	0.112	0.000***	-0.947	-0.406
	Food Processing (2)	1	0.126	0.115	0.519	-0.149	0.402
		3	-0.550*	0.133	0.000***	-0.870	-0.230

	Dairy products (3)	1	0.677*	0.112	0.000***	0.406	0.947
		2	0.550*	0.133	0.000***	0.230	0.870
F5: Bargaining power of customers (buyers)	Chemical (fertilizer, pesticide, distillery). (1)	2	-0.320	0.180	0.184	-0.752	0.110
		3	-0.109	0.176	0.808	-0.532	0.313
	Food Processing (2)	1	0.320	0.180	0.184	-0.110	0.752
		3	0.211	0.208	0.573	-0.289	0.711
	Dairy products (3)	1	0.109	0.176	0.808	-0.313	0.532
		2	-0.211	0.208	0.573	-0.711	0.289
F6: Preparedness for change	Chemical (fertilizer, pesticide, distillery). (1)	2	0.052	0.110	0.882	-0.211	0.316
		3	-0.407*	0.107	0.001***	-0.666	-0.149
	Food Processing (2)	1	-0.052	0.110	0.882	-0.316	0.211
		3	-0.460*	0.127	0.002**	-0.766	-0.154
	Dairy products (3)	1	0.407*	0.107	0.001***	0.149	0.666
		2	0.460*	0.127	0.002**	0.154	0.766
*. The mean difference is significant at the 0.05 level							

Sig: Significance

As ANOVA results were significant for five out of six competitive factors. Post hoc Tukey helped in understanding which of the groups behaved differently. Hence, *hypothesis H_{2b}: There is a significant difference in the means of nature of industry on the basis of Competitive factors* has also been accepted.

4.3 Designing a strategic framework for enhancing productivity and competitiveness in Agri-Biotech sector

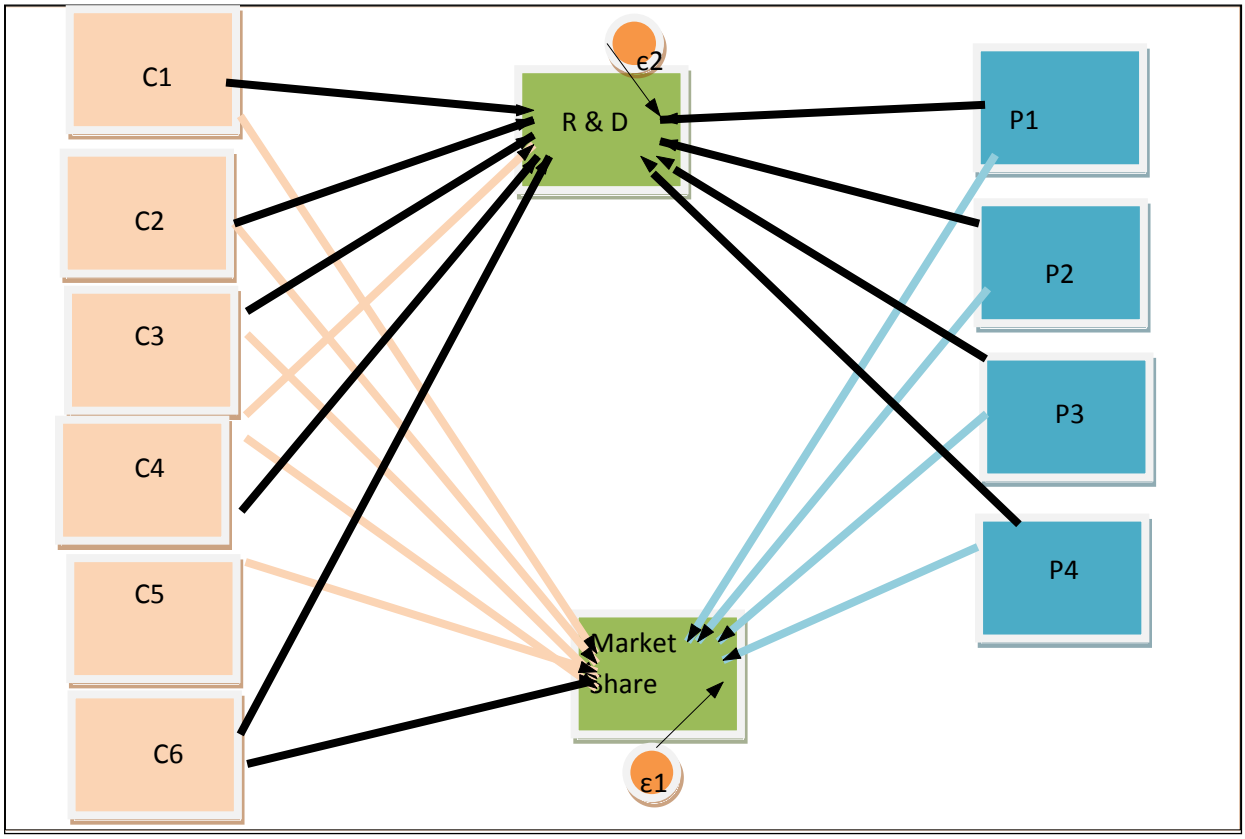
The last objective of the study is:

O4: To design a strategic framework for enhancing productivity and competitiveness in Agri-Biotech sector

Structural equation modelling (SEM) was used for designing a strategic framework for enhancing productivity and competitiveness in Agri-Biotech sector.

Market share and investment on research and development were the endogenous i.e. dependent variables and the exogenous i.e. independent variables were the competitive factors and productivity factors derived through factor analysis. The six competitive factors include: C1: threat of new competition; C2: threat of substitute products or services; C3: bargaining power of suppliers; C4: intensity of competitive rivalry; C5: bargaining power of customers (buyers) and C6: preparedness for change. The productivity factors taken for analysis include: P1: internal and external environment; P2: cost efficiency; P3: production planning and control and P4: technological advancement. It is essential to design a conceptual model for studying the relation among the dependent and independent variable.

The present study has used the following conceptual model:



R&D: Research & Development; €1, €2: Error Terms

Figure 4.7: Conceptual model

The results of SEM relationship of productivity and competitive factors with market share and Investment on Research and development were analysed. Initially the relation with of productivity and competitive factors with market share have been presented through table 4.17.

Table 4.17: Relation among productivity and competitive factors with market share

Variables	Coefficient	Std Error	z	P>|z|
C1:Threat of new competition	2.375	4598	5.16	0.000***
C2: Threat of substitute products or services	0.308	0.276	1.11	0.266
C3: Bargaining power of suppliers	-14.414	4.444	-3.24	0.001**
C4: Intensity of competitive rivalry	11.017	4.204	2.62	0.009*
C5: : Bargaining power of customers (buyers)	-6.883	1.707	-4.04	0.000***
C6: preparedness for change	4.965	0.854	5.81	0.000***
P1: Internal and External Environment	-2.099	0.966	-2.17	0.030 *
P2: Cost Efficiency	-7.911	2.489	-3.18	0.001**
P3: Production Planning and Control	7.472	1.993	3.75	0.000***
P4: Technological Advancement	-0.689	0.348	-1.98	0.048 *
Cons	22.742	9.974	2.28	0.023*
Mkt share	0.205	0.030		

***p≤0.001; **p≤0.01; * p≤0.05

All productivity factors viz. P1: internal and external environment; P2: cost efficiency; P3: production planning and control and P4: technological advancement are significant as values of $p<0.05$. In case of productivity factors except for P3: production planning and control all other variables are inversely related with market share. The related hypothesis H_3: There is a relation amongst Market share and factors influencing Productivity *is accepted though the results reflect that they are related inversely, except for* P3: production planning and control.

From the six competitive factors C1: threat of new competition; C2: threat of substitute products or services; C4: intensity of competitive rivalry; and C6: preparedness for change was positively related with market share. C3: bargaining power of suppliers and C5: bargaining power of customers (buyers) was inversely related with market share. All competitive factors, leaving only one, viz. C2: threats of substitute products or services, the values of beta were significant. Bargaining power of suppliers emerged with a high beta value amongst the determinants and is positively related with market

share. The value of C3: bargaining power of suppliers is also high but it is inversely related with market share. This is true as high bargaining power of suppliers may have a discouraging effect as it involves high costs. Hence, H_4: There is a relation amongst Market share and factors influencing Competitiveness *has been accepted*.

The results of relationship of productivity and competitive factors with R&D expenditure have been presented in table 4.18.

Table 4.18: Relation among productivity and competitive factors with investment on research and development

Variables	Coefficient	Std Error	Z	P>|z|
C1: Threat of new competition	0.405	5356	0.76	0.450
C2: Threat of substitute products or services	-0.353	0.322	-1.10	0.272
C3: Bargaining power of suppliers	-0.320	5.177	-0.05	0.951
C4: Intensity of competitive rivalry	0.083	4.898	0.02	0.987
C5: : Bargaining power of customers (buyers)	-0.279	1.988	-0.14	0.888
C6: Preparedness for change	0.404	0.995	0.41	0.684
P1: Internal and External Environment	-0.004	1.125	-0.00	0.997
P2: Cost efficiency	0.236	2.900	0.08	0.935
P3:Production Planning and Control	0.224	2.321	0.10	0.923
P4: Technological Advancement	0.402	0.406	0.99	0.322
Cons	-0.925	11.619	-0.08	0.937
R&D:Research & Development	0.279	0414378		

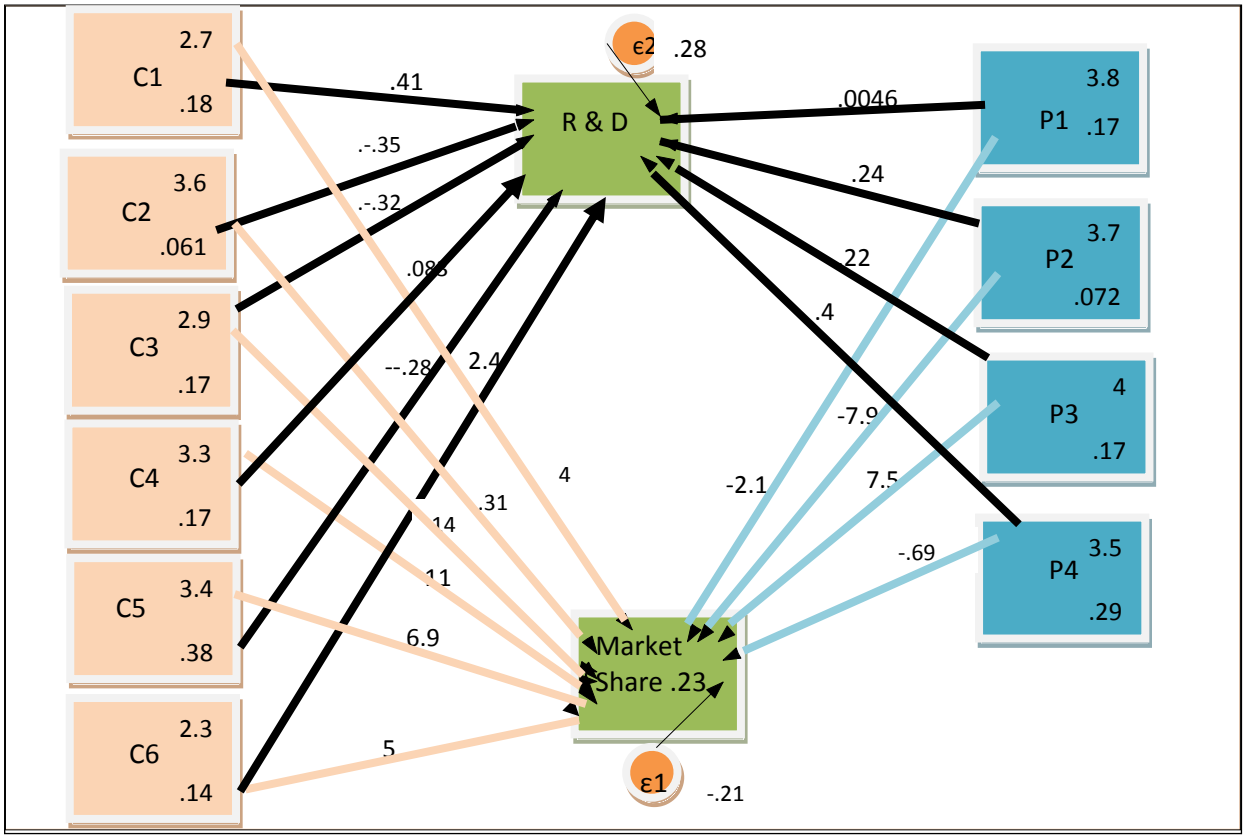
***p≤0.001; **p≤0.01; * p≤0.05

The results indicate that for two factors, viz. C3: bargaining power of suppliers and C4: intensity of competitive rivalry the values of beta are significant. Three competitive factors have inverse relation with R&D expenditure. These are: C2: threat of substitute products or services; C3: bargaining power of suppliers and C5: bargaining power of customers (buyers). The value of beta coefficient is low for all six competitive factors.

The related hypothesis *H_6: There is a relation amongst R&D Expenditure and factors influencing Competitiveness has been accepted.*

In case of productivity factors except for P3: production planning and control all other variables were inversely related with market share. All productivity factors do not have significant values as $p \geq 0.05$. In case of productivity factors only P1: internal and external environment was inversely related with R& D. Thus, in case of R& D expenditure productivity factors are important, but the beta values are quite small. Thus the next *H5: There is a relation amongst R&D Expenditure and factors influencing Productivity has been accepted.*

Overall results indicate that Indian firms in Agri-Biotech sector are still relying more on market share and less on investment in R & D. This is otherwise also visible from the low level of IPR filings and low total factor productivity. As is indicated by TFP indices of this sector, there is a need to focus on enhancing productivity.



R&D: Research & Development; €1, €2: Error Terms

Figure 4.8: Measurement Model

The results of SEM relationship of productivity and competitive factors with R& D investment has been presented in Figure 4.8.

The model fit statistics (Table 4.19) indicate that Chi-square (3.8; p; 06) is significant. The model is good fit. A "good model fit" only indicates that the model is probable and plausible. The Chi-squared test indicates the difference between observed and expected covariance matrices. Values closer to zero indicate a better fit; smaller difference between expected and observed covariance matrices. Chi-squared statistics can also be used to directly compare the fit of nested models to the data. One difficulty with the chi-squared test of model fit, however, is that researchers may fail to reject an inappropriate model in small sample sizes and reject an appropriate model in large sample sizes. Thus other measures of fit have been developed.

Table 4.19: Fit Statistics

	Actual Value	Recommended Value/range	Reference
Chi2_ms(21)	3.781		
p > Chi2	0.06	p≥0.05	
Population error			
RMSEA	0.055	0.08	Browne et al. (1993)
90% CI, lower bound	0.000		
upper bound	0.376		
p-close	0.079	0.08	
Baseline comparison			
CFI: Comparative fit index	0.965	≥0.90	Bentler (1990);Browne et al. (1993); Hu &Bentler (1999)
TLI: Tucker-Lewis index	0.869	≥0.85	
Size of residuals			
SRMR: Standardized root mean squared residual	0.012	0.05	Browne et al. (1993)
CD	0.652		

CD: Coefficient of determination; RMSEA: Root mean squared error of approximation

Although there is no consensus regarding an acceptable ratio for this statistic, recommendations range from as high as 5.0 (Wheaton et al, 1977) to as low as 2.0 (Tabachnick and Fidell, 2007). Good model fit would provide an insignificant result at a 0.05 threshold (Barrett, 2007), thus the Chi-Square statistic is often referred to as either a 'badness of fit' (Kline, 2005) or a 'lack of fit' (Mulaik et al, 1989) measure. The results are in recommended range i.e. Chi Square is 3.781 and p is 0.06. Thus, the model is a good fit one.

The comparative fit index (CFI) help in analyzing the model fit through examination of the discrepancy between the data and the hypothesized model, while adjusting for the issues of sample size inherent in the Chi-squared test of model fit and the normed fit index. The range of CFI values is within 0 to 1. Larger values indicate a better fit; a CFI value of 0.90 or larger is normally considered to specify acceptable model fit. The value of CFI: Comparative fit index is 0.965 is high suggesting better fit. The non-normed fit index (NNFI; known as the Tucker-Lewis index has been built on an index formed by

Tucker and Lewis, in 1973. It resolves some of the concerns and issues of negative bias, though NNFI values may sometimes fall beyond the 0 to 1 range. Tucker-Lewis index in the present model is 0.869 and is acceptable.

Next it is important to consider the root mean square residual (RMR) and standardized root mean square residual (SRMR). SRMR is the square root of the discrepancy between the sample covariance matrix and the model covariance matrix. The RMR is at times difficult to understand and interpret, as its range is based on the scales of the indicators in the model. This is the reason SRMR is considered, as the mean square residual removes this difficulty and its range fall within 0 to 1. A value of 0.08 or less is indicative of an acceptable model. In the present model the value of SRMR is 0.012 and is lower than 0.08 and thus is adequate.

It is good to consider the explanatory power of the model. The value of coefficient of determination is 0.652. The model thus explains 65.2 percent of variation. There are no modification indices to report as all MI values are lower than 3.84, and thus MI were not needed. Thus looking at all these indices are indicative of a good fit model. The results indicate that the reliance is more on market share, as reported through the model. There is a need to focus on R& D expenditure as has been indicated through the results of the model. Regarding competitive and productivity factors, the performance of competitive factors is better. The results also highlight that added consideration needs to be given to improve and enhance productivity factors.

Summing Up

Detailed analysis of secondary data as well as data was also collected from respondent firms regarding the factors influencing productivity and competitiveness. Factors affecting productivity and competitiveness were analysed. There are four factors influencing productivity and six factors of influencing competitiveness. These were identified with the help of factor analysis. ANOVA was performed to study whether there is a significant difference in the factors influencing productivity on the basis of plant size and productivity factors. ANOVA was also performed to study whether there is a significant difference in the factors influencing productivity on the basis of nature of industry and productivity factors. Similar steps were repeated for plant size and nature of industry and competitive factors. For analysing inter firm differences on the basis of size of the firm and nature of industry post hoc Tukey was performed.

Finally the structural model was designed depicting relation among factors of productivity and competitiveness in relation to market share and R& D Investment. The results depicted that the model is a good fit model. The study indicates that regarding competitive and productivity factors, the performance of competitive factors was better in comparison to the productivity factors.

A conducive and holistic policy framework approach was used to identify competitive and productivity factors through a participative stakeholder analysis. This chapter using various research methods analysed these factors and finally a strategic model was designed to understand the relation of these competitive and productivity factors with R&D and market share. Thus, the basic purpose with which this study was intended was achieved.

CHAPTER-5

CONCLUSION

The present chapter aimed to recollect the various phases of the study. Section 5.1 of this chapter wraps up the major findings of the research study. Section 5.2 covers the revisiting of the objectives to find out how the objectives have been achieved. Section 5.3 indicates the limitations of the study; Section 5.4 covers implications of the study. The final section 5.5 explains the future scope of the study.

5.1 Major findings of the study

The major findings of the study are:

1. The initial part of the study focused on analyzing productivity and competitiveness scenario in Agri-Biotech sector.

2. An overview of this sector highlights that this is a growing sector of Punjab economy.

3. The study used both secondary and primary data to build a complete picture of this sector.

4. Using secondary data the study focused on the empirical measurement of growth of output, capital and labour, capital productivity, labour productivity and total factor productivity. Labour productivity (V/L) is measured as the ratio of value added to total no of persons employed. Capital Productivity (V/K) is measured as the ratio of value added to gross fixed capital.

5. Result highlight that TFP growth of Food and Beverage sector#15 is positive although it is low and lies in the range of 0.789 to 1.028. This supports that food and Beverage sector #15 is a growing sector. Partial productivity indices are indicators of efficiency of labour or capital input, while total factor productivity is an aggregative index depicting growth of the sector.

6. Partial productivity indices for Food and Beverage sector#15 reflect that labour productivity is growing at a faster pace than capital productivity. There is evidence of high capital intensity, viz. capital/labour ratio. Capital/labour ratio increased from 2.613 in 1998-99 to 11.491. Thus, growth in TFP is a reflection of high capital intensity.

7. Result of TFP for Manufacture of Chemicals and Chemical Products #24 indicates that the growth lies in the range of 0.755 to 1.19. TFP growth is positive and this is also a growing sector. Partial productivity indices reflect that labour productivity is growing at a faster pace than capital productivity. There is evidence of high capital/labour ratio.

8. The study highlighted low capital productivity as compared to labour productivity and low total factor productivity for food and beverage sector as well as Chemicals and Chemical Products #24. A comparative analysis depicts that Chemical and Chemical products have grown at a faster pace than Food products and Beverage.

9. The next part of analysis was based on survey based analysis collecting data from Agri-Biotech firms through self structured questionnaire to get greater insight into productivity and competitive factors.

10. The variables influencing productivity and competitiveness in Agri-Biotech sector were identified through literature.

11. The productivity factors extracted were then extracted through factor analysis. These were: P1: internal and external environment; P2: cost efficiency; P3: production planning & control; P4: technological advancement.

12. The competitive factors were: C1: threat of new competition; C2: threat of substitute products or services; C3: bargaining power of suppliers; C4: intensity of competitive rivalry; C5: bargaining power of customers (buyers) and C6: preparedness for change.

13. ANOVA was used in the survey based analysis for finding the relation between size and factors influencing productivity and competitiveness of firms in Agri-Biotech sector. ANOVA results indicated a significant difference among size of the firm and factors influencing productivity and competitiveness.

14. ANOVA was also used in the survey based analysis for finding the relation between nature of Industry and factors influencing productivity and competitiveness of firms in Agri-Biotech sector. ANOVA results indicated a significant difference among nature of industry and factors influencing productivity and competitiveness.

15. Structural equation modeling (SEM) was used to design a strategic framework for enhancing productivity and competitiveness in Agri-Biotech sector. The endogenous variables are market share and investment on research and development. The exogenous variables are competitive factors viz. C1: threat of new competition; C2: of substitute products or services; C3: bargaining power of suppliers; C4: intensity of competitive rivalry; C5: bargaining power of customers (buyers) and C6: preparedness for change.

16. The productivity factors were: P1: internal and external environment; P2: cost efficiency; P3: production planning and control and P4: technological advancement.

17. The value of coefficient of determination is 0.652. The model explained 65.2 percent of variation. All these results are indicative of a good fit model.

These were the brief of findings from the study. It is important to revisit the objectives to understand how they have been achieved and to discuss them in relation to other studies. The next section covers this aspect.

5.2 Revisiting the objectives

It is necessary to revisit the research objectives to see whether the study has been able to accomplish the same.

O1: To determine productivity trends in Agri-Biotech sector

The first objective related with finding productivity trends about Agri-Biotech sector. Data for Food and Beverage sector#15 and Chemicals and Chemical Products #24 was collected through Annual survey of Industries published by Central statistical organisation (CSO). The results of capital and labour productivity highlight that both the sectors had low capital productivity, high labour productivity. These results are

supported through earlier studies on productivity, although these studies don't cover the recent data. This study fills that gap. A study by Kaur et al. (1991) highlights that labour productivity for Food and Beverage sector#15 grew at a rate of 7.96 per cent per annum in the period 1991-92 to 2002-03 and for Chemicals and Chemical Products #24 grew it was 5.62 per cent per annum. Capital productivity for Food and Beverage sector#15 grew at a rate of 1.42 per cent per annum and for Chemicals and Chemical Products #24 it had a negative growth of -0.23 per cent per annum. Many earlier studies depict that Indian manufacturing has not performed well on the capital productivity front (Goldar 1986; Ahluwalia 1991). Singh (2004) also highlighted that there was an increase in capital intensity in Indian manufacturing during 1983-84 to 1998-99. Results of the present study also highlight a similar trend for the current period as well although there is now some improvement in capital productivity in the state of Punjab.

The current study highlights that TFP for Chemicals and Chemical Products #24grew at a rate of 1.19 per cent per annum and that TFP growth for food and beverage sector shows that TFP is 1.028. A study by Kaur et al. (1998) indicates that TFP of Food Products and Beverages #15 was 0.96 per cent per annum and that of Chemicals and Chemical Products #24 was 0.35 percent per annum. According to Das (200) Food and beverages sector the rate of growth of TFP was 2.37 per cent per annum and that of Chemical and Chemical Products #24 was 2.71 percent per annum. While Das (2003) suggested a deceleration in post-1991 reform period in TFP, Srivastava (1996) suggested acceleration in TFPG rates occurred in 1987, although it was negative for 1980-81 to 1984-85. The results of current study report that TFP for Chemical Products #24 is higher than that of Food Products and Beverages #15. Thus, the first objective was fulfilled and productivity trends in Agri-Biotech sector reflected that this sector was a growing sector although TFP growth rates were low but they were positive.

O2: To identify the factors affecting productivity

The study used factor analysis to identify factors influencing productivity. These were: internal and external environment; cost efficiency; production planning and control; and technological advancement. These four factors account for 90.669 percent of total variation. Internal and External Environment emerged as a vital factor explaining 31.208 percent of total variation. Similar thoughts were reverberated by Evans and Lindsay (1997), as they advocate that business with multi-functional competencies have improved and enhanced the opportunity to grow. Ruzzier et al., 2006 also supported this and felt that managing innovation, global impact and change management are vital for competing at global level.

The second factor emerging from factor analysis was cost efficiency. This factor accounted for 24.600 percent of total variation. Production planning and control was the third factor influencing productivity and explained 18.685 percent of total variation. There is supportive evidence regarding this factor (Alinaitwe et al., 2007; Lim et al. 1995; Ailabouni et al. 2007). Technological advancement emerged as next factor with total variation of 16.176 percent. While (Sheel, 2002) expressed that technological advances are essential for creating hyper competitive environment, there are studies as that of Bartelsmann, van Leeuwen and Nieuwenhuijsen (1996) advocating contradictory results regarding the importance of new technology for productivity growth in Netherland. Along with technology, there should be a focus on investment on IPRs for improving commercial value.

Firm-wise analysis was also done for understanding the relation amongst size of the firm and factors influencing productivity. ANOVA results reflect that there is a significant difference in three factors influencing productivity on the basis of plant size. These are: Internal and External Environment, production planning and control and Cost Efficiency. For remaining one factor, viz. Technological advancement the results didn't reflect significant difference on the basis of plant size. This suggests that there is similarity of sensitivity amongst all types of firms, small, medium and large that technology advancement is important factor for productivity. Similar thoughts were reverberated by Khamba and Singh (2001), who opined that technology adoption and

adaptation is highly critical for a firm's performance. Crépon, Duguet and Mairesse (1998), studying some four thousand French manufacturing firms between 1986 and 1990 found a relation between productivity and new and advanced technologies. Thus the hypothesis *H_{1a}: there is a significant difference in the means of size of the firms on the basis of factors affecting productivity* has been accepted.

ANOVA results for relation between nature of industry and factors influencing productivity reflect that there is a significant disparity among all four factors influencing productivity on the basis of nature of industry. The results are significant for: Internal and External Environment, Cost Efficiency; Production Planning and control and Technological advancement. The next hypothesis *H_{1b}: There is a significant difference in the means of nature of industry on the basis of Productivity factors* has been accepted.

O3: To identify the factors affecting competiveness

This was done through factor analysis of twenty four questions pertaining to competition in the survey. On the basis of factor analysis these were reduced to six factors, viz. i) Threat of new competition, ii) Threat of substitute products or services; iii) Bargaining power of suppliers; iv) Intensity of competitive rivalry; v) Bargaining power of customers (buyers); and vi) Preparedness for change. These six factors account for 96.208 percent of total variation. Threat of new competition emerged as an important factor explaining 20.452 percent of total variation. Thus, threat of competition is very important (Porter, 1998). For competitive advantage, Porter's ``five forces model" (Porter, 1985) has utmost relevance. All the variables in this factor account for loadings in the range of 0.821 to 0. 891. Economies of scale and Barriers to entry loaded heavily on this factor. Bain (1956) advocated barriers to competition decreased the efficient allocation of resources.

For deeper analysis, it was essential to conduct ANOVA on the basis of size of the firm and competitive factors to find out whether there is a significant dissimilarity on the basis of these regarding the six competitive factors. ANOVA results were significant for F1: Threat of new competition, F2: Threat of substitute products or services, significant

for F3: Bargaining power of suppliers, F5: Bargaining power of customers (buyers) and F6: Rivalry among existing firms. Results were not significant for F4: Intensity of competitive rivalry. As the p-values were significant for all but one factor, hence the next hypothesis, *H_{2a}: There is a significant difference in the means of size of the firms on the basis of competitive factors* has been accepted.

ANOVA results for Nature of Firms and Competitive factors indicate that except for one factor, viz. F5: Bargaining power of customers (buyers), ANOVA results were significant for all other factors. Thus this highlights that there is a significant differentiation amongst firms regarding the competitive factors on the basis of nature of the industry. Thus the hypothesis *H_{2b}: There is a significant difference in the means of nature of industry on the basis of Competitive factors* has been accepted.

O4: To design a strategic framework for enhancing productivity and competitiveness in Agri-Biotech sector

The dependent variables were market share and investment on research and development. The independent variables were competitive factors viz. C1: threat of new competition; C2: threat of substitute products or services; C3: bargaining power of suppliers; C4: intensity of competitive rivalry; C5: bargaining power of customers (buyers) and C6: preparedness for change. The productivity factors were: P1: internal and external environment; P2: cost efficiency; P3: production planning and control and P4: technological advancement.

The results of relationship of productivity factors with market share highlight that In case of productivity factors except for P3: production planning and control all other variables are inversely related with market share. The related *hypothesis* H_3: There is a relation amongst Market share and factors influencing Productivity *is accepted though the results reflect that they are related inversely, except for P3: production planning and control.* This again is pointer to improving productivity performance.

The results of relationship of Competitive factors with market share indicate that C1: threat of new competition; C2: threat of substitute products or services; C4: intensity of competitive rivalry; and C6: preparedness for change had a relation with market share. Except for C2: threat of substitute products or services, all other factors emerges as significant factors. Bargaining power of suppliers had a strong Beta value in determinants with positive relation. The value of C3: bargaining power of suppliers is high but it is inversely related with market share. Hence, the related *hypothesis H_4: There is a relation amongst Market share and factors influencing Competitiveness* has been accepted. Earlier literature suggests that that if market share is an asset, then competition should be fierce enough to diminish the net long-term returns to zero (Schendel and Patton 1978; Rumelt and Wensley 1981; Spence 1981).

In case of productivity factors only P1: internal and external environment was inversely related with R& D. This indicated that for P2: cost efficiency; P3: production planning and control and P4: technological advancement share a positive relation with R & D Expenditure. Thus, in case of R& D expenditure productivity factors are important, but the Beta values are relatively small. Thus the next *H5: There is a relation amongst R&D Expenditure and factors influencing Productivity has been accepted.* The results are corroborated through earlier literature as significant evidence is available suggesting improvement in productivity through investment in R & D (Odagiri, 1985; Martino, 1983; Morton, 1971; Zaltman, 1973; (Griliches and Mairess, 1984); Sherer, 1991).

*The results of relation amongst R&D Expenditure and factors influencing competitiveness i*ndicate that for two factors, viz. C3: bargaining power of suppliers and C4: intensity of competitive rivalry the values of Beta are significant. Three competitive factors, viz., C2: threat of substitute products or services; C3: bargaining power of suppliers and C5: bargaining power of customers (buyers) have an inverse relation with R&D expenditure. The value of beta coefficient is low for all six competitive factors. Narain et al. (2004) advocated stress on advanced technology, technical manpower, and investing strongly on innovative research and development. The related hypothesis *H_6: There is a relation amongst R&D Expenditure and factors influencing Competitiveness has been accepted.*

Results indicate that for R&D productivity factors are more important and for Market share competitive factors play a vital role. Thus for improving performance of Agri-Biotech sector, reliance needs to be given to competitive as well as productivity factors.

Thus all the objectives were achieved and the study has brought interesting facts. The results indicate that Indian firms in Agri-Biotech sector lay more emphasis on market share and there is a need to enhance focus on investment in R & D. There are lesser IPR filings. The productivity indices indicate that total factor productivity is positive but the rate of growth is still low. Thus, there should be focus on enhancing productivity.

An Overview of research has been presented through Figure 5.1. This gives the details of research along with results.

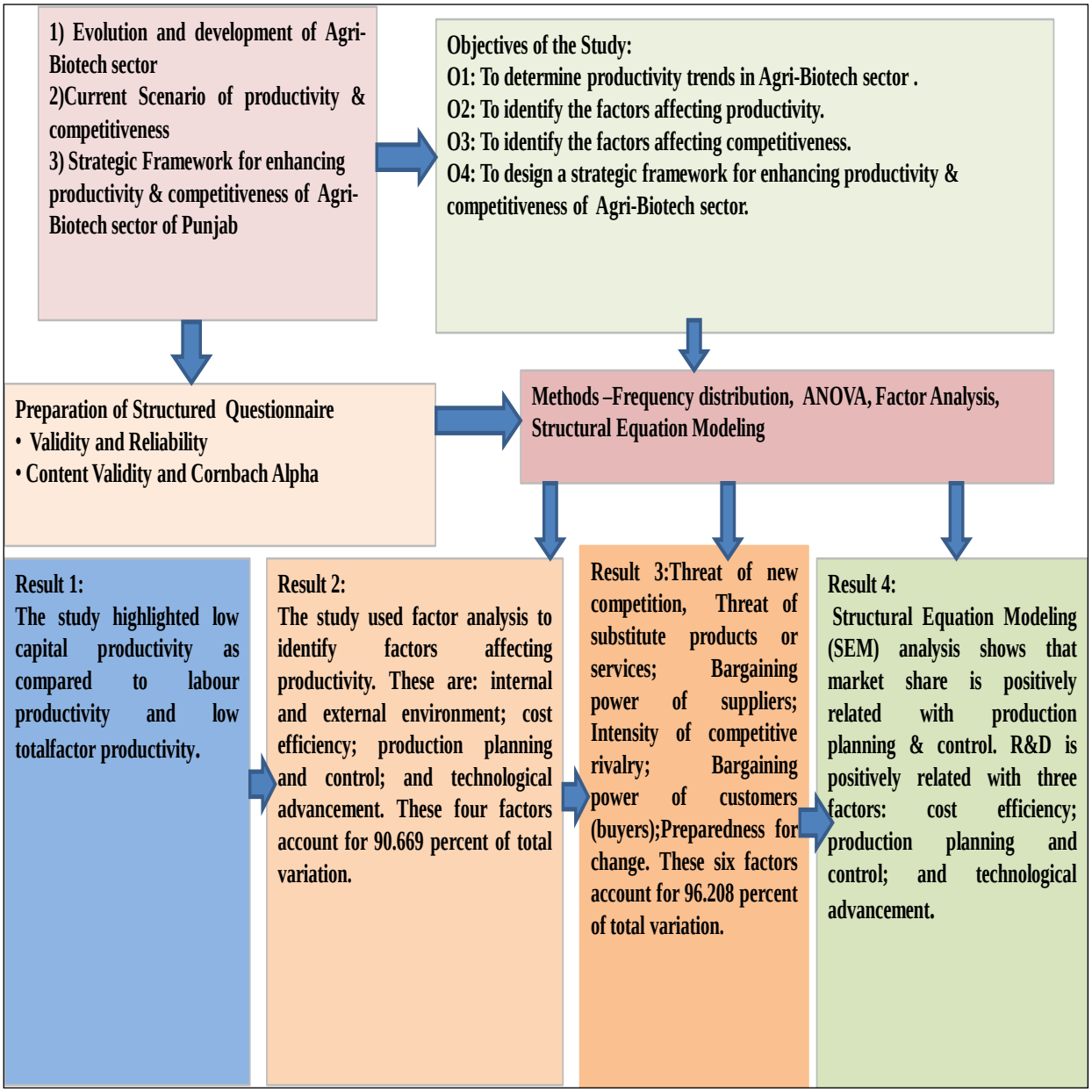


Figure 5.1: An Overview of research

5.3 Limitations of the study

The limitations of the present study originate mainly from the database and methodology used for calculating productivity. There are certain biases in the estimates of the output and input. There are conceptual problems in the measurements of these variables and these are not easy to cover and overcome them. The standard methodology used in the productivity analysis has limitations, especially in the measure of total factor productivity growth (TFPG) used in the study. TFPG used in the current study has been derived from Translog production function under the assumption of competitive equilibrium where the factors are paid the value of their respective marginal products and constant returns to scale. These assumptions have been questioned in the literature. However, these limitations may focus on opportunities for future areas of research too. Some limitations also arise from the survey based analysis. Surveys are easy and quick way of collecting data. Often reliance is on the data provided by respondents. It is not easy to collect data from firms, despite repeated visits; the sample size was just adequate. A larger size could have helped more. Moreover the reliance is on the information provided by respondent firms.

5.4 Implications of the study

The findings of this study have significant policy implications for the Agri-Biotech sector of Punjab and not only for India but for other developing countries as well. Based on the current analysis, the following policy implications can be offered.

The Agri-Biotech sector of Punjab is using higher inputs, but still the performance in terms of productivity is low and needs to be improved. This sector is using more of capital input, as capital labour ratio is higher. Focus thus has to be concentrated on the efficient use of capital. The higher growth of capital in the production, suggests capital intensive production. This calls for steps to use capital judicially along with labour. Specific guidelines are required to enhance productivity. The efficient usage of capital could make important productive contribution to the Agri-Biotech sector of Punjab.

Starting from the initial phase underlining the purpose and rationale of the study, the research moved to design a questionnaire on the basis of literature review, adapting items of competitiveness and productivity. Collecting and collating data significant results were achieved, which have been presented in this chapter. The study helped in identifying the factors influencing the productivity and competitiveness of Agri-Biotech firms in Punjab and suggested a framework for enhancing productivity and competitiveness. The study also highlighted the factors influencing the innovation and IPR culture of these firms to enhance their competitiveness in the changing global environment. Thus, a step by step approach as highlighted in the form of different chapters of this thesis has led to these results. Thus, the study will be useful not only for academics but equally important for entrepreneurs and managers to put their effort in the right direction and focus on those factors which help to enhance productivity and competitiveness of Agri-Biotech firms of Punjab.

5.5 Further scope of research

Present study has identified factors influencing competitiveness and productivity. Further case-study analysis can be done to validate the factors identified in the study. Moreover, since this research was carried out in one state, duplicating this research in other cities could test the truth of the findings when applied to other regions. Similarly, researching and conducting similar research in other developed countries, where the financial services and products are more advanced, could then be compared with the domestic situation. This may contribute to a better understanding of relation among the factors affecting productivity and competitiveness.

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Appendix I

Ph. D. Questionnaire

on

A STRATEGIC FRAMEWORK FOR ENHANCING PRODUCTIVITY AND COMPETITIVENESS IN AGRI-BIOTECH SECTOR OF PUNJAB

1.	Name of the firm	
2.	Address of the firm	
3.	Survey respondent 's name and designation	
4.	Respondent's mail & contact no	
5.	Scale of the firm	Small ( ) Medium ( ) Large ( )
6.	Category of Industry	Dairy Products ( ) Food Processing ( ) Distillery( ) Pesticide ( ) Fertilizers( )
7.	Certifications of company	Yes ( ) No ( )
8.	Number of employees	50-100 ( ) 100-150 ( ) > 150
9.	Collaboration with some foreign company ,if any	Yes ( ) No ( )
10.	Has your firm obtained Trade Marks?	Yes ( ) No ( )
	If Yes Specify No	
11.	Has your firm obtained Patents?	Yes ( ) No ( )
	If Yes Specify No	
12.	Has your firm obtained Copy Rights?	Yes ( ) No ( )
	If Yes Specify No	
13.	Employee Training per year (Specify No)	
		Please rate each factor on a 5 point scale of (1, 2, 3, 4, 5) by ticking (✓) one of the five boxes for each factor. (1 means most least relevant, 5 means most relevant)

14.	Technical Expertise % of Total Employees	1	2	3	4	5
15.	R & D as % of output	1	2	3	4	5
16.	Rate of growth of output	1	2	3	4	5
17.	Status regarding Market Share	1	2	3	4	5
	Factors Influencing Productivity					
	Factors	Please rate each factor on a 5 point scale of (1, 2, 3, 4, 5) by ticking (✓) one of the five boxes for each factor. (1 means most least relevant, 5 means most relevant)				
18.	Adoption of new technology	1	2	3	4	5
19.	In-house R&D Expertise	1	2	3	4	5
20.	Capital Intensity	1	2	3	4	5
21.	Planning and viability study	1	2	3	4	5
22.	Consequential changes in related products/ processes	1	2	3	4	5
23.	Attitude of employees towards technology adoption	1	2	3	4	5
24.	Education and training of employees	1	2	3	4	5
25.	Participation of engineers in technology adoption	1	2	3	4	5
26.	Availability of Professional Consultants	1	2	3	4	5
27.	Material Supplies	1	2	3	4	5
28.	Cost of new technology	1	2	3	4	5
29.	Opportunities created due to globalization lead to new technology adoption	1	2	3	4	5

30.	Threats caused due by globalization forced to go for new technology.	1	2	3	4	5
31.	Availability of better technology due to globalization attracted to go for it	1	2	3	4	5
32.	Govt regulations (environmental related etc) lead to new technology adoption	1	2	3	4	5
33.	Cost of training	1	2	3	4	5
34.	Increased maintenance expenses	1	2	3	4	5
35.	Skill of Production managers	1	2	3	4	5
36.	Compatibility of equipment	1	2	3	4	5
37.	Availability of finance	1	2	3	4	5
	Factors Influencing Competitiveness					
38.	Factors	Please rate each factor on a 5 point scale of (1, 2, 3, 4, 5) by ticking (✓) one of the five boxes for each factor. (1 means most least relevant, 5 means most relevant)				
39.	Barrier to entry	1	2	3	4	5
40.	Competitor products with patents	1	2	3	4	5
41.	Profitability of industry	1	2	3	4	5
42.	Economies to scale	1	2	3	4	5
43.	Buyers propensity to substitute	1	2	3	4	5
44.	Product differentiation	1	2	3	4	5
45.	Substitute products in market	1	2	3	4	5
46.	Quality of substitute products	1	2	3	4	5
47.	Buyer concentration	1	2	3	4	5

48.	Bargaining power of buyers	1	2	3	4	5
49.	Buyer switching cost	1	2	3	4	5
50.	Buyer information available	1	2	3	4	5
51.	Buyers price sensitivity	1	2	3	4	5
52.	Product uniqueness	1	2	3	4	5
53.	Supplier switching cost relative to firm switching cost	1	2	3	4	5
54.	Degree of depreciation of inputs	1	2	3	4	5
55.	Supplier concentration to firm concentration ratio	1	2	3	4	5
56.	Existence of labour unions	1	2	3	4	5
57.	Ability for forward integration	1	2	3	4	5
58.	Competitive advantage through innovation	1	2	3	4	5
59.	Competitive strategy	1	2	3	4	5
60.	Customization	1	2	3	4	5
61.	Level of advertising expenses	1	2	3	4	5
62.	Competition b/w online & offline companies	1	2	3	4	5
	Competitive Position:					
63.	Perception regarding the competitive position of the company in the market in next 5 years	1	2	3	4	5

Appendix II

LIST OF PUBLICATIONS

S. No	Authors	Title of Paper	Journal Name	Index
1	Mr. Sandeep Singh, Dr. Ravi Kiran, Dr. Dinesh Goyal	Identification Of Key Factors for Enhancing Competitiveness: An Exploratory Study Of Selected Agri-Biotech Firms of Punjab in India	Agric.Econ-Czech, 61,2015 (4):179-188	SSCI
2	Mr. Sandeep Singh, Dr. Ravi Kiran, Dr. Dinesh Goyal	Market Share, R &D And Determinants of Productivity: Firm Based Analysis of Agri-Biotech Sector of Punjab In India	Custos e @gronegócio on line -11 (3):166-182	SSCI
3	Mr. Sandeep Singh, Dr. Ravi Kiran, Dr. Dinesh Goyal	Examining the Relation of Productivity and Competitive Factors with Market Sales and R&D: A Study of Selected Agri-Biotech Firms of Punjab	Global Journal of Management and Business Research: A Administration and Management, 15(11):31-44	Global Journal