Designing a strategic framework for stimulating agri-biotech sector performance through productivity and competitive factors: an emerging economy case

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Abstract

Agri-biotech sector is an emerging sector of Indian economy. The present study covers empirical research on the selected Agri-Biotech firms of Punjab. The sample has been chosen from the state of Punjab in India covering Food Processing Industry, Fertilizer and Pesticides Industry. On the basis of factor analysis, the study has identified key factors influencing productivity and competitiveness. Results indicate that the key factors influencing productivity are: Internal and External Environment; Cost Efficiency; Production Planning and Control; Technological Advancement. 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 are the factors affecting competitiveness. The study used structural equation modelling to design a strategic framework enhancing productivity and competitiveness in Agri-Biotech sector of Punjab. Market share and investment on research and development were used as dependent variables. The independent variables were the 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.

Keywords: Productivity factors. Competitive factors. Agri-biotech sector. Strategic Framework.

1. Introduction

Indian economy is going through a transition phase where the restructuring of industries and firms are taking place in the form of privatization, globalization, and liberalization. Along with the global economic integration, there has been a marked acceleration in the pace of technological and scientific progress. 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, efficiency and competitiveness.

The present study has been carried out to design a framework for stimulating performance in Agri-biotech sector of Punjab with a focus on Productivity and competitive factors. Key features of productivity and competitiveness were identified through literature. Key factors of productivity and competitiveness analysed through factor analysis. It was important to analyse their relation with Market sales and Research & Development expenditure to focus on key predictors of productivity and competitiveness. This will help foster growth in Agri-Biotech sector.

The study has been taken with the following broad objectives:

O1: To identify the factors affecting productivity.

O2: To identify the factors affecting competitiveness.

O3: To design a strategic framework for enhancing productivity and competitiveness in Agri-Biotech sector.

2. Review of Literature

Productivity is the sine-qua-non of modern economy. There are many studies covering partial as well as total factor productivity. Alinaitwe et al. (2007) has identified 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 as key features of productivity.

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 worker hiring problems, increasing labour turnover, remaining absent; and language problems as features of productivity.

Ailabouni et al. (2007) analysed determinants of 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. The results by Odagiri & Yasuda (1996) confirm that greater Central bank autonomy has helped maintain low inflation levels. Significant differences exist in the area of banking supervision where many central banks have retained a key role.

Table 1: Key Features of Productivity

Key Features of Productivity	Supportive Literature
1. Adoption of new technology	Sethi et al. 2007; Khamba & Singh (2001); Kiran, 1998; Zhu et al. 2006; Baldwin and Diverty (1995)
2. In-house R&D Expertise	Odagiri & Yasuda(1996); Scherer (1983)
3. Capital Intensity	Alinaitwi, Mwakali, and Hansson (2007); Terlechky (1974), Scherer (1983); Griliches (1979; Griliches & Mairess (1990) ; Odagiri (1991); Bartelsmann et al. (1996)
4. Planning and viability study	Alinaitwi, Mwakali, and Hansson (2007)
5. Consequential changes in related products/ processes	Alinaitwi, Mwakali, and Hansson (2007); Bresnahan and Trajtenberg (1995)
6. Attitude of employees towards	Alinaitwi, Mwakali, and Hansson 2007

technology adoption	
7. Education and training of employees	Lim et al. (1995);
8. Participation of engineers in technology adoption	Alinaitwi, Mwakali, and Hansson (2007)
9. Availability of Professional Consultants	Lim et al. (1995);: Ailabouni et al. (2007)
10. Material Supplies	Alinaitwi, Mwakali, and Hansson (2007)
11. Cost of new technology	Lim et al. (1995)
12. Opportunities created due to globalization lead to new technology adoption	Mascus (2000) ; Cameron, Proudman and Redding (1999); Zakeri et al. (1996)
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 lead to new technology adoption	Alinaitwi, Mwakali, and Hansson (2007)
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); Siegel, D. & Griliches, Z. 1991

Researchers focusing on Competitive features 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 (19684) 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. Employees are trained by the companies so that they develop the skills

essential for technology adoption (Baldwin & Sabourin, 1996). 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. 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 & Zinnkhan, 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 et al., 2011). As highlighted by Rainer et.al (2009) the role and importance of information systems. Information comprises of all the information about the level of quality of the substitute products available.

Kelly & Gosman (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). As opined by Jonathan & Janjhyuk (1999) 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). The dissimilarity of transaction prices and the listing prices due to online price dispersion (Zhao et al. 2015). 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 & Schreier, 2008).

The relationship of the switching costs with the competition dynamics was pointed out by Farell & Shapiro (1988). He focused on how to achieve a dynamic competition with switching costs. Oyeniyi & Abiodun (2010) conducted a study in the mobile phone market of Nigeria to recognize the effect of switching costs on customers' loyalty. The study highlighted 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). The preferences of the consumers for brands are influenced by advertisements (Ayanwale, & Ayanbinipe, 2005). There may be a change in the strategies in order to face the new competitive environment. Barney (1991) 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. For competitive advantage, Porter's five forces model' (Porter, 1980) are of paramount importance. Undoubtedly, it has been supported by empirical evidences as highlighted in literature.

Table 2: Key Features of Competitiveness

Key Features of Competitiveness	Supportive Literature
1. Barrier to entry	Porter (1980), Scherer, 1988; Bunch and Smiley, 1992; Bain (1956)
2. Competitor products with patents	Mascus (2000); Porter (1980,98)
3. Profitability of industry	Bain (1956); Lall, (2001); Buckley et al. 1988; (Tangen, 2003)
4. Economies to scale	Porter (1980); Caves, (1982)
5. Buyers propensity to substitute	Porter (1980); Hines,(2013)
6. Product differentiation	Porter (1980);Burton, et al.(1987); Esteban et al.(2007)
7. Substitute products in market	Porter (1980); 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 (1980); Kelly, et al.(2000); Bradburd.(1982); Connor et al. (1996)
10. Bargaining power of buyers	Porter (1998); Kilne, S. & Botterill,.(2007); Shona, et al.(2003)
11. Buyer switching cost	Porter (1998); Lee (2007); Rust, et al (1995)
12. Buyer information available	Chin-Oh Chang et al.(1993);
13. Buyers price sensitivity	Shrivastava, et al.(2015); Anuradha 2011)
14. Product uniqueness	Porter (1998); Lall, (2001); Franke & Schreier.(2008)
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 & Shapiro (1988); Rust, et al (1995)

18. Existence of labour unions	Discon,(2010); Gitelman,(1984)
19. Ability for forward integration	Jallat. et al.(2001)
20. Competitive advantage through innovation	Geroski (1991); Becker et al. (2005)
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	Shang,.et al.(2009)

3. Agri-Biotech Performance

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 Van-Pottelsberge (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.

Griffith et. al. (2004) covered thirteen manufacturing industries in 12 OECD countries for the period 1970-92, found a relation between R&D and TFP. 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 & Mulani (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.

The present study was planned to identify the factors which are influencing productivity and competitiveness in Agri-Biotech sector of Punjab. Finally, it moves to designing a strategic framework for enhancing productivity and competitiveness in this emerging sector.

4. Materials & Methods

In the present study descriptive research design was used. Primary data was collected through a structured Questionnaire. The study covered the Food Process Industry, Fertilizer and Pesticides Industry in Agri-Biotech sector. Data have been collected from 69 firms from the state Punjab in India. Section 1 of questionnaire covered descriptive statistics regarding nature of firms and plant size. Section 2 covered factors influencing productivity. Section 3 had factors influencing competitiveness. Section 4 covered Agri-business performance measured through Market share and investment on research and development. All the sections had reliability Score measured in terms of Cronbach Alpha greater than 0.70.

Factor analysis was applied to identify factors influencing productivity and competitiveness culture in Agri-Biotech sector. A Structural equation modeling was used to design a strategic framework for enhancing productivity and competitiveness in Agri-Biotech sector.

5. Results and Discussion

This paper covers the survey based analysis of Agri-Biotech firms of Punjab. Section 5.1 covers the profile of respondent firms. Section 5.2 covers the Productivity factors. Section 5.3 covers the competitive factors. A framework designed is explained in Section 5.4.

5.1. Profile of respondent firms

Data has been collected from 69 firms from the state Punjab in India. Punjab is a progressive state of India. Break up of these firms has been depicted through figure 1. Sample is dominated by dairy products, followed by chemical and food processing units.

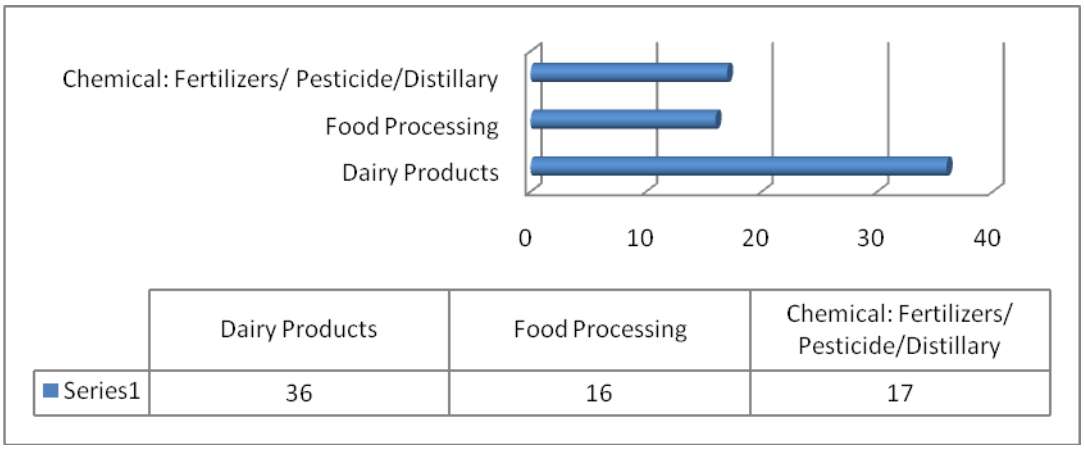

Figure 1: Nature of Industry

Size-wise analysis depicts that the sample is dominated by large sized firms as reflected through figure 2.

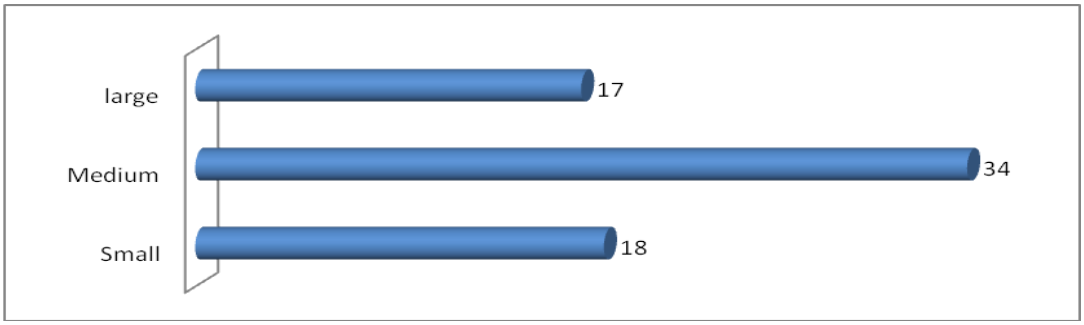

Figure 2: Plant Size

The researchers tried to find out the number of firms having ISO certifications. Majority (72%) of firms possessed the certifications as depicted through figure 3.

Figure 3: ISO Certification

Regarding status of IPRs as shown in figure 4, the agri-biotech firms have low levels of IPR filings.

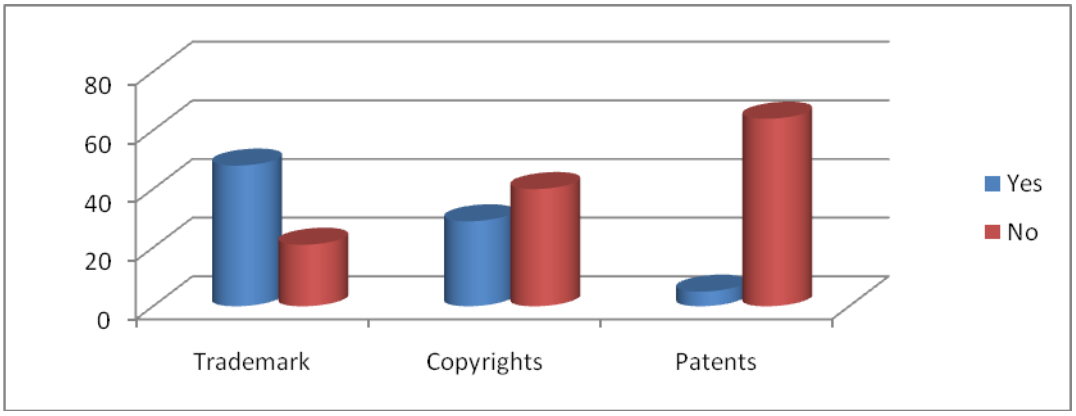

Figure 4: IPR scenario of sample firms

Majority of firms 48 out of 69 have filed trademarks, followed by 29 firms who have filed copyrights and only 5 firms have filed patents.

5.2. Factors affecting productivity

The first objective of the study was:

O1: To identify the factors affecting productivity

The study used factor analysis to identify factors influencing productivity. The results have been depicted through table 3.

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

i. internal and external environment;

ii. cost efficiency;

iii. production planning and control; and

iv. technological advancement

The above mentioned four factors accounted for 90.669 percent of total variation. Internal and External Environment emerged as a vital factor and this factor explained 31.208 percent of total variation. Education and training and Govt regulations had comparatively high item loadings of 0.992 and 0.963. 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, again an internal factor needed additional focus as this item had lower loading.

Table 3: Factor Analysis for Productivity

Factor Name	Items	Factor Loading	Eigen Value	% of Variance	Cum.	AVE	Construct 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 0.992 0.556					
	iii. Education and training	0.620 0.718					
	iv. Participation of engineers	0.963					
	v. Selection of supplier of technology						
	vi. Availability of better technology due to globalization						
	vii. Govt regulations						
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 0.806 0.961					
	iii. Threats	0.824					
	iv. Cost of training and						

		education v. Lack of finance						
3.	Production Planning & Control	i. Cost of new technology ii. Opportunities due to globalization iii. Increased maintenance expenses	-0.647 0.756 -0.807	2.990	18.685	74.493	0.547	0.782
4.	Technological Advancement	i. Adopting new technology ii. Attitude of employees towards adoption iii. Availability of Professional Consultants iv. Production management skill deficiency v. Problem of compatibility of equipment	-0.821 -0.632 0.623 0.946 0.973	2.588	16.176	90.669	0.661	0.815

Cost does cast an important influence as the decision to acquire new technology involves financial liability. Not only this, once technology is acquired it needs to used efficiently to enhance cost efficiency. Thus, the second factor emerging from factor analysis is cost efficiency which accounted for 24.600 percent of total variation. The items threats, cost of training and education, lack of finance had item loading of 0.806, 0.961, 0.824 whereas the item alternate cost effective processes and economic viability study loaded negatively with item loading of 0.975 and 0.639. This was an indicator that firms were not relying on these.

The next factor, viz. production planning and control explained 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 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 with enough competency to realise the potential opportunities that globalisation brings with it and there is lack of skill, training and expertise in this agri-biotech sector. This again indicates the reasons for low productivity indices of this sector in case of total factor productivity growth.

Construct 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. The values are acceptable as they are more than 0.70. The average variance extracted (AVE) is also greater than 0.50. Hence all these four factors were retained for further analysis.

5.3. Factors influencing Competiveness

The next objective of the study is:

O2: To identify the factors affecting competitiveness.

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. The results are shown in Table 4. 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.

The total variation explained by these six factors influencing competitiveness is 96.208 percent. 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 low. Hence all items of this factor have been retained for further analysis.

Table 4: Competitive Factors

Factor Name	Items	Factor Loading	Eigen Value	% of Variance	Cum.	AVE	CR
F1:Threat of new entrants	i. Economies of scale ii. Barriers to entry iii. Importance of brand loyalties in purchase decision	0.891 0.821 0.663	5.113	20.452	20.452	0.636	0.836
F2: Threat of substitutes/ services	i. Buyers' switching costs ii. Quality of substitutes iii. Perceived level of product differentiation iv. Number of substitutes available in the market v. Buyers' propensity to substitute	0.930 0.922 0.787 0.738 0.660	4.989	19.958	40.410	0.663	0.906
F3: Bargaining power of suppliers	i. Supplier switching costs ii. Supplier concentration iii. Ability for forward vertical integration	0.863 0.764 0.591	4.286	17.144	57.553	0.559	0.788
F4: Intensity of competitive rivalry	i. Online competition ii. Customization iii. Competitive advantage through innovation iv. Level of advertising expense	0.951 0.938 0.778 0.760 0.631	4.227	16.906	74.459	0.673	0.910

	v. Strong competitive strategy						
F5:Bargaining power of customers (buyers)	i. Availability of Buyer information ii. Products uniqueness iii. Influence of Buyers iv. Buyer concentration v. Buyer price sensitivity	0.886 0.813 0.769 0.678 0.575	2.808	11.231	85.690	0.566	0.864
F6: Preparedness for change	i. Rapid adjustment to stocks ii. Sensitivity to market changes iii. Workplace Flexibility	0.933 0.636 0.625	2.630	10.518	96.208	0.555	0.783

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 is highlighting another important issue that buyers today are not only relying on price competitiveness, but on other qualitative variables as well. Thus, firms recognize and realise that price may not be the only variable to be considered for 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 composite 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 is once again highlighting 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.

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

The last objective of the study is:

O3: To design a strategic framework for enhancing productivity and competitiveness in Agri-Biotech sector.

Structural equation modelling 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 as shown in Figure 5:

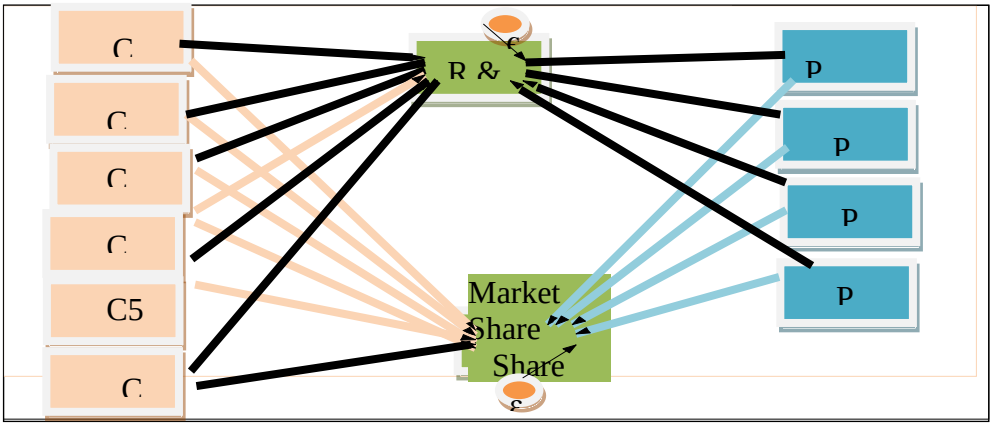

Figure 5: Conceptual model

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 5.

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 are positively related with market share. C3: bargaining power of suppliers and C5: bargaining power of customers (buyers) is inversely related with market share.

Table 5: Relation among productivity and competitive factors with market share

Variables	Coefficient	Std Error	z	P>|z|
C1:Threat of new competition	2.375	4598725	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. Thus, t*here 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.

Results indicate that all competitive factors, leaving only one, viz. C2: threats of substitute products or services, the values of beta are significant. Bargaining power of suppliers emerged has 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, t*here 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 6. In case of productivity factors except for P3: production planning and control all other variables are 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 is inversely related with R& D. Thus, in case of R& D expenditure productivity factors are important, but the Beta values are quite small. *Thus there is a relation amongst R&D Expenditure and factors influencing productivity has been accepted.*

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. Thus, *there is a relation amongst R& D Expenditure and factors influencing Competitiveness has been accepted.*

Table 6: 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	5356856	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		

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.

The results of SEM relationship of productivity and competitive factors with R& D investment has been presented in Figure 6.

The model fit statistics (Table 7) indicate that Chi-square (3.81; 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.

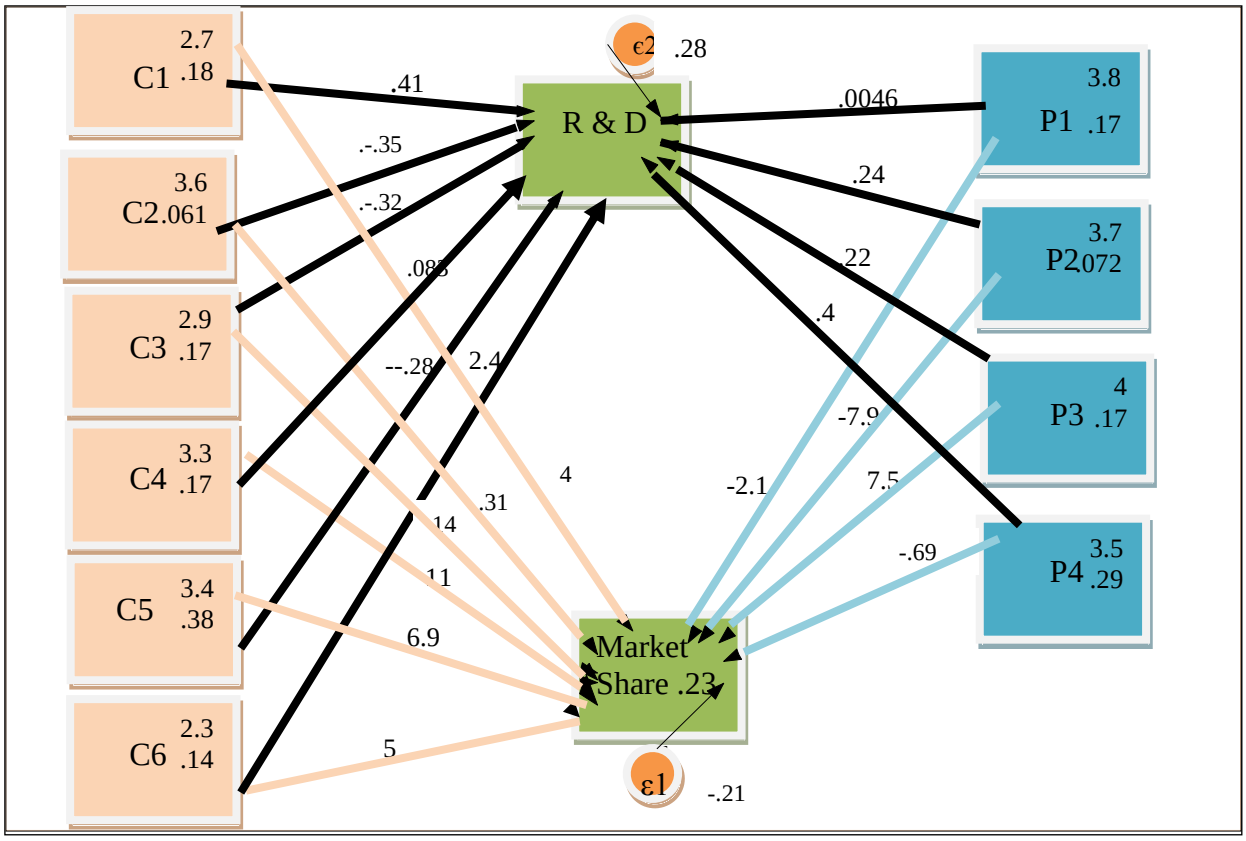

Figure 6: Measurement Model

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.

Table 7: Fit Statistics

	Actual Value	Recommended Value/range	Reference
Chi2_ms(21)	3.781		
p > Chi2	0.06	p≥.05	
Population error			
RMSEA	0.055 Root mean squared error of approximation	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	≥.90	Bentler (1990); Browne et al. (1993); Hu &Bentler (1999)

TLI: Tucker-Lewis index	0.869	≥.85	
Size of residuals			
SRMR	0.012 Standardized root mean squared residual	0.05	Browne et al. (1993)
CD	0.652 Coefficient of determination		

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.

The study used factor analysis to identify factors influencing productivity. These are: 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 Mcadam & Evans (2004) 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 & Alum, 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 et. al. (1996) advocating contradictory results regarding the importance of new technology for productivity growth in Netherland. Along with technology, there was a focus on investment on IPRs for improving commercial value.

O2: 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). 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 competitive advantage, Porter's ``five forces model'' (Porter, 1998) suggests the best answer.

O3: To design a strategic framework for enhancing productivity and competitiveness in Agri-Biotech sector.

The dependent variables are market share and investment on research and development. The independent variables are 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 are: 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. Thus, t*here 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 are positively related with market share. C3: bargaining power of suppliers and C5: bargaining power of customers (buyers) are inversely related with market share. From the six competitive factors except for C2: threat of substitute products or services all others are significant. Bargaining power of suppliers is emerging with 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, t*here 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 is inversely related with R& D. This indicates that for P2: cost efficiency; P3: production planning and control and P4: technological advancement there is 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, t*here 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 (Ahluwalia,1985;1991; Odagiri & Yasuda, 1996; Griliches and Mairess, 1990); Kiran & Kaur, 2007).

*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. Thus, *there is a relation amongst R& D Expenditure and factors influencing Competitiveness has been accepted.*

6. Conclusion

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 sectors, 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 is a need to focus on enhancing productivity.

The findings of this study suggest that 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.

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, 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.

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8. Further scope of Research

This study has identified factors influencing competitiveness and productivity. For future work 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.