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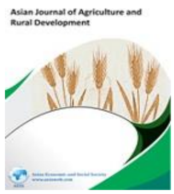

IMPLICATION OF TECHNOLOGY ON ECONOMIC PROGRESS OF FARMERS: A CASE OF INDIA

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ABSTRACT

This paper stresses the implication that technology has an important role in the economic progress of farmers. Analysis through the structural equation modelling reveals that technology has a high impact on a significant portion of the rural areas. With 150 respondents from the Osmanabad district of the state of Maharashtra this study focusses on two major reasons for adoption of agro technology. The initial schedule contained 116 items on various dimensions of self-motivation, external influences, social development, economic development, economic progress, health, and behavioral aspects. 90 items were retained. Since it is a multivariable study, confirmatory factor analysis and Structural Equation Modeling (SEM) are used in this study for data analysis in addition to parametric statistical tools. SPSS (20.0) and AMOS has been used for the same. It has been found that there is a correlation between technology and economic progress of farmers and that health consciousness has increased and the behavioral pattern has changed among farmers in rural areas.

Contribution/ Originality

This study reveals that there is a need for empowerment of the whole families and people associated with farmers to contribute to the social development of the country. This will be possible only when the use of technological skills such as smart farming, precision of agriculture, the Internet of Things etc. are adopted and farmers adapt to these tools.

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1. INTRODUCTION

Technology has it all from the very own artificially grown hamburgers through 3D printers that give out chocolates to salt watered veggies that are delivered to customers by drones. Technology has taken leaps and witnessed radical innovations in the past decade.

The objective is also to make the reader understand the significance of his existence today and what tomorrow holds for him. It is a starting point for debate that seeks to inspire the reader to think about the future for him. Granted, the agro & food sector is a complicated business. But it is high time for a debate. In 2050 the earth will be inhabited by 9 billion people. Natural resources will by then have become very scarce (IBEF, 2017).

The rampant changes in the advancements of technology and adoption are rapidly bringing out changes in the impact through scientific and technological policies. Complex technologies are developed and disseminated by networks of agents. The impact of these networks depends on the assets they command, their learning routines, the socio-economic environment in which they operate, and their history.

In today's world there are both modern and conventional modes in the agricultural sector. This is more prominent in the developing economies. Though the productivity or yield is comparatively lower in the modern sector, the canonical model developed by Lewis (1954) emphasizes the aspect of additional labor in the agricultural sector. With low productivity rate, wages will be higher in the modern sector. This will compel the labor to move from one place to another in search of better wages.

This study highlights the concepts and analyses based on the transitions that have been brought from conventional to modern methods of agriculture. These are agriculturally driven structural developments (Rostow, 1960; Johnston and Mellor, 1961) developed by modern methods of agriculture and technology. The discussed methods ensure maximizing productivity and better output (Murgai, 2001; Restuccia *et al.*, 2008). The rampant changes in the technology also propel developments in the scientific and technological policies. The impact of this depends on the socioeconomic environment in which they operate and their industry. There is a need for taking advantage of the recent developments in science and technology in rural areas which will increase the socioeconomic status of the rural population with emphasis on the farmers. Science and technology are two crucial components of all efforts aimed at fostering growth and socioeconomic development of nations (Herz, 1993). Many developing countries face the challenge of increasing income of the rural sector through different approaches and minimizing the gap between the urban and the rural. Most of the developing countries are agrarian economies, which are understood to be low productive and operating in smallholder capacities. The question is what hinders science and technology from being applied in agricultural sectors - rural areas. Science and technology have been widely criticized for being a double-edged sword. Technology has been central and crucial for attaining food security. The Green Revolution in Asia and Central and Latin America in 1965 is a stark example. Many third world nations have been quick to apply science and technology as tools for rural development. The necessity of harnessing science and technology in rural India is found to be very recent. The current government of India has drafted a science and technology policy aiming to transform rural India in identified thrust areas. However, farmers' socioeconomic status depends on the adoption of technology, so this study focuses on the impact of technology on farmer's socioeconomic development.

2. LITERATURE REVIEW

Developing economies have been described as dual economies with a traditional agricultural sector and a modern capitalist sector. The low productivity level and inadequacy of labor is also related to low wages in agriculture sector which are very low in comparison to modern sector. This has turned agriculture labor towards the industrial sector which in turn effect economic growth (Wang and Piesse, 2013). This migration of labor and increasing population has an effect on food supply which is another important point to look at in agricultural sector (Schultz, 1964). According to Kuznets' (1966) agriculture sectors has dual role to play in economic development - one to supply cheap food and second to supply low wage labor to modern industrial sector. Thus growth in productivity in the agriculture sector greatly contributes in overall economic growth of a country. However, industrialization is seen as the ultimate driving force behind a country's development and agriculture as a tradition allow-productivity sector. Agriculture is extremely important sector responsible for the development and economic growth of a Country. According to various yearly reports of Indian Brand Equity Foundation (IBFE) - Agriculture is known for being backbone of Indian economy for four major reasons - 1) constitutes the large share of national income, 2) it turn to be major source of employment for more than 50% population in India living in rural areas, 3) the performance of agriculture have an considerable impact on the growth of other sector, and 4) bring in foreign currency to some extent. India produces variety of agricultural goods in terms of area under cultivation and production. It has also made several attempt in terms of revolution to improve its productivity. This attempts were products or goods oriented -green revolution (wheat), white revolution (milk and milk products), Yellow revolution (oil seeds), Blue revolution (marine products), Golden revolution (Honey), Golden Fiber revolution (jute), silver fiber revolution (cotton), brown revolution (cocoa), rainbow revolution (fruits, vegetables, floriculture plantation, spices etc.) This has resulted in India becoming largest producers of spices, pulses, milk, tea, cashew an jute and second largest producer of wheat, rice, fruits & vegetables, sugarcane, cotton and oilseeds, as per report by Agriculture and allied Industries', Indian Brand Equity Foundation, 2018. The existing situation is looking ideal and most significant. But it can be improved to large extent by bringing radical change by introducing required technology in agro business. This will ease out the factors that cause severe load on the food system.

IBEF says that introduction of technology into agriculture will help farmers do their work with precision. The differences in the size of income stand as a barrier to adoption of technology. Therefore indirect intervention of local and private bodies and demonstration proving profitability of accepting technologies is suggested by Barnes *et al.* (2019). Rural sociologists and geographers have studied local farming knowledge and practices to understand the way farmers will come to know and adopt new technologies, techniques, and programs run by governmental and nongovernmental agencies that are flexible, adaptable, and fit their local circumstances (Higgins *et al.*, 2017). Model farmers are a very common feature of agricultural extension networks in developing countries which have diverse political, economic, and socio-cultural climates. Model farmers help not only to improve production and transfer traditional knowledge, but also disseminate information about new cultivation techniques and technologies to local communities (Taylor and Bhasme, 2018). Though radical innovations have been happening in technology and agriculture, it is extremely challenging to promote them to make the entire process dynamic and different (Kiptot *et al.*, 2007). Several drivers influence the adoption of these innovations. Researchers interested in seeing the results must themselves get accustomed to these technologies and acquaint the farmers with the technologies. The network can be created through different social platforms and an informal learning method (Gielen *et al.*, 2003). Adopters would embrace this at an early stage with appropriate understanding of information networks that would recommend the flow of information amongst the farmers and network colleagues (Aguilar-Gallegos *et al.*, 2015).

The World Government Summit – "Agriculture 4.0 – the future of farming technology" 2018 reported four main dimension that requires to be addressed, they are – Demographics, Scarcity of natural resources, Climate change, and good waste. The operations and functionality of farmers had differed to great extent due to the advancement in technology. The use of 3D Printing and 4D Printing, Robotics, Sensor technology, Smart farming, Information technology & IT infrastructures, Big Data, Bioinformatics, Renewable energy, Protein transition, Food design and Vertical agriculture will change the face of farming. Now farmers can use minimum quantities required and target specific areas. These advancements will enable the farmer to be in a better position, and would promise more environmentally friendly environment. By challenging the traditional legacy model and pursuing such a program, governments can, Ensure food security and reduce dependency on imports, Become a net exporter not only of products but also IP and new solutions, Increase productivity and support the shift towards an innovation- and knowledge-based economy.

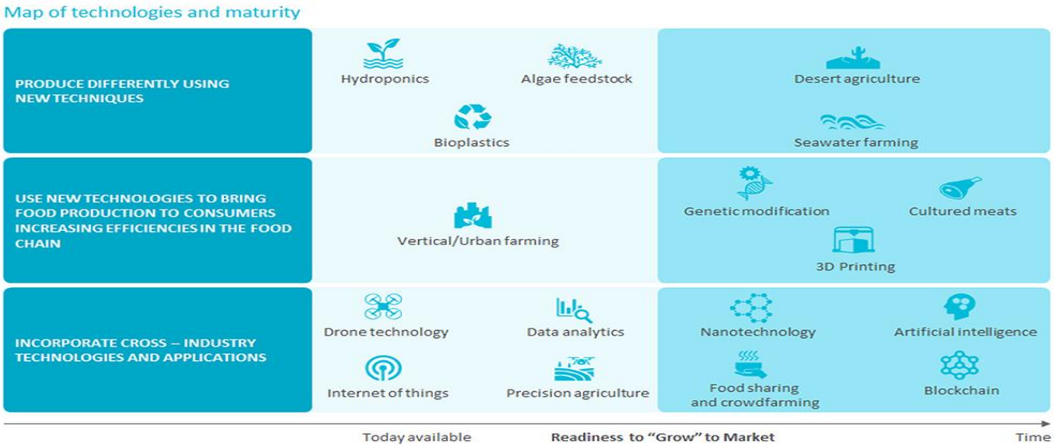
According to IBEF 2017 report - India has 20 agro-climatic region with 15 major climates of the world existing in India and possesses 46 out of 60 soil types of the world. And increasing demand of food supply to the second largest population is the core concern. Though the technology has been priority point in national policy of India from last few years. The IBEF report also discusses the technological adoption of agricultural sector of India and their product growth drivers – 1) Demand side drivers – population and income growth, increasing export, and favorable demographics, 2) Supply side drivers – hybrid and genetically modified seeds, mechanization, irrigation facilities, and agricultural revolutions took place in different parts of country, 3) Policy support – where the Government of India has supporting farmers with Agricultural technology management agency (ATMA), Paramparagat Krishi Vikas Yojana, Price Subsidization fund, Pradhanmantri Gram Sinchai Yojana etc. National Horticulture Mission, National Horticulture Board, Technology Mission for Integrated Development of Horticulture in North-East are some of the initiatives taken by the Government of India to boost the horticulture sector of the country resulted in being a second largest producers and supplier of fruits and vegetables.

There exist two major key factors that lead to an efficient way of developing agriculture clubbed with technology. This is mostly witnessed in the developing countries (Foster and Rosenzweig, 2010). The first comprises of availability and affordability of technology to a farmer and second comprises of the bundle of expectations that each farmer has towards adopting the technology with the question of sustainability in mind. For sustainability, it is important for farmers to ensure on the aspect of profitability that comes from the output of production at regular intervals. The fluctuations in prices of agricultural products is one of the key determinant that builds apprehensions in adopting the advancements in technology. Kijima *et al.* (2011). Since the psyche is such that, these farmers tend to reject or stop using a specific technology if the expected benefit levels are unmet. Though the identification of problem from the grass rout is important, that may not happen in all cases, resulting in abandoning of technology. In the technological adoption process, availability of land is another important attribute to curtail liquidity constraints faced by farmers and also helps in minimizing risk. (De Janvry *et al.*, 2011).

Productivity is assumed to be lower in agriculture than in the modern sector. The canonical model was put forward by Lewis (1954) and subsequently extended by Ranis and Fei (1961). Lewis' model rests on the idea of surplus labour in the agricultural sector. With lower productivity in agriculture, wages will be higher in the modern sector, which induces labour to move from agriculture to the modern sector, which in turn generates economic growth. Other pre cursors, such as Schultz (1964), also point out the importance of food supply by the agricultural sector .In Schultz's view, agriculture is important for economic growth in the sense that it guarantees subsistence for society, without which grow this not possible. This early view on the role of agriculture in economics matched Kuznets' (1966) empirical observation that the importance of the agricultural sector declines with economic development. In this view, the role of agriculture in economic development is to supply cheap food and low wage labour to the modern sector. Innovation has not taken place to the extent it should have leaving no space for betterment of lives of people. Food scarcity would therefore be one of the major problems in the coming time. Smart farming is the mantra for the hour. With drones and Precision technology, the output is bound to be smart and to be double. Thus making the entire data and process of agriculture grow. This growth can be seen both in terms of amount and scope. This is when the farming will be data-driven. Other advancements like the Internet of Things, sensors, robotics and Cloud Computing bundled together lead to Smart Farming (Sundmaeker *et al.*, 2016). Smart farming is all about using the appropriate tools along with having the laid the tasks of Production based on location and data, triggered further to the real-time data. (Wolfert *et al.*, 2017). Since Smart farming is comparatively a new concept, and yet to be percolated in the minds of famers, beneficiaries, which is further clubbed with huge set of apprehensions. The amount of research is also limited yet in this sector. The expectations could be too many fom such technologies, referred as the peak of inflated expectations, Gartner's Hype Cycle (Fenn and LeHong, 2011; Needle, 2015). There are numerous projects upcoming in the field of ICT in rural areas across the globe. Digital Green in India comes out with videos and facilitates screenings in the rural areas to ensure that the knowledge transfer successfully happens here to enable exchange of good quality of output. This would lead to nutritious and healthy output to farmers. (Gandhi *et al.*, 2009). In Uganda, there is a Lifelong Learning for Farmers program that ensures to provide tools that are interactive in nature. For instance, SMS service is provided coupled with appropriate information on agriculture to farmers. Similarly in Niger, cellular phones are used to communicate on pricing details of agricultural products (Aker and Mbiti, 2010).

Baributsa *et al.* (2010) came up with videos for farmers which contained information on innovations in agriculture. Further to this, Cai and Abbott (2013) also provided videos on training for farmers. This was on overcoming the constraints in gender and having accessibility to appropriate information on farming. Cellular phones have proved to be very effective, when it comes to exchanging and updating information on farming. (Asenso-Okyere and Mekonnen, 2012). There are cost-effective versions available in cellular phones which enable everyone to make proper use of this technology among the rural population as well, (Bello-Bravo *et al.*, 2013;). As per Lawal-Adebowale (2012) cellular phones are widely used in Western African rural areas, with 62.9% of farmers having this device in Nigeria. Several Government initiatives along with investors, and innovative agricultural technologies have been taken up in recent times. Agriculture 4.0, for instance will no more rely on fertilizers, pesticides, applying water, uniformly across entire fields. Rather, with 4.0 farmers will use the minimum quantities required and target very specific areas. Due to the technological advancements, the operations and functionality of farmers will vary to a great extent. The use of IT, smart farming, sensors, and robotics will change the face of farming. Farmers will be well equipped with usage of sophisticated technologies like drones, moisture sensors, and GPS technology. These advancements will enable the farmer to be in a better position, and would promise more environmentally friendly environment.

Today available	Readiness to Grow	Time



Source: Oliver Wyman – Agriculture 4.0 – The future of farming technology

2.1. Technological developments in agriculture

There are many advancements that have taken place in the field of Agriculture in the recent times. These advancements have a major impact on the food sector.

Sample Responses to the survey for technological developments in agriculture

Variables	Questions	Sample responses
3D Printing and 4D Printing	Advanced printing solutions	Printing using digital platform. This also helps is understanding the Product from all angles and helps to overcome loopholes in the Product. Prototypes come as a cheaper option and faster as well.
Robotics	Automation	Robotics are the automated systems which have both theoretical and practical solutions through automated systems. In Agricultural sector, utility is from sowing to harvesting.
Sensor technology	Application	Sensor technology is where the use of applications takes place. These appliances are the ones that could feel and sense weight, light and sound. To sense the quality of a Product without touching it physically. It could be testing of soil, the crop, grains, food etc. In the Agricultural sector, Sensor technology is widely used to test the crops through the sensors that are encompassed in the machines. These sensors provide the farmers with the correct information about the soil and crop.
Smart farming	Testing techniques	Smart farming is the farming technique through which, the needs of the farmers in terms of treating the soil and crop appropriately is met. Unlike the conventional methods, which had the farmer to look at the entire herd, with Smart farming the famer can specifically address the individual need of a specific animal at a given time. Similarly, the soil condition, the sunlight, water required etc. for the best of the yield can be made possible through Smart farming.
Information technology & IT infrastructures	IoT	The advancements in the Information technology and It Infrastructures has been possible through the way in the important information is collected and retrieved when required. The electronic appliances are connected to the Internet of Things (IoT). This implies that the amount of information that can be crucial can be collected, stored and can be easily retrieved as and when required. The intensity multiplies with the usage of Internet of things.
Big data	Utilization of Data	The information is currently stored in the digital formats. By 2045, the information would get 20,000 times bigger. This collection of this huge amount of information is nothing but Big Data. For instance, the data will help for the betterment of the people in the society to understand the complexities of a specific disease, the precautions, the infection, cure etc.
		Bioinformatics includes the process of upgrading the biological knowledge thereby applying this expertise of Information technology to the biological data.

Bioinformatics	Biological up gradation	The biological data is stored and analyzed in huge quantities. Bioinformatics helps in analyzing the required data to influence the different aspects of plants, animals and humans as well.
Renewable energy	Cost and energy saving	Renewable energy is the kind of energy that is collected from renewable resources. These sources include the ones that are replenished naturally on a human timescale, like the natural sunlight, rain, waves, wind, and geothermal heat.
Protein transition	Protein intake	The protein transition is the concept, where the consumption patterns of proteins are derived from plants and other options like salt water organisms and insects. The protein transition emphasizes that there should be less amount of reliability on sources like chicken, cow and pork. This entire concept contributes to a larger extent to decrease the emission of greenhouse gases. The protein from mushrooms is used in making products that resemble meat. Snacks and nuggets contain a combination of alternative proteins.
Food design	Taste enhancers	Food design is the concept where components get added or extracted to the food in order to enhance the taste and make it nutritious for consumption. The addition is through the water to fat products, through which small droplets of water are encapsulated by the fat. Food design related courses are much in demand these days. The significance of this concept is that you address each customer's need as per their specification. Based on the need and choices that each individual has, the customization is possible.
Vertical agriculture	Other forms of agriculture	Vertical agriculture refers to the fact as the name indicates, that the plants and grown vertically. These plants are cultivated behind glass of skyscrapers.
IT in Agriculture	Information technology	Information is the entire amount of data on demand, supply, fluctuations in market conditions, changes in pricing structures irrigation, and other seasonal changes. Data relating to weather is the most significant factor for the farmer.
GPS in Agriculture	accessibility	GPS is one of the most significant factor that enables easy accessibility across different places. GIS is another technology used in effective farming.
Soil and water sensors	Detection techniques	Soil and water sensors are responsible for detecting the nitrogen levels, amount of moisture in soil and similar aspects responsible for better output. The water sensor enables to decide on the watering schedule in the farm

Source: De Clercq *et al.* (2018)

2.2. Objectives

1. To study the arbitrating correlation between technology and economic progress through socioeconomic development
2. To evaluate the impact of technology on health, spouses' emotions, and children's education across the socioeconomic profile of the respondents
3. To examine the direct impact of technology on social development, economic empowerment, and economic progress

4. To discover the reasons for adoption of technology with respect to self-motivation or external influences

2.3. Hypothesis

H_1a. Technology has direct impact on social development
H_1b. Technology has direct impact on economic and Conservation technological Empowerment
H_1c. Technology has direct impact on economic progress
H_2. Social development mediates the relationship between technology and economic progress
H_3. Nature of technology differs across the socio-economic variables

3. METHODOLOGY

3.1. Generation of scale items and data collection form

Extensive relevant literature has been reviewed to generate items pertaining to different dimensions of technology, social and economic empowerment, economic progress, behavior, and health. Since no paper has been found with well-established scale, the research papers were reviewed to get an idea of framing a self-developed schedule. The scale items were finalized after reviewing the literature. Detailed discussions followed with experts and academicians. The schedule was used for collecting requisite information from the respondents. Schedule consisted of two sections - a general one and one to elicit information about eight dimensions of technology, namely reasons for external influences, self-motivated factors, social development, economic empowerment, economic progress, health, and behavior. The schedule comprised of 90 items of which 13 related to general information, 30 to adoption of technology (18 of external influences, 12 of self-motivation), 13 to social development, 10 to economic empowerment, 10 to economic progress, 5 to health, and 9 to reasons of behavior. The data were collected on a 5-point Likert scale on the basis of knowledge regarding social development, economic empowerment, economic progress, health, and behavioral issues (where 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree).

3.2. Sampling techniques and data collection

The study was conducted in the Osmanabad district of the Marathwada region of the Maharashtra State. This district was purposively chosen for the study because it is surrounded by the most rural and farmer communities mainly familiar with the agricultural sector and adopted technology for their development. Convenient sampling was used as the sampling technique and 150 farmers were selected. The period of study was Jan-March 2018. A structured tested questionnaire was used as the data collection instrument. Prior testing of the questionnaire was done in a small group of farmers. Osmanabad comprises prevalently of rural population of which approximately 83% live in rural regions. Agriculture is therefore the sole source of earnings for the families. The irrigated area comprises roughly about 10% of the total net cultivated land. It has been divided into six zones according to the agro climatic conditions. These classifications are based on rainfall, soil depth topography, and irrigation facilities. The survey provided the basis for analyzing the situation that was more suitable for attaining the expected results from the study. Details of areas identified for the study are provided below.

3.2.1. Sampling justification

Solvin's formula was used for sample size justification.
Solvin's formula: Solvin's formula for a population of 14632 farmers in Osmanabad.
Confidence level is 95 percent, alpha level of 0.05.

Solvin's formula: $n = N / (1 + N e^2)$

Where n = no. of samples

N= Total population
E = error tolerance

Application: n = 14632/(1+14632*0.05*0.05)
14632 / (14633 * 0.0025)
14632 / (36.5825) = 399

Our sample size is 150 which is 37.59 % of 399

3.3. Factor analysis

Primary data were collected through a structured questionnaire. The respondents were asked to rank each statement on a 5-point Likert scale (1= strongly disagree, 5 = strongly agree). The factor analysis technique was used to analyze the primary data. Trimming a high number of variables down to a few factors to explain the original data more economically and efficiently by factors analysis is a widely used multivariate technique in research. It is an important tool for resolving this confusion and identifying factors from an array of seemingly important variables. Adequacy of the data was tested by the Kaiser-Meyer-Olkin (KMO) measures of sampling adequacy and Bartlett's test of sphericity (homogeneity of variance).

Table 1: KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.872
Bartlett's Test of Sphericity	Approx. Chi-Square	3725.533
	Df	190
	Sig.	0.000

The KMO measure of sampling adequacy is 0.872 (shown in Table 1) which indicates the present data suitable for factor analysis. Bartlett's Test of Sphericity tests the hypothesis whether the population correlation matrix is an identity matrix. The existence of the identity matrix puts the correctness of the factor analysis under suspicion. Table 1 shows that chi square statistic is 3725.533 with 190 degree of freedom. This value is significant at 0.01 levels both the results; KMO statistic and Bartlett's Test of Sphericity indicate an appropriate factor analysis model.

Table 2: Factor loadings and variance explained after scale purification (Rotated Component Method)

Factor-wise dimension	Mean	Std. dev.	Factor loading	Eigen value	Variance explained %	Cumulative explained %	Communality	Alpha (α)
EXTERNAL INFLUENCE FACTOR								
Factor 1: Socio-cultural				5.264	42.53	42.534		0.912
Factor 2: Political				1.507	14.58	57.190		0.693
Factor 3: Economical				1.244	12.45	69.575		0.780
Factor 4: Environment				1.147	8.391	77.966		
SELF MOTIVATED FACTOR								
Factor 1: Socio-cultural				3.562	29.51	29.516		0.945
Factor 2: Political				1.765	22.743	52.259		0.710
Factor 3: Economic				1.203	20.30	72.561		0.872
Factor 4: Environment				1.106	12.643	85.204		
SOCIAL DEVELOPMENT								

Factor 1: Self Realization	4.972	25.346	25.346	0.648
Factor 2: Community Development	2.683	15.896	37.989	0.881
ECONOMIC PROGRSS				
Factor 1: Improvement	4.558	40.266	40.266	0.664
Factor 2: Progress	1.039	29.694	69.920	0.803
BEHAVIOURAL	4.351	36.428	36.428	
Factor 1: Psychology				
Factor 2: Emotions	1.864	23.627	60.055	
Factor 3: Social Recognition	1.446	8.893	46.882	0.782
Factor 4: Social Status	1.159	8.662	67.874	0.659
ECONOMIC EMPOWERMENT				
Factor 1: Immovability	4.993	46.76	46.768	0.909
Factor 2: Economic Status	1.116	21.106	67.874	0.865

Source: Field Survey, 2018

Further to the KMO measure of sampling adequacy the rotated component matrix table depicts the loadings amongst different factors (Garson, 2002).

Under external influencing factors, self-motivating factors, social development factors, economic and behavioral factors, and economic empowerment were assessed by the rotated component method. The factors are listed in the first column. The Eigenvalues refer to the variance accounted for in the number of items' worth of variance that each explains. Factor 1 explains almost as much variance as there is in five items. Eigenvalues refer to the variance accounted for in terms of the number of items' worth of variance that each explains.

For external influence factors the percentage of covariation among items accounted for by each factor before and after rotation is 42.53, for sociocultural it is 14.85, for political and economic 12.45, and for environmental factors 8.391. The percentage of covariation among items is accounted for by each factor before and after rotation. Similarly the percentage of covariation is drawn for all other factors, as shown in the table. 42.534, 57.190, 69.575, 77.966 depict half of the variance accounted for by the first three factors. Variance percentage is the percentage of covariation among items accounted for by each factor before and after rotation.

3.4. Confirmatory factor analysis (CFA)

CFA is a statistical tool that enables to confirm or reject a preconceived theory. It is a deductive approach and multivariate statistical technique used to test how well the measured variables represent the construct and model building. To perform CFA it is essential to specify both the number of factors that fall within a set of variables and which factor of each variable will load highly before results can be computed. It is generally based on a strong theoretical and empirical foundation that allows analysts to specify an accurate factor structure. CFA is conducted with the objective of verifying the fitness of each latent construct. In this study it is performed to assess the fitness, reliability, and validity of five measured constructs, viz. Technology (TECH) consists of two main dimensions i.e. external influences and self-motivation; social development (SDEP); economic empowerment (EEMP); and economic Progress (EPGR). Once baseline models are identified and measures are validated for discriminate and convergent validity, reliability is assessed through the computation of Cronbach's alpha, composite reliability, and average variance extracted (Hair *et al.*, 2010).

CFA is carried out construct-wise to restrict the number of indicators. Items from the latent constructs having SRW below 0.50 got deleted during CFA (Hair *et al.*, 2010). All the CFA models can have enough degrees of freedom to estimate all free parameters. The constructs have been found to be both uni- and multidimensional. Most of the indices such as GFI, AGFI, NFI, TLI, and CFI are above 0.90 whereas badness of fit indices i.e. RMSEA of all the constructs are below 0.08 and Chi-square statistics (CMIN/DF) is less than the recommended 0.5 level (Bagozzi and Yi, 1988).

3.5. CFA models

CFA is applied to assess the fitness, reliability, and validity of six constructs, viz. Technology (TECH) consists of two main dimensions i.e. external influences and self-motivation; social development (SDEP); economic empowerment (EEMP); and economic Progress (EPGR). The various resulting models are below.

3.6. CFA model for external influences factor

First order CFA is performed on External influences factor dimension, which constituted of eighteen items. Among eighteen items, ten items got deleted as they are not meeting the criteria i.e. SRW's > 0.50. After deleting, CFA produced good fit as CMIN/DF = 4.182, GFI = 0.934, AGFI = 0.961, NFI = 0.940, TLI = 0.962, CFI = 0.978 and RMSEA = 0.076. The model has been found to be valid and reliable. The alpha value is.768 whereas composite reliability came out to be 0.973 thereby indicating that all items are reliable. Model has been proved to valid, as AVE came out to be 0.549. The construct validity also stands established as all the indicators have factor loading above 0.50. Out of the eight items, 'poverty' & 'Lack of labour availability' emerged to be strongest contributor towards External Influences factor dimension, as its regression weight is 0.85 & 0.90 respectively.

CFA model for Self Motivated Factor, (SDEP) Social development, (EEMP) Economic empowerment, (EPGR) Economic Progress, (BEHR) Behavior, and (HLTH) Health is performed on various dimensions of all these factors and results are shown in Table 1 and 2 to regarding SRWs, CMIN/DF, GFI, AGFI, NFI, TLI, CFI, alpha value, composite reliability, and regression weight.

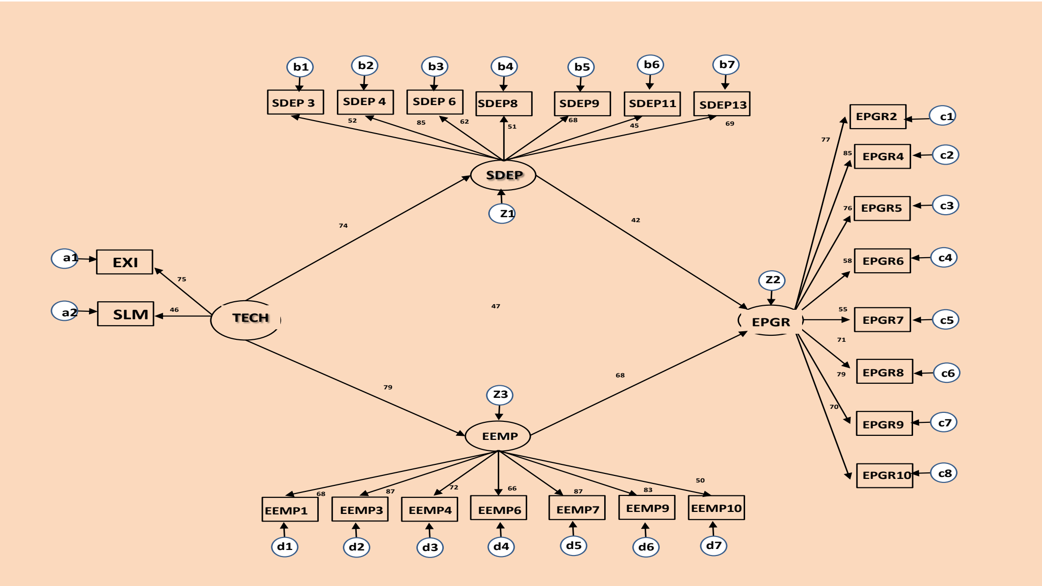


Figure 1: Overall structure equation model

EXI = External Influences Factor, SLM = Self Motivated factor TECH = Technology EEMP = Economic Empowerment; SDEP = Social Development; EPGR = Economic Progress

3.7. Outcome

The external influencing factors and the self-motivated factors leading to technology further bifurcate to factors of economic empowerment and social development. The model further depicts factors on economic progress. The entire model comprises the combination of external and internal factors associated with self-motivation, empowerment, and technology.

Advancement with the advent of technology is a complex process comprising of several dimensions such as external influencing factors, self-motivated factors, technology, economic empowerment, social development factors, and economic progress factors. In this study an attempt was made to understand the significant factors that largely govern the progression of technology in agriculture. Technology has a high impact on a significant portion of rural area; the empirical study shows that technology has an unambiguous impact on socioeconomic status and points to various mechanisms for poverty reduction besides simply increasing current household consumption.

The AMOS software was used to validate the sample data. The structural equation model is adopted to test the theoretical model as well as to prove the hypothesis.

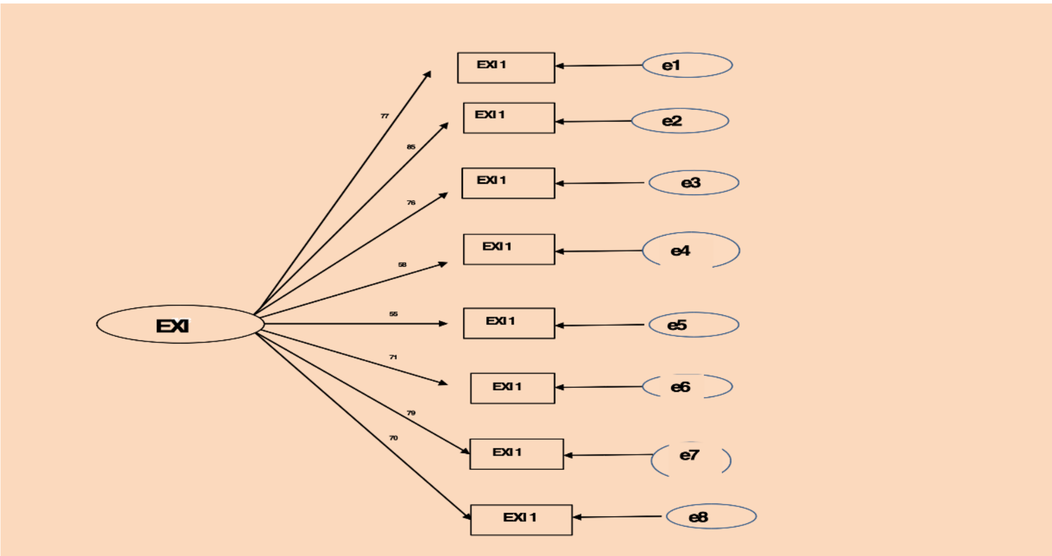


Figure 2: External influencing factors

3.8. Inference

Figure 2 depicts that the overall comprehensive fitting indexes are in concurrence with the evaluation criteria. This indicates that the fitting created by the data is correct and can further be used to test the hypothesis.

4. DISCUSSION

There are more than 80% of farmers who can be classified as marginal to small. They do not yet have adequate resources to get into smart farming. They can be influenced by the power of technology. Analysis for reliability and validity of the measurement scales was done followed by hypothesis testing through review of literature and analysis. The SEM models adopted in earlier studies were also referred to and the authors observe that the proposed model of SEM in this study is reasonably good as per recommended levels (Bollen, 1990). Technology offers economic empowerment and progress in villages. Technology offers stimulation to educate children, especially girls, with the help of additional income. Technology offers social status and reorganization because of civic engagement in community development. It gives scope to spouses to decide on agriculture and family issues and makes them self-confident and independent. Technology has a negative impact on young farmers' psychology; they favour a more commercialized, more self-centered, more egoistic approach. There is positive impact of technology on physical health of dependence through proper hygiene. Comparatively farmers with high land holding have adopted more technology and developed their social status and lifestyle. It also seems that in scheduled cast and scheduled tribes famers have not adopted technology due to lack of self-motivation and therefore are not in a position to participate in rural community development.

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