AN EXPLORATORY STUDY OF USE OF SELECTED TECHNOLOGIES IN AGRICULTURAL VALUE CHAIN SYSTEM AND ITS IMPACT ON FARMING WITH REFERENCE TO ONION FARMING IN NASHIK DISTRICT

N.J. Salunke[1] and Y.T. Pawar[2]
[1]MVP's K.B.T. College of Engineering, Nashik
& Research Student - MGV's IMR, Panchavati Nashik
[2]MGV's IMR, Panchavati, Nashik

ABSTRACT

An exploratory study of use of selected technologies in agricultural value chain system and its impact on farming with reference to onion farming in Nashik district was undertaken to make an assessment of technology diffusion in value chain with emphasis on an efficient marketing system. 400 onion growing farmers from various Taluka places of Nashik district were surveyed for the study. A standard agricultural value chain is used in practice by the onion growing farmers. Use of technology at different stages of agricultural value chain by the onion farmers is very low. At the same time it is heartening to note that the farmers are of the opinion that if technology is used at the various stages of the value chain it will have a positive impact on all the aspects including those of selling and marketing. There is wide acceptance of non-conventional channels of distribution by the onion growing farmers.

Keywords: *Agriculture value chain, Onion growing farmers, Non-conventional distribution channels*

Introduction

Background and Introduction

The origin of diffusion was first given by Tarde (1904) as an "imitation" which is today called "adoption". He introduced the S curve and the opinion leadership which was further conceptualized by Rogers in 1962. Rogers, portrayed diffusion as, "The process by which an innovation is communicated through certain channels over the long haul among the individuals from a social system where a social system is a bunch of interrelated units that are engaged in joint critical thinking to accomplish a common goal". Similarly, Fichman (2000), portrayed diffusion as, "The process by which a technology spreads across a population of organizations". Here the units differ in their behavior, through homo (similarity between the individuals, that regarding education level, beliefs and social status) and heterophily (where individuals differ on these attributes). Rogers emphasized that diffusion of technology relies on various factors; the information, communication channels and opinion leaders or the change agents. Change agents are those individuals who influences users innovation decisions in a direction desirable by the change agency (a firm or a NGO which attempts to execute the technology), who arrive from outside the community through interpersonal and mass media communication. Here interpersonal communication act as an integral asset in convincing a population to accept the new innovation which passes from first openness of the innovation until its adoption or rejection takes place.

Diffusion of Technology or Innovation (DOI) is a theory popularized by American communication theorist and sociologist, Everett Rogers, in 1962 that aims to explain how, why, and the rate at which a product, service, or process spreads through a population or social system. In other words, the diffusion of innovation explains the rate at which new ideas and technology spread. The diffusion of innovation theory is utilized widely by marketers to understand the rate at which consumers are probably going to adopt a new product or service (Corporate Finance Institute, 2021).

Research Objectives

Taking into account the research questions and the research gap following objectives were set for the research:

1. To study the agricultural value chain system concept
2. To study the agricultural value chain system of onion in Nashik district
3. To study the use of technology at various stages of agricultural value chain system of onion in Nashik district

4. To study the impact of technology used at various stages of agricultural value chain system on onion farming in Nashik district
5. To study the non- conventional distribution channels for onions

Significance of the study

There are several reasons as to why farmers are in distress. In order to limit their stress, two things need to be achieved. First, is the use of better technology across the value chain and second, to market their produce using non-conventional distribution channels. The first factor will improve the yield and the efficiency at each step of the value chain and the second factor will help in getting the right price for the produce. The improved technology and access to superior infrastructure (such as cold storage etc.) will definitely help in lowering the farmers' stress.

Review of Literature

Low-carbon power generation technologies like solar, wind, and carbon capture and storage are anticipated to play vital roles in a decarbonized world. Though, presently tremendous price may deteriorate the competitiveness of such technologies. One significant cost reduction mechanism is the "learning by doing", via which growing deployment outcomes in technology costs deterioration (Huang et al., 2017). Novel technology diffusion and learning is a vital boosting force to enhance the competitiveness and total factor productivity. Implementing Chinese local data, the study builds green total factor productivity as per the SBM–Global–Luenberger index (Wang et al., 2021). Constant change has long been identified as a fundamental feature of retailing, its current acceleration unparalleled, yet innovation in retailing remains under-studied, particularly within fashion retailing. The outcomes recognize the innovation acceptance tactics implemented, the kinds of in-store technologies accepted over period of time and the fashion retail innovation adopters (Alexander & Kent, 2021). By the acceptance of Electric Vehicles (EVs), technology inventions are anticipated to overcome numerous hurdles. The study discovered the task of battery and charging technologies in the diffusion of EVs. (Zhuge et al., 2021). For economic growth and development, technical transformation is a major driving force thus technological diffusion and innovations could be a powerful procedure that opens up opportunities to increase social welfare and benefits for societies (Gries et al., 2018). The goal of the study is to comprehend the procedure via which external diffusion of business-to-business (B2B) electronic procurement affects organizational performance. The study model has been formed to analytically assess the role of information transparency and supply chain coordination in enhancing the organizational monetary performance through peripheral diffusion of electronic procurement (Kumar & Ganguly, 2020). In industrial markets, diverse players agree to diffuse the novel products and facilities. Though, in high-regulated sectors, organizations might discover considerable restrictions to their usual tactics (Schiavone & Simoni, 2019). The study reviews the swiftly developing domain of global value chain study by assessing various highly mentioned theoretical frameworks, technological diffusion and further assessing global value chain studies accessible in such guidelines as global business, supply chain management, operations management, general management, monetary geography, local and development studies, and global political economy (Kano et al., 2020). A general and driving hypothesis in agricultural study is that the introduction of study trials, novel performs and advanced technologies will result in technology diffusion, and will later create advantages for farmers and other shareholders (Alexander et al., 2020). The study has pursued to discover the technology diffusion in agricultural value chain and comprehend what disruption means within agricultural technology by explaining what it means, who may be disturbed, how it happens and the pathways along which it is attained (Krishnan et al., 2020). The study argues that input-intensity and a dearth of democratic control over the circumstances for advanced technology diffusion specifies that low-tech approaches, in spite of producing lesser harvests, may be best located to enhance food security as a basis for sustainable agricultural value chain (Adenle et al., 2019). The study presents the special issue engrossed on links

amid innovation, food system evolution, and technology acceptance in all sections of agricultural value chains from inputs to farming to post-harvest sections comprising logistics, wholesale, dispensation, and retail using technological diffusion. The study recognizes the issues and the gaps in the existing information, and later note vital points and contributions of the information in the special issue. The study later emphasizes food policy insinuations (Reardon et al., 2019). In current years, chief technological developments have been a chief power driving channel development. In specific, the Internet of things has offered a means for few organizations to experience the growth of one of the most advanced and cutting-edge channels; the platform enterprise (i.e., organizations such as Amazon, Etsy, and Airbnb) (Dimitrova et al., 2020). As resellers in business markets characteristically signify several suppliers, a chief variable in the study of a non – conventional distribution channel is reseller allocation of effort, which comprises understanding how much time and resources a reseller dedicates to a supplier to assist the supplier support its products (Kim & Gilliland, 2017). To determine the fundamentals of the vending marketing mix, the study led interviews with global industry experts and undertake 170 direct observations at several universities to validate the differences amid the marketing mix proposals of different target markets (Stoyanov, 2021). It's concluded that price spread and marketing margin in diverse non – conventional distribution channels discovered that net revenues were high in controlled marketing channel i.e., channel – I and low in local markets i.e., channel – III. Producer share in consumer rupee and marketing efficacy were high in regulated markets and low in local markets (Naik & Maurya, 2020).

The review quite clearly shows that literature in Indian context is highly limited. Most of the studies related to technological diffusion, its role in value chain including the agricultural value chain have been carried in foreign countries. Moreover studies adopting value chain approach are relatively less. There is a limited literature that has been applied to study agriculture value chain with special consideration to non-conventional distribution channels. The present study aims to address all these gaps and provide a comprehensive view of the topic specifically dealing with the following research questions:

1. What is the value chain system concept for agriculture?
2. What is the agricultural value chain system for onion farming in Nashik?
3. What is the use of technology at various stages of agricultural value chain system of onion in Nashik district?
4. What is the impact of use of technology at various stages of agricultural value chain system of onion in Nashik district?
5. What are the non-conventional distribution channels for onions?

Research Methodology

Purpose of research and formulation of hypotheses

An exploratory study of use of selected technologies in agricultural value chain system and its impact on farming with reference to onion farming in Nashik district makes an assessment of technology diffusion in value chain with emphasis on an efficient marketing system.

Formulation of hypotheses

Ho1: Onion farmers do not follow a standard value chain system for growing onions
Ha1: Onion farmers follow a standard value chain system for growing onions
Ho2: Technology is reasonably used at various stages of agricultural value chain system of onion in Nashik district
Ha2: Technology is not used at various stages of agricultural value chain system of onion in Nashik district
Ho3: Use of technology does not have a major impact on onion farming in Nashik district
Ha3: Use of technology has a major impact on onion farming in Nashik district
Ho4: Non-conventional distribution channels will not be beneficial
Ha4: Non-conventional distribution channels will be beneficial

Primary data collection scheme

The primary data was collected from 400 onion-growing farmers from Nasik district.

The Proforma of the questionnaire is given at the end of the thesis in an annexure. These were administered through MS Excel and Google Forms in Marathi language.

Method set for testing of Hypotheses

The steps designed for testing the hypotheses are outlined below:

1. In case of section I and IV of the questionnaire the extreme responses of completely agree and completely disagree were assigned weights of 2 each to distinguish them from the somewhat agree and somewhat disagree responses.
2. For each of the questions under the two sections, agreement and disagreement percentages were calculated after applying the weights as stated in point 1.
3. In case of the 1st and 4th hypotheses the average agreement percentages for the two sections were calculated for the respective ten statements responses for sections I and IV.
4. The average agreement percentages for the two sections were compared with a hypothesized population mean of 50% agreement connoting an agreement by chance.
5. A t-test was applied at 95% confidence level to compare the sample mean and the population mean and it was ascertained if the agreement was statistically significant or not.
6. In case of section II and III of the questionnaire the extreme responses of very low and very high were assigned weights of 2 each to distinguish them from the low and high responses.
7. For each of the questions under the two sections, low and high percentages were calculated after applying the weights as stated in point 6.
8. In case of the 2nd and 3rd hypotheses the average high/low percentages for the two sections were calculated for the respective ten statements responses for sections II and III.
9. The average high/low percentages for the two sections were compared with a hypothesized population mean of 50% high/low connoting an event by chance.
10. A t-test was applied at 95% confidence level to compare the sample mean and the population mean and it was ascertained if the sample mean was statistically significant or not.

Population and Sample
Population

As per the census survey of 2011 (Censusindia.gov.in. 2013), total rural population of Nasik district was 35,09,814. Considering this size of the total rural population it was easily estimated that the population of onion-growing farmers should be a large population in statistical terms, that is, more than 10000.

Sample Size

Standard sample size tables like Krejcie and Morgan (1970) using 95% Confidence Level and 5% Confidence Interval returns a sample size for a population of 10000 as 370. It was rounded off to 400. The total sample was divided more or less equally over the 14 rural blocks of the district.

Method of Sampling

As the research belongs to category of social sciences, the demand for accurate quantitative analysis was not there. The respondents' selection was made based on judgment, where the possibility of getting the responses was relatively higher. Judgmental sampling is a non-probability sampling technique where the researcher selects units to be sampled based on their knowledge and professional judgment. This type of sampling technique is also known as purposive sampling and authoritative sampling. The name of the respondent was not recorded for ensuring confidentiality.

Validity and Reliability of the instruments used for the research

The instruments' validity was confirmed with the help of the guide and other experts in the field. Reliability was ascertained by performing the Cronbach's Alpha tests for sections I to section IV separately and in aggregate. Since the Cronbach's Alpha was found to be more than 0.70, the questionnaire was considered as reliable.

Data Analysis and Interpretation

Data analysis and interpretation scheme explained

The scheme formulated was as under:

Table 1: Data analysis and interpretation scheme explained

Sr. No.	Data Analysis	Expected Outcome	Interpretation
1	Adoption of standard value chain in Onion farming	Agreement/disagreement percentages along with p-values	If average agreement percentage is significantly more than hypothesized population mean of 50% agreement, reject the null hypothesis, onion farmers do not follow a standard value chain system for growing onions
2	Use of technology at different stages of value chain	High/Low percentages along with p-values	If low percentage is significantly more than hypothesized population mean of 50% low percentage, reject the null hypothesis, technology is reasonably used at various stages of agricultural value chain system of onion in Nashik district
3	Perception about impact of use of Technology	High impact/Low impact percentages along with p-values	If average high impact percentage is significantly more than hypothesized population mean of 50% high impact, reject the null hypothesis, use of technology does not have a major impact on onion farming in Nashik district
4	Non-conventional channels of distribution	Agreement/disagreement percentages along with p-values	If average agreement percentage is significantly more than hypothesized population mean of 50% agreement, reject the null hypothesis, non-conventional distribution channels will not be beneficial

Summary of data analyses of responses & overall interpretation

The following table summarizes key parameters and the overall interpretation:

Table 2: Summary of data analyses of responses and overall interpretation

Sr. No.	Data Analysis	Expected Outcome	Interpretation
1	Adoption of standard value chain in Onion farming	Agreement percentage 81%, p-value <0.0001	As average agreement percentage is significantly more than hypothesized population mean of 50% agreement, rejected the null hypothesis, onion farmers do not follow a standard value chain system for growing onions
2	Use of technology at different stages of value chain	Low percentage 67%, p-value <0.0001	As low percentage is significantly more than hypothesized population mean of 50% low percentage, rejected the null hypothesis, technology is reasonably used at various stages of agricultural value chain system of onion in Nashik district
3	Perception about impact of use of Technology	High impact percentage 68%, p-value <0.0001	As average high impact percentage is significantly more than hypothesized population mean of 50% high impact, rejected the null hypothesis, use of technology does not have a major impact on onion farming in Nashik district
4	Non-conventional channels of distribution	Agreement percentage 77%, p-value <0.0001	As average agreement percentage is significantly more than hypothesized population mean of 50% agreement, rejected the null hypothesis, non-conventional distribution channels will not be beneficial

Findings, Conclusions and Suggestions For Further Research

Research Findings

Findings related to profile

i) The distribution of Age was 16 of <30 years group; 122 for 30-40 years group; 137 for 40-50 years group; and 125 for >50 years group.

ii) The division of Education was 43 of Illiterate group; 148 for Primary School group; 194 for Secondary School group; and 15 for Graduate and above group.

iii) The distribution of Size of landholding was 144 of <5 acres group; 122 for 5-10 acres group; and 134 for >10 acres group.

iv) The spread of Onion Farming experience was 86 of <5 years group; 147 for 5-10 years group; 116 for 10-15 years group; and 51 for >15 years group.

v) The distribution of Share of Onion Crop was 95 of <25% group; 98 for 25-50% group; 111 for 50-75% group; and 96 for >75% group.

vi) The division of Channel of distribution of onion produced was 150 of 100% conventional group; 133 for Mix of conventional and non-conventional group; and 117 for 100% non-conventional group.

vii) The spread of Per acre output of onion was 140 of <100 q/acre group; 143 for 100-150 q/acre group; and 117 for >150 q/acre group.

viii) The distribution of Average price realized for sale proceeds was 115 of Less than average group; 115 for At par with average group; 170 for More than average group; and 400 for Total group.

Inferential and finer data analysis

i) The average agreement in case of adoption of standard value chain in Onion farming was found to be 81%.

ii) The average low use of technology at different stages of value chain was found to be 67%.

iii) The average high impact (positive) perception through use of technology at different stages of value chain was found to be 68%.

iv) The average agreement for use of non-conventional channels of distribution was found to be 81%.

v) Use of technology at different stages of value chain explained 38% variability of per/acre output of onions and it was found to be statistically significant.

vi) Use of non-conventional distribution channels explained 53% variability of the price realization and it was found to be statistically significant.

vii) The demographic variables do not exhibit a significant association with the use of technology.

Conclusion

1. A standard agricultural value chain is used in practice by the onion growing farmers. This has been concluded on the basis of large scale agreement to statements like I am able to ensure reasonable efficiency in case of seed suppliers, I am able to ensure reasonable efficiency in case of suppliers of pesticides and fertilizers, I am able to procure the required equipment's for onion farming, I am carrying the farming and fertilization activities efficiently, I am able to perform the weeding and harvesting activities efficiently, I am able to secure necessary transportation for dispatch of onions, I am able to exercise quality control measures at different stages, I have access to reasonable storage facilities for the output, I am able to export my produce if opportunity exists and I know the retail channels for ultimate sales of my products.
2. Use of technology at different stages of agricultural value chain by the onion farmers is very low. For different stages in the value chain like Vegetative Phase, Bulbing and blooming, Site selection and land preparation, Planting and cultivation, Onion sets and Irrigation, Weed and pest control, Harvesting, Storing, Transportation and Selling and Marketing, the usage of technology was found to be quite low.
3. At the same time it is heartening to note that the farmers are of the opinion that if technology is used at the various stages of the value chain it will have a positive impact on all the aspects including those of selling and marketing.

4. There is wide acceptance of non-conventional channels of distribution by the onion growing farmers. Large scale agreement was expressed for statements like Non-conventional channels of distribution are available for onion sales, There are problems with the conventional channels of distribution, Adoption of non-conventional channels is possible with reasonable effort, Non-conventional channels being technology based are convenient, These channels are beneficial for the customers, They can fetch a much better price for onions, With the availability of social media and internet they are quite feasible, Governments support is available for non-conventional channels, These channels represent adoption of modernization and progress and Adoption of non-conventional channels reflect the innovation spirit of the farmers.
5. Use of technology at the various stages of value chain has a positive impact on the production yield.
6. Use of non-conventional channels of distribution helps the onion growing farmers in fetching a better than average price.

On an overall basis, there is a clear mandate for use of technology in the agricultural value chain for onion growing farmers. It not only helps increasing the crop yield but also ensures better price realization and solves distribution and marketing related issues.

Suggestions

Following suggestions are offered:

1. Technology should be adopted by the farmers at every stage of the value chain to increase the output.
2. In this direction the Government should extend both financial and non-financial support like training to the farmers.
3. Agencies like the Federation of farmers should create awareness amongst farmers about the use of technology in the agricultural value chain.
4. Non-conventional distribution channels should be used by the farmers to fetch better prices. B2C models of distribution should be explored.
5. The cooperative movement should support the farmers at the various stages of agricultural value chain, especially the marginal farmers.

References

1. Adenle, A. A., Wedig, K., & Azadi, H. (2019). Sustainable agriculture and food security in Africa: The role of innovative technologies and international organizations. Technology in Society, 58, 101143.
2. Alexander, B., & Kent, A. (2021). Tracking technology diffusion in-store: a fashion retail perspective. International Journal of Retail & Distribution Management.
3. Alexander, K. S., Greenhalgh, G., Moglia, M., Thephavanh, M., Sinavong, P., Larson, S. & Case, P. (2020). What is technology adoption? Exploring the agricultural research value chain for smallholder farmers in Lao PDR. Agriculture and Human Values, 37(1), 17-32.
4. Corporate Finance Institute. (2021). Diffusion of Innovation - Definition, Rationale and Adopter Categories. Retrieved from https://corporatefinanceinstitute.com/resources/knowledge/other/diffusion-of-innovation/
5. Dimitrova, B. V., Smith, B., & Andras, T. L. (2020). Marketing channel evolution: From contactual efficiency to brand value co-creation and appropriation within the platform enterprise. Journal of Marketing Channels, 26(1), 60-71.
6. Fichman, R. G. (2000). The diffusion and assimilation of information technology innovations. Framing the domains of IT management: Projecting the future through the past, 105127, 105-128.
7. Gries, T., Grundmann, R., Palnau, I., & Redlin, M. (2018). Technology diffusion, international integration and participation in developing economies-a review of major concepts and findings. International Economics and Economic Policy, 15(1), 215-253.

8. Huang, W., Chen, W., & Anandarajah, G. (2017). The role of technology diffusion in a decarbonizing world to limit global warming to well below 2 C: An assessment with application of Global TIMES model. Applied energy, 208, 291-301.
9. Kano, L., Tsang, E. W., & Yeung, H. W. C. (2020). Global value chains: A review of the multi-disciplinary literature. Journal of international business studies, 51(4), 577-622.
10. Kim, S. K., & Gilliland, D. I. (2017). Working more or working less? Contingent allocation of reseller effort in distribution channels. Industrial Marketing Management, 64, 44-56.
11. Krishnan, A., Banga, K., & Mendez-Parra, M. (2020). Disruptive technologies in agricultural value chains. Insights from East Africa. Working paper 576.
12. Kumar, N., & Ganguly, K. K. (2020). External diffusion of B2B e-procurement and firm financial performance: role of information transparency and supply chain coordination. Journal of Enterprise Information Management.
13. Naik, S. R., & Maurya, M. K. (2020). An economic analysis of chickpea to estimate marketing channels, marketing cost, marketing margin and price spread in each channel of distribution in Kurnool district of Andhra Pradesh.
14. Reardon, T., Lu, L., & Zilberman, D. (2019). Links among innovation, food system transformation, and technology adoption, with implications for food policy: Overview of a special issue. Food policy, 83, 285-288.
15. Schiavone, F., & Simoni, M. (2019). Strategic marketing approaches for the diffusion of innovation in highly regulated industrial markets: the value of market access. Journal of Business & Industrial Marketing.
16. Stoyanov, D. (2021). Marketing of vending channels: a case of French university campuses. International Journal of Retail & Distribution Management.
17. Tarde, G. (1903). The Laws of Imitation, trans. by Elsie Clews Parsons. New York, Chicago, Holt.
18. Wang, X., Wang, L., Wang, S., Fan, F., & Ye, X. (2021). Marketisation as a channel of international technology diffusion and green total factor productivity: Research on the spillover effect from China's first-tier cities. Technology Analysis & Strategic Management, 33(5), 491-504.
19. Zhuge, C., Dong, C., Wei, B., & Shao, C. (2021). Exploring the role of technology innovations in the diffusion of electric vehicle with an agent-based spatial integrated model. Resources, Conservation and Recycling, 174, 105806.