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Organic tomato value chains and determinants of market linkage: a smallholder's perspective for inclusive growth

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Abstract

Background/Abstract: India is the world's second-largest tomato producer, and the crop is produced through millions of smallholdings across the country that lack access to remunerative markets. Karnataka is the second largest tomato producing state which accounts for 11.4% of total production where, about 75 % of the families in rural and 85% of the families in urban area consume tomatoes every day. This study seeks to map the current organic tomato value chains, identifying and analyzing the factors contributing to organic tomato farmer's market linkage.
Methods: The survey was conducted in Karnataka state of India, by involving 100 organic smallholder farmers through purposive random sampling drawn from an official list of organic farmers. The data analysed by using SPSS software adopting a logistic regression model.
Findings: Results revealed, organic tomato farmers are unorganized and prevailing tomato value chain models vary from long chains where multiple intermediaries involved to very short where farmers directly sell their products to consumers through online. Considering the growing e-commerce retailing trend in fresh products like tomato, there is enormous potential for linking smallholder producers to market through organized producer's group in an effective way. Further, allied activities (Dairy), group certification & marketing, frequent extension contacts, accessing market information through mobile phones, were the main determinants for linking smallholder organic tomato farmers to the market.
Applications/Improvement: Results have implications for policy makers, Farmer Producer Organizations and other stakeholders in development of inclusive organic farming specifically tomato farming.
Keywords**:** Organic Tomato Value chain, Market Linkage, Smallholder farmer, Inclusive Growth.

1. Introduction

Globally, 2.5 billion rural poor depend on agriculture for their livelihood, out of this 1.3 billion are smallholder farmers and landless labours [1]. Similarly, 137 million agricultural holdings in India, of which 99 million are small and marginal, the majority of them are poor [2]. Agriculture plays a critical role in the economic development of these people [3,4].Research has shown that growth generated from agriculture is more effective in reducing poverty than the growthof other economic sectors in India. In this sense, agriculture is being recognised as an essential sector for rural development. Tomatoes are an important horticulture crop for both the farmer and the consumer in India. 75 % of the families in rural and 85% of the families in urban area consume tomatoes every day [5]. A significant portion of tomatoes production in India is done by smallholder farmers (estimated at nearly half of farming communities).India contributes11% of global tomato production which is highest after China. The major tomatoes production comes from southern and central states of India's including the states of Andhra Pradesh, Telangana, Karnataka and Maharashtra. Farmers typically sell to a local aggregator or a trader in a regional *mandi.*Despite second highest tomato producer, less than 1% of India's tomato production is processed, way below the average of 26% for the world's top 10 tomato producing countries [6].Tomatoes are the most important protective vegetables, because of its special nutritive value. It is the world's largest vegetable crop after potato and sweet potato [7]. Karnataka is one of the largest producer of tomatoes with an estimated production of 2068.38 thousand metric tonnes in the year 2013-14. Districts of Kolar, Chikkaballapur, Belgaum, Tumkur, Hasan are major producers of tomatoes.

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The cultivated varieties in Karnataka are Pusa Ruby, Arka Saurabh, Arka Vardan, Arka Abhijit, Avinash-2, Pusa hybrid-1, Pusa Hybrid 4, and Vishal Arka [5].Post-harvest losses are high as compared to other vegetables in Karnataka, which account to nearly 19% of the total production. Losses occur mainly due to pests, diseases, over-ripening and crack in fruits [8]. According to a study conducted in Karnataka, the fertilisers (22%), pesticides (20%) and family labour (16%) account for significant costs of tomato production.On one flip side, many smallholder producers realised that growing tomatoes with the high inputs cost is expensive, and they were not sure about the returns. On the other, consumers are demanding pesticide-free safe produce in their food basket. So, since 2004, the Karnataka state government has been encouraging smallholder producers to adopt organic farming through group certification. Therefore, many producers in the state are switching to organic farming and the number increasing year after year in the state.

2. The scope of the study

With the above backdrop, among the so called “safe food”, organic fruits and vegetables are an integral part of new diets. They provide essential micronutrients vital to human health and development. On the one hand, increasing consumer awareness of health and environmental issues provides a promising potential to develop domestic markets for organic products [9], andon the other, organic farmers are facing a number of challenges to produce and market their organically grown produce. Small and marginal farmers are being excluded from emerging innovative value chain models owing to the high transaction cost in aggregation, poor quality and information asymmetry among the farmers. Linking smallholder farmers with well-functioning domestic and global markets play a critical role in the long run strategies to reduce rural poverty. Here, the ability to understand how to successfully link poor smallholder producers to relevant and beneficial markets, as well as identifying which markets may benefit what kind of producers, are of critical importance in improving the livelihood of smallholders. The emergence of organic fruit and vegetable value chains in India has brought with it opportunities and challenges for the whole local socioeconomic system involving different actors and institutions. However, to assess both the positive and negative impacts of organic fruit and vegetables produced in the local system, it is necessary to reveal the interactions and relationships between the actors and institutions influencing the operations of these chains. This study seeks tomap the current organic tomato value chains, identifying and analyzing the factors contributing to organic tomato growing smallholder’s market linkage in Karnataka. Further, to draw evidence-based policy and practical implications to develop organic farming and its market, specifically organic tomato.Although there has been a proliferation of studies on organic farming, relatively little attention has been directed towards mapping the current tomato value chains and analysing the factors which influence smallholder farmers for market linkage torealise the better price for their produce.

3. Method

The research was conducted in Karnataka state in South India, one of the highest tomato producing states and the first state in the country to implement an organic farming policy. The source of information used in this study was mainly obtained from personal interviews based on the structured questionnaires, carried out on a sample of 100 respondents of organic farmers. Purposive random sampling was drawn from an official list of certified organic farmers. Further, interviewed 14 other value chain actors to obtain necessary information and more objective understanding of the relations in the chains. In this study, the methods employed for collecting empirical data are through survey method, focus-group interviews, key informant interviews and direct observations. The combination of these different data sources is an attempt to overcome the intrinsic biases derived from using a single source and to explainin details as well as to give a more balanced picture of the study. There is no clear-cut method to carry out value chain analysis;methodologies differ with purpose and context. Therefore, their application and usefulness vary depending on the circumstances and focus of the analysis. The analysis and mapping of the value chain was carried out through six major steps as below:

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Step I — Mapping
{Identification of actors, service providers, theirfunctions, activities and relations. Identification of flow of product and enablers involved in each step. Interactions and interventions of the value chain actors.}

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Step II — Analysis of vertical relations in the chain

⇩

Step III — Analysis of horizontal relations in the chain

⇩

Step IV — Analysis of enabling environment

⇩

Step V — Analysis of the external environment

⇩

Step VI — Analysis of end market

Source: Own elaboration

4. Statistical analysis

The Statistical Package for Social Sciences (SPSS 16.0) was selected for analyzing the data because of its ability to extensively analyze quantitative data. Logistic regression was adopted to analyse the data collected through a survey. Antecedent to this univariate analysis was performed on all the variables which are included in the study to observe their individualbehaviour and to check the presence of any outliers. To identify and analyze the factors contributing to market linkage in the value chain for smallholders, the logistic regression was applied.

5. Logistic regression

Firstly, a logistic regression model is selectedbecause of its ability to determine the effect of variables on the probability of market linkages. Secondly, it yields the highest predictive accuracy possible with a given set of predictors [10]. Logit analysis was estimated to find the probability (Pi) that farmers have market linkage, as influenced by factors influencing market linkage. The dependent variable is dichotomous, taking two values 1 for farmers who are having market linkage, zero otherwise. X_i = Independent variable determining Y shown in Table 1. The relationship between P_i and X_i is not linear. The probability which farmers would cultivate the organic crop, approaches zero at a slower and slower rate, as X_i becomes small, and the probability approaches one at slower and slower rate as X_i becomes large. Since, $P_i = E(Y_i) = 1$ given X_i, non-linearly increases with X_i, P_i is a logistic function of Z_i, given by:

1

$$P_i = \frac{}{[1 + e^{(-Zi)}]}$$

Where $z = A + \sum B_i X_i$

As z ranges from $-\infty$ to $+\infty$, P_i ranges from 0 to 1, and that P_i is non-linearly related to z

1

$$\text{If Pi} = \frac{}{[1 + e^{(-Zi)}]} \quad \text{---------- (1)}$$

Subtracting P_i from 1 on both sides of theequation (1), we have,

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$$1 - P_i = 1 - \frac{1}{[1 + e^{(-Zi)}]}$$

Or,

$$1 - P_i = \frac{e^{(-z)}}{[1 + e^{(-Zi)}]}$$

$$1 - P_i = \frac{1/e^{(z)}}{1 + 1/e^{(z)}}$$

Then,

$$1 - P_i = \frac{1}{1 + e^{(zi)}} \quad \text{---------- (2)}$$

Therefore, from equation (1) and (2), $[P_i/(1 - P_i)] = e^{z}$

Here $[P_i/(1 - P_i)]$ is called the odds ratio. Taking logarithm of these odds ratio to the base e, we get

$$\text{Log}\,[P_i/(1 - P_i)] = z = A + \sum B_i X_i \quad \text{---------- (3)}$$

$$L^* = z = A + \sum B_i X_i, \quad \text{---------- (4)}$$

Here, L* is the logit as it follows a logistic distribution.

For better interpretation of *β* coefficients, antilog of *β*is calculated, and the function takes on the following form-

$$\left(\frac{P_i}{1 - P_i}\right) = e^{\beta 1 + \beta 2\, Xi + ui} \quad \text{---------- (5)}$$

Table 1.Variables and units of measurements of key variables

Variables	Definition
Dependent variable Y	1 if the farmer having market linkage, 0 otherwise
Independent variables	
Age (AG)	A number of years in ageof the household
Education level (EDU)	Illiterate,1; primary,2; high school,3; college,4
Family labor size (FLBR)	A number of family members working on the farm
Having Dairy activities (DA)	Activities undertook other than farming, 1=yes, 0=no
Contact with extension agent (EXTNCONT)	Number of times per year
Participation in training activities (TRAG)	Participation in training and visits (times /yr)
Getting market information through mobile phones (ICT)	1=yes, 0=no
Farm size (FRMSZ)	Ownership of the farm in acres
Quality Test and Certification for their produce (CERT)	1=yes, 0=no

6. Results and discussion

Mapping the value chain facilitates an understanding of the system dynamics and has the capacity to reveal key actors' that are involved, their functions, and linkages with other actors and supporting institutions involved along the chain. This section presents the mapping of prevailing organic tomato value chains in the study area; various chain actors it involves, their functions, linkages and enabling environment.

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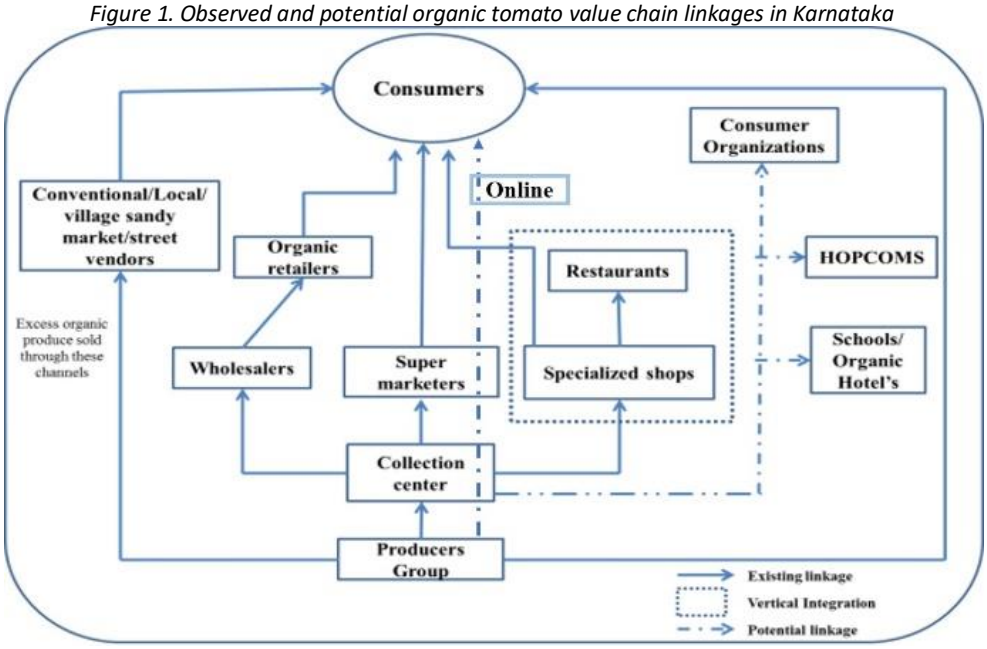
The most common marketing channel in the case of Tomato in Karnataka is in the sequence of farmers to intermediaries to retailers to consumers. Well-organized marketing channel for smallholder farmers rarely exists. However, marketing of Organic Tomato in the study area is carried out in the following ways. i) Farm gate or on-farm selling, ii) Direct selling, iii) Selling to middlemen or commission agentandiv) Collective or group marketing, v) Online MarketingActors and their Functions in Organic Tomato Value Chains.

The identified actors involved in the organic tomato value chain are shown in Figure 1. These actors include input suppliers, producers, buyers, consumers and support institutions like ICCOA and Government dependencies. Here we understand each value adding an activity or production process that the product sequentially undergoes from being a raw material up until reaching the consumer. Within the value chains, the various actors have a range of roles and responsibilities as the organic products move along from the farm to the consumer while meeting the certification and quality criteria demanded by consumers. The functions of each actor involved in the organic tomato value chains are described below. Input suppliersare the important actors from the production point of view. They supply the necessary inputs required for the organic production processes. They provide not only physical inputs like seeds, bio fertilizers, bio pesticides, implements,etc., but also provide technical inputs through training, seminars, Krishi-mela, field visits, etc. Of the total samples, 80% of the sampled farmers prepare some of the inputs on their own. In very few cases, they depend on the input dealers. The state government also provides a certain amount of biofertilizers on a group-wise, for the production of fruit and vegetables in the study area.

Figure 1. Observed and potential organic tomato value chain linkages in Karnataka



Producers are the most valued actor in the value chain. They are responsible for cultivating crops according to organic procedures that can be certified by the appropriate authority in the state. Major portion of the produce from the sampled farmers marketed through a collection point organized by the farmer's group and ICCOA. Among the sampled farmers, some farmers mentioned that they are in the contract (informal) with the specialized organic stores in Bangalore city. Further, in some cases, the individual farmers are also responsible for transporting their products to organic as well as conventional marketplaces in Bangalore which is megacity in south India. They sell directly to consumers in the weekly organic market or they sell it to outside markets through various levels of traders through the middlemen in the APMCs. Organic farmer's organizations in Karnataka, act more like solidarity groups in their relations with government programs. The smallholder individual producers come together and form organic producers groups to get organic group certification. Further, the group is undertaking some upgrading activities for marketing their produce directly to supermarkets or for the specialized stores.

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The farmer group representative member handles the collection, storage, grading, and packing of the produce with the help of NGO as show in Figure 2. Producers are involved in value addition to the product at a various level, starting from farming process upgrading to sorting, grading, weighing, Packaging and labelling. However, producer's share in consumer rupee is around 30-35% only in the case of tradition value chain where more number of actors is involved.Producer's share increase up to 45-50% in the case of contract farming with e-commerce food retail companies such as BigBasket.

Figure 2. Sorting, grading, weighing, packaging and labeling the produce

Source: Authors own compilation

Buyers:Different types of buyers exist with diverse roles in the value chains in the state. They are Supermarkets, specializedshoppers, wholesalers, brokers/commission agents, and retailers. At the simplest level, the buyer receives the organic Tomato from the collection centre and pays the supplier through NGO. Further, the buyer has invested for handling, packing according to their requirements and transporting the produce from the collection centre to their shops for selling to consumers. The farmers and buyers frequently meet to discuss problems and opportunities with respect to quantity, quality, grading and packing. Few buyers also provide extension advice and occasionally organize formal meetings with producers group. Also, they share information related to production and marketing.

However, there are differences in coordination, price structure, contract type, quantity, payment mechanism, access to market information and frequency, between producers and different type of buyers.

Commission Agents/ Brokers: The actors who purchase the product and sell on a commission basis to the wholesalers or retailers are the commission agents. A very negligible number of smallholder organic producers are selling their products through these agents. Knowledge and support service providers*:* Support services are intended to provide organic farming knowledge, information to farmers and other participants in the value chain. They include technical assistance to improve skills and technologies, market development services, product differentiation techniques (packaging, certification, branding and marketing activities) accreditation for organic certification, and market information. There is considerable support for organic farming in the study area. Local government (Gov), international organisations and NGOs are concentrating their technical assistance only on the primary (production) stages of the value chain. However, a few NGO's like ICCOA in the study area concentrating on services in both production and marketing of organic Tomato. It makes a considerable contribution to raising organic producers incomes beyond those of farmers who grow conventional products.

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There is asymmetric information among the producers about the potential market, price, quality, branding certification etc.Therefore, there is a need for a service provider who can provide information about the various stages of organic production, marketing etc. Presently, the organic food market is in the early phase of its development in the state, and it is mainly concentrated in big cities like Bangalore. Majority farmers, don't know where to sell their organically produced tomatoes and finally end up with selling in the conventional market. Hence there is a need for specialised extension service providers to promote organic farming in the state. Many of the extension officers do not know the technical aspects or organic farming, certification etc.

7. Factors influencing market linkage of smallholder producers of organic tomatoes

In most developing countries, smallholder farmers tend not to be organised in markets as they usually sell any surplus agricultural produce individually and directly to traders or consumers without linking [11-13]. In other words, smallholder farmers lack collective action in markets. Individual marketing of small quantities of produce weakens the smallholder farmers' bargaining positions and often exposes them to price exploitation by traders [14-15]. This also means that they are unable to benefit from economies of scale: linkages can multiply and spread the benefits of growth for smallholder farmers [16]. In developing countries like India, smallholder farmers are more habituated to producing within the context of particular seasons and selling to spot markets, without directing a production at the requirements of the market. Indeed, as highlighted by some researchers, the predominant philosophy of the majority of the smallholder farmers is "*produce first and then look for the market*". Instead of analysing the market opportunities, making the necessary contractual arrangements with buyers, and then producing what the market really wants [17]. The emerging organic produce supply chains in India have been found to be excluding small producers. This is due to reasons of high certification costs, smaller volumes they produce, and tighter control by chain leaders in the absence of local market outlets for the organic producers [18].Collective action enables smallholders to acquire technology, attain group certification for their produce to comply with required quality standards, and also be aware of and supply the desired quantity.We can also find similar kinds of examples from other developing countries: [19] did a case study on the role of collective action institutions in improving market access for the rural poor. Results reveal that collective action for marketing enabled smallholders to overcome multiple market imperfections and deal with the high transaction costs associated with marketing.

8. Determinants of smallholder organic tomato producers market linkage

Various factors which influence smallholder farmer's market linkage.The factors which influence the tomato market linkagesare presented in Table2. The results of coefficients in a logistic regression model represent the amount the logit of the probability of the outcome changes with a unit increase in the predictor. The result reveals that the farmers with dairy activities have a 2.73 times greater chance of having market linkage than non-dairy farmers. Farmers who have dairy as an allied activity regularly get the extension service, credit service,animal health care service throughdairy cooperatives. Farmers regularly get access to information and in touch with other farmers as a result exchange of information happens. As a result of information leverage by smallholder farmer has a better chance of market linkage.

Furthermore, the result shows that when dairy activities are not taken on by the farmers in the study area, the probability of having market linkage stands at only 37%. A group of authors [20] reported that organic livestock production is an emerging opportunity for producers in developing countries. In addition, well managed organic dairy farms can reduce many of the environmental and public health risks associated with most conventional dairy farms [21]. The present study results reveal that farmers who hold organic certification and with expertise in grades and standards have 1.88 times greater chance of having market linkage than non-certified farmers. This indicates that only well-organised farmers can benefit from the market by adopting strict quality control measures and obtaining the necessary certification for their goods. The results are in line with the findings of [22],[23] in which the acquisition of expertise in grades and standards by smallholder farming households increased their level of market participation.

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However, smallholder farmers have difficulties in meeting market grades and standards in many developing countries, which leads to their exclusion from mainstream agriculture and marketing [24-26]. Further, the present study result reveals, when the farmers do not hold a certification, the probability of having market linkage stands at 58%. Organic products are credence goods, thus for consumers certification is the only visible document to confirm the product is organic. Therefore, organic certification has a positive influence on farmer's market linkage as buyers also in search of authentic certified organic products. This may be due to the fact that, many of the retailers are claiming products are organic without any certification, having certification for products like a tomato which is consumed daily will enhance the demand intern on production.

Table 2. Logistic regression coefficients of the factors influencing market linkage

Variables	B	EXP (B)
Allied activity (Dairy)	2.73***	15.45
Certification	1.88**	6.55
Education	1.35	3.87
Extension contact	1.03**	2.72
Information Communication and Technology	3.51***	33.4
Constant	-9.05	0.00

Nagelkerke R Square: 0.78, Chi-square: 83.86, -2 Log likelihood: 44.34, statistically significant at1% (***), 5% (**) and 10% (*)

Education plays a vital role in alleviating poverty, and also plays a crucial role in increasing market participation for smallholders.The standard of education of an individual is used as an indication of the ability to process information. It also affects differences in the level of understanding, the degree of access to, and interpretation of the information in question. Therefore, better education is likely to reduce search, screening and information costs for smallholder producers. Lack of education, skills, and awareness prevents the resource-poor smallholder producers from full participation in a trade or operating within more sophisticated markets. Further, market information is vital to the market participation behavior of smallholder farmers. It allows farmers to take informed marketing decisions including searching for potential buyers, price negotiation, awareness and supply of produce in demand, monitoring and enforcing contracts. The information necessary for such decisions includes awareness of consumer preferences, the quality of the produce, quantity demanded, price, market requirements and potential opportunities. The source of market information is also very important because it determines the accuracy of the information [22][27]. In the present study, access to information has been set as a dummy variable, where smallholder farmers with access to information through mobile phones takes the value of one, and a farmer that has no access to information takes a value of zero. In addition, access to information was expected to influence market participation positively and to imply that smallholders with access to information are more likely to participate in marketing as well as in making use of formal markets.

The results reveal that access to ICT by farmers increased the chances of having market linkage by 3.51 times than non-ICT farmers. Moreover, when the smallholder does not have access to ICT the probability of having market linkage is only 22%. Next variable that is closely linked to information availability is access to extension services, such as farming advice and knowledge through extension officers, who work directly with the farmers. Their primary role is to aid the farmer's groups to increase agricultural production through more informed decision making. Extension officers are constantly armed with the latest techniques and information related to agriculture, and they relay this guidance to farmers and agricultural businesses. Also, agricultural extension officers often provide consultations with farmers in which, they give talks, provide instructions, and where possible actual demonstrations of the latest technologies related to agriculture,and how the smallholder farmers can take advantage of such technologies. Furthermore, they stage seminars and work with other experts in agriculture to learn more, or even develop new methods that could advance production. In the study area among the interviewed respondents, organic farmers were found to visit the extension workers and receive information related to production more frequently in comparison with conventional farmers. The results reveal that with a unit change in the frequency of extension contact to the average frequency of extension contact by the organic tomato farmer the probability of the farmer to have market linkage increases by 1.03 times compared to farmers who do not have an extension contact.

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Therefore, by providing the necessary information about the production, marketing and other knowledge through extension contacts play a vitally important catalytic role in the market linkage. Such findings have been consistent with the findings of other studies that revealed a significant positive influence of training and extension contact on adoption and marketing of organic produce [28-33]. Overall, for the smallholder farmers who have frequent contact with extension officers; use ICT for farming related information access, Organic certification and allied activities, the probability of having market linkage is 90%.

9. Conclusion

Tomato is one of the importantvegetables,and it is being consumed every day by a majority of the Indians. A large number of smallholder farmers grows much of India's tomatoes. However, smallholders are being excluded from innovative value chain models,andthe majority of them are not linked to appropriate marketsin Karnataka where they can realize better price.With the advent of changing consumer's preferences towards organic food products, producers need to understand what the consumer is demanding. In this context, linking smallholder tomato producers to market is very crucial as it will provide a better price for farmers on the one hand and the other, provide healthy vegetable like tomatoes which is consumed daily basis to consumers.Based on our study, tomato value chains vary from long chains where many of the intermediaries involved to very short value chains where farmers directly sell theirproducts to consumers through online.

There is a need to promote competitive, inclusive, sustainable short value chains for perishable crops like tomato, where both producer and consumers will benefit. Considering the consumer mode of purchase, there is huge potential for online marketing of organic produce such as tomato. However, the governmentshould make an effort to create awareness among the farming community about the use of online marketing of their produce. Thoughthe government of India initiated the eNAM for some of the commodities, however, for organic products there are no specific platform or even if it is there farmers not aware about such advancements. Smallholder farmers lack collective action in markets. Individual marketing of small quantities of produce weakens smallholder farmers' bargaining positions and often exposes them to price exploitation by traders. They also do not benefit from economies of scale. On the other hand, market linkages can multiply and spread the benefits of growth to smallholder farmers. Therefore, public organizations, NGOs, e-commerce companies etc. Should promote organic commodity specific farmers producers groups locally, so that, it will be effective in certification,maintaining standards, product aggregation, providing extension services and achieving economies of scale leading to market linkage. Through producer groups, information asymmetry will be minimized among the organic tomato value chain actors.Some of the factors which have a positive impact on farmer's market linkage can be addressed by necessary interventions or by designing necessary policies, such as recruiting and capacity building of extension professionals exclusively for promoting organic agriculture in the state. Presently, the ratio of extension workers to farmers is low at 1: 1162 at the national level as against recommended ratio of 1:750. There is no exclusive extension support for organic farming in the state.Further, ICT tools in effective information access about the markethave great potential. Proper ICT system may be established in association with public-private through producers groups to deliver the right information to right farmers in the right time in right place is very crucial. In a nutshell, allied activities (Dairy), group certification and marketing, frequent extension contacts, accessing market information through mobile phones, were the main influencing factors on market linkages among smallholder organic tomato farmers in Karnataka.

10. Limitations and further research

The research is focused on one region with small sample size (100) in the country; the generalizationof the findings should be approached with caution.Findings need to be further verified by further research with an expanded survey, and the use of an increased number of respondents may provide better results.

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