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RESEARCH PAPER

Traceability systems and its impact on the farming community of Southern Tamil Nadu

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Abstract : The international organization for standardization has defined the traceability as the ability to follow the movement of food or feed through the specified stages of production, processing and distribution.Chilli is one of the principal spice exported to several countries during the pre and post-globalization era. Pesticide residues and presence of Aflatoxins in the samples of chilli cautioned the import destinations to choose the concept of traceability. Traceability addresses the hygienic production, processing and value addition practices stage by stage and framed certain minimum standards for export of chilli. Following the standards, how the traceability is addressed from farm to fork is discussed in detail and at the same time the socio-economic impact of traceability is also addressed for redefining the trade.

Key Words : Traceability, Traceability systems, Value chain, Socio-economic impact of farming community

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INTRODUCTION

Chilli is one of the most valuable crops in India. It is grown almost throughout the country. Different varieties are grown for vegetables, spices, condiments, sauce and pickles. Chilli is also known as 'Hot pepper' and capsicum as 'Bell pepper'. The portuguese brought bell pepper from Brazil to India during the year 1584. Chilli is a fruit of the plants '*Capsicum annum* belonging to the family of Solanaceae', which also includes tomato and potato. Theses fruits are small in size and known for their sharp acidic flavor and colour. Currently chillies are used throughout the world as a spice and also in the making of beverages and medicines. If some varieties of chillies are famous for red colour, because of the pigment '*Capsanthin*', others are known for biting pungency attributed to '*Capsiacin'*. India is the only country which is rich in many chilli varieties with different quality parameters.

Production of chillies:

The world production of chilli crop is estimated at seven million tonnes, which is cultivated approximately in an area of 1.5 million hectares. India is the world leader in chilli production which is arrived at 40 per cent of global production followed by China (8.67%) and Peru

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(4.74 %) (Bhavani Devi *et al.,* 2016). A large demand for chilli comes from several chilli- consuming countries as it form a part of cuisines of various cultures and are also as a colouring agent. Most of its demand is generated in the food processing sector.

The major chilli producing states in India, are Andhra Pradesh, Karnataka, Orissa, West Bengal, Maharashtra, Gujarat and Tamil Nadu contribute around 83 per cent of area and 90 per cent of the production of the country.

Export potential of chillies :

India has immense potential to export different types of chillies required by various markets around the world. It is the leader in export, with 25 per cent share in world trade, followed by China with 24 per cent share in total global export. According to the statistics of spices board of India (2014), India had exported 2.40 lakh tonnes of chillies worth of INR 1536 Crores. Clearly, China is a serious competitor to India in the international markets, penetrating all major markets like Indonesia and the US. Indian chilli exports are mainly affected by domestic demand and uneven production which is due to erratic monsoon, drought, and yield factor. It is observed that India's chilli exports are showing an increasing trend from the last decade on rising export demand coupled with short supply from other major producing countries, and ban by the European Union on imports of Chilli from Pakistan due to presence of Aflatoxin in its produce (Rajur and Patil, 2013). Pakistan's export share in global trade has been grabbed by India that resulted in historic high export from India in the last couple of years.

Aflatoxin and pesticide residues are the two major constraints in increasing our exports. Buyers expect a high degree of hygiene and sanitation in processing and preparation of chillies for export. The potential for increasing exports of whole chillies, chilli powder and crushed chillies in consumer packs is very high, provided we meet the stringent quality requirements of importing countries. The consumers in importing countries insist on 'Clean spices' and to meet this challenge we have to make every effort to prevent contamination from external sources during harvesting, post-harvest handling, processing and storage. This can be achieved only through an integrated approach with the collective efforts of farmers, processors and traders. In this context, Traceability assumes much importance for the products which are considered to be potential for export (Mugadza, 2014).

ISO standards allows the organizations operating at any step of the food chain to trace the flow of materials; identify necessary documentation and tracking each stage of production; ensure adequate co-ordination between the different actors involved and improve the appropriate use and reliability of information, effectiveness and productivity of the organization (Banerjee and Menon, 2015). In this context, the study has focused on assessing the farm level traceability and upto the consumer level by mapping the value chain. While mapping the value chain, the product flow, information flow and the services flow and the linkages with the stakeholder institutions as evinced by Banerjee and Menon during, 2015 are also discussed and the need based information were analysed and documented for better understanding.

Design of the study:

Tamil Nadu is one of the developed state in India which is blessed with 32 districts. Among the 32 districts of Tamil Nadu, only 3 districts have the notable area under red chilli cultivation. Among the 3 districts, the traditional red chilli growers were belonged to Ramanathapuram, Sivagangai, Thoothukkudi districts whom are cultivating traditional varieties of red chilli has changed their attitude towards practicing improved varieties like K-1 and K-2 varieties of red chilli based on the influence of Garden Valley Export Corporation, Virudhunagar started practicing good agricultural practices following the principle of Traceability. Hence, these three districts were chosen in the first stage purposively for the study.

In the second stage, the taluks which are having higher area under chilli cultivation under contractual arrangement with Garden Valley Export Corporation has been chosen *viz.,* Vilathikulam taluk in Thoothukkudi district, Kamuthy taluk from Ramanathapuram district and Thiruppuvanam Taluk from Sivagangai district. In the third stage, two villages per taluk which is having higher number of registered farmers with Garden Valley Export Corporation have been chosen randomly. From each villages 20 registered farmers and 10 non-registered farmers were randomly selected following a three-stage random sampling technique.

To study the intervention of non-tariff barriers, mapping of value chain of red chilli and traceability, the traders who are actually promoting the procurement, processing and export of red chilli were enlisted from

different Web sites and from the list, 50 traders were randomly selected and interviewed to document the product flow, information flow and services flow.

To sum up, the number of samples selected in respect of registered sample households were 120; non-registered sample households were numbering to 60 and the traders numbering to 50 were randomly selected forming a total sample of 230 from the study area of Southern Tamil Nadu. The information relating to the agriculture year 2016-2017 was collected and the respondents were interviewed during the month of October to December 2017.

In the study area, there were two to three organizations were also involved whom are promoting the technology (Good agricultural practices) adoption practices among the farmers in the study area and hence, their role and type of services available to the farm households were also documented. The results of the study were analysed and discussed based on the descriptive statistics like mean and percentage analysis.

RESULTS AND DISCUSSION

The results and discussion related to traceability aspects in the transfer of red chilli from the producer to the ultimate consumers both domestic and international markets are analysed under the following heads. They are

– Adoption of good agricultural practices
– Methods of processing of red chilli
– Methods of packaging practiced in red chilli
– Documenting and tracking the production of red chilli
– Traceability information system in chilli spice
– Mapping of red chilli value chain
– Socio-economic changes made due to traceability.

Adoption of good agricultural practices (GAP):

The concept of GAP was evolved as a result of the big concern for food safety, security and quality. Microbial contamination in spices, a major concern was the driving force behind the establishment of the good agricultural practices (GAP) policies and surveillance systems. Following are the components of GAP in chilli cultivation which were approved by the American Spice Trade Association (ASTA) and also recommended by spices board of India (*www.asta.com*). The processing firms provide trainings to registered farmers in all these components of GAP for chilli cultivation. The adoption of GAP technologies in chillies is presented in Table 1.

Table 1 revealed the details of various good agricultural practices adopted by the registered farm households. The responses of the registered and un-registered farmers on the good agricultural practices practiced were asked to rank one by one. The responses of these two section of farm households were analyzed

Table 1: Technological adoption of good agricultural practices in chilli cultivation

Sr. No.	Good agricultural practices	Registered farmers (No. = 120)	Non-registered farmers (No. = 60)
1.	Certified seeds from authorized source	46.77	32.45
2.	Seed treatment methods practiced	70.56	64.38
3.	Adoption of nursery establishment and/or obtaining seedlings from centralized nursery	54.35	49.32
4.	Application of farm yard manure before land preparation	41.38	39.56
5.	Application of inorganic fertilizers	31.56	29.58
6.	Application of compost manure after planting	52.49	48.25
7.	Avoiding plant protection chemicals after flowering to pod formation stage	52.01	48.62
8.	Picking the pod upwards while harvesting	44.60	42.19
9.	Restricting animal movement during harvest time	88.62	68.43
10.	Application of bio-control measures	86.39	75.65
11.	Providing appropriate sanitary wares and facilities to labourers	82.63	79.54
12.	Cleaning and sanitizing harvest containers before use	80.68	70.85
13.	Avoiding harvest practices in respect of chilli within 120 days of chemical application	75.26	68.55
14.	Drying of harvested materials on clean, elevated racks, concrete floors, or on Tarpaulin sheets	78.66	69.32
15.	Excluding field debris from packing and storage facilities	70.82	64.90
16.	Using new and unused bags for packing and logistics purpose	65.29	58.62

using the garette ranking technique. Among the many GAPs, the registered farm households are restricting the movement of animals inside the garden, practicing bio-control measures to control the pest and diseases, appropriate hand washing and sanitization measures for field workers and cleaning and sanitizing the containers to be used for harvest of chilli were found to be the principal good agricultural practices followed by the registered farm households. It is revealed from the highest score obtained in respect of registered farm households. This is also true in respect of non-registered farm households. They do practice the same because of the learnings from their neighbouring farms. Though many of the farmers resort to good agricultural practices as delineated in Table 1, very few of the farmers are adopting bio-control measures and plant growth regulator differently. In this circumstance, special effort has been taken to document these practices separately and presented in Table 2.

Table 2 revealed the details of plant parts and components used in the process of preparation of bio-control extract to control Thrips in chilli garden. The farmers used to adopt the plant parts as revealed in the Table 2 and draw the extract and are mixed with the cow urine and the same is kept aside for processing for five days. At the end of five days, one litre of processed bio-control mix in a concentrate form is diluted with 12 litres of water and sprayed in the chilli garden. The problem of Thrips will be vanished. To induce the bunch of flowers at the time of induction of flowers, plant growth regulator using the bio products is also sprayed in the chilli garden. These details are analyzed and the results are presented in Table 3.

Table 3 revealed the details of plant parts used in the preparation plant growth regulator for promotion of flower buds induction in the chilli garden. The components comprising are ginger, garlic, green chilli and cow urine which are, respectively accounted for 10 per cent, 13 per cent, 10 per cent and 67 per cent to the total extract which are very well mixed and can be directly sprayed in the chilli garden during the time of induction of flower buds. These efforts pay dividend and one could realize profuse flowering and able to get considerable yield from the practice. But these are the technologies at the interest of the farmers and the same has to be standardized for realizing the maximum level of production. However, these practices are adopted by very few farmers.

Methods of processing of red chilli :

While harvesting, to avoid the Aflatoxin infection, the farmers used to resort the sanitation related measures at field itself and they use the containers for extraction of chilli with well dried and cleaned manner. The fresh fruits collected were brought to the drying yard and are dried under the open sun using the tarpaulins provided by the chilli growers welfare association, Virudhunagar. In these circumstance, the method of processing of red chilli is analyzed and the results are presented in Table 4.

Table 2: Bio-control measures adopted by the registered farmers

Sr. No.	Common name of the plant part	Botanical name	Units	Quantity	Percentage to total
1.	Datura	*Datura metel*	Kg	2.000	10.00
2.	Aloe	*Aloe vera*	Kg	2.500	12.50
3.	Pirandai	*Cissus quadrangularis*	Kg	2.000	10.00
4.	Nochi leaves	*Vitex negundo*	Kg	2.500	12.50
5.	Vasambu	*Acorus calamus*	Kg	1.000	05.00
6.	Cow urine	Urine of *Bos taurus*	Litre	10.000	50.00
	Total quantity			10 + 10	100.00

Table 3 : Plant growth regulators used for induction of flowers in the chilli garden

Sr. No.	Common name of the plant part	Botanical name	Units	Quantity	Percentage to total
1.	Ginger	*Zingiber officinale*	Kg	1.500	10.00
2.	Garlic	*Allium sativum*	Kg	2.000	13.33
3.	Green chilli	*Capsicum annuum*	Kg	1.500	10.00
4.	Cow urine	Urine of *Bos taurus*	Litre	10.000	66.67
	Total quantity			15.00	100.00

Table 4 revealed the details of methods of drying of red chilli followed by chilli farmers. The Principal mode of drying is found to be the drying yard which is prepared and processed by the farmers before the harvest of fresh red chilli. The drying yard facility is created by themselves in the tank foreshore areas during the non-rainy days and dry the red chilli using Tarpaulins provided by the chilli growers welfare association, Virudhunagar. Though the solar drying facility is installed in certain villages, the services of solar dryer is not much utilized by the chilli growing farmers for want of installed capacity and promotes queuing process and forced farmers to wait for long to dry their produce. The solar dryer installed is capable of drying only 60 kg of fresh red chilli and the solar dryer will take around two days for effective drying. But the solar drying provides good colour to the red chilli which is capable of commanding good price in the market. But the garden Valley export corporation is not discriminating the produce either it is dried under open environment or in the solar dryer in offering the price per unit of the produce.

Methods of packaging practiced in red chilli:

The well processed and dried produce of red chilli is ready for packaging has to be packed using the good packing materials and hence, the methods of packaging and packaging materials used are analyzed and the details are presented in Table 5.

Table 5 revealed the details of packaging materials used for packing the dried, processed red chilli. While they do packaging services after drying the product, they take utmost care on preventing the field debris and other unwanted materials or impurities away and packed in the jute fibre bags and provide the tags for easy identification. The dried red chilli is packed by using the jute bags of 20 kg capacity and are tailored well with the appropriate tags for the identification of the produce. The tag used for the first farmer in the list of Peraiyur village is GVEC / PYR / 01. The meaning of the tag is provided below.

– GVEC stands for garden valley export corporation, Virudhunagar

– PYR denotes Peraiyur village

– 01 is the code given to the first name of the farmer in the registration list.

The packed red chilli is transported using the insulated containers or carriers to avoid any influence due to weather changes and deposition of debris or dust. After reaching the destination of garden valley export corporation, the packed items are stored in the warehousing facility on rental basis or in their storage. The average price received per bag is arrived at Rs. 1647/- but the price received by the farmer per ton of dried red chilli is arrived at INR 82350/-. Normally the

Table 4: Methods of processing of red chilli

Sr. No.	Mode of drying	Quantity handled per day in kgs	Duration of drying (Days)	Number of farmers followed (%)
1.	Solar dryer	60.000	02	12 (10.00)
2.	Drying yard (Tank foreshore areas)	800 - 900	04 - 05	72 (60.00)
3.	Thrashing floor	600 - 700	05 - 06	27 (22.50)
4.	Village roadsides	200 - 300	05 - 06	09 (07.50)
	Total		05	120 (100.00)

(Figures in parentheses indicate percentage to total)

Table 5 : Details of packaging materials used for red chilli

Sr. No.	Particulars of packing	Remarks
1.	Name of the packing materials used	Jute bags
2.	Quantity of dried red chilli packed per bag in kg	20.000
3.	Removal of foreign materials and discolored chilli	Concerned farm household
4.	Traceability tags used	GVEC / PYR / 01
5.	Mode of transportation used	Insulated carriers / containers
6.	Average price awarded per bag	INR 1647.00
7.	Procurement arrangements made in each village	Procurement supervisor
8.	Monthly salary for procurement supervisor	INR 7000.00
9.	Procurement made by	Garden valley export corporation, Virudhunagar

procurement related arrangements are made by the procurement supervisor exclusively appointed by the garden valley export corporation in each village and the individual is commanding the monthly salary of INR 7000/ - and the entire commodity is received by the head quarter of garden valley export corporation based at Virudhu nagar. Beyond that certain value addition activities of red chilli is taking place *viz.*, conversion of red chilli into red chilli powder; extraction of oleoresin which are exported to different destinations from Virudhunagar. But the garden valley export corporation authorities have declined to provide any value added information and the quantity exported to different destinations considering the trade secret which cannot be disclosed. In these circumstances, the value added details are unable to be documented. However, the tracking of the produce produced in different farm lands are possible and are documented under the heading of tracking the production of red chilli. Similarly in all the villages the harvested, processed dry chilli is packed in different packs and are coded uniquely. The model code adopted in packaging of red chilli is presented in Fig. 1.

Fig. 1 illustrated that the dried red chilli is packed in the gunny bags and are coded and the codes are clearly visible in the tags attached to the gunny bag. In that code, the first farmer has supplied 14 bags of dried and processed whole red chilli during the year 2017. Similar codes are attached to each lot and are exported to different destinations after getting the import permits. In this circumstance, it is necessary to document the value chain partners. These are discussed in the ensuing section entitled "Mapping of value chain in red chilli".

Fig. 1 : Methods of tagging practice followed in red chilli

Documenting and tracking the production of red chilli :

The registered farmers who are complying the rules and regulations of garden valley export corporation, their harvest samples will be permitted for testing and if the test parameters within the European Norms, those lots will be packed in the village itself with some tag systems. The details of coding and tagging given to the farmer by the garden valley export corporation is analyzed and the details are presented in Table 6.

Table 6: Coding practices adopted by garden valley export corporation for each farmer

Sr. No.	Name of the farmer	Code given to the farmer	Audited area in acres
1.	Andiyappu, K	GVEC / PYR / 01	00.93
2.	Chelladurai, T	GVEC / PYR / 10	00.84
3.	Muthumanickam, V	GVEC / PYR / 20	00.55
4.	Sathaiya, R	GVEC / PYR / 30	01.01
5.	Chandrasekaran, J	GVEC / PYR / 41	01.99
6.	Hema Malini, A	GVEC / PYR / 52	00.98
7.	Krishnan, P	GVEC / PYR / 62	01.22
8.	Premakalaiarasan, K	GVEC / PYR / 74	01.71
9.	Velmurugan, P	GVEC / PYR / 87	01.09
10.	Kalieswari, C	GVEC / PYR / 99	01.48
11.	Malaimeenal, I	GVEC / PYR / 112	01.24
12.	Palammal, K	GVEC / PYR / 122	00.78
13.	Rohini, K	GVEC / PYR / 135	00.61
14.	Velusamy, K	GVEC / PYR / 151	01.35
	Average area in cultivation of chilli per farmer in Peraiyur village		01.13

Table 6 revealed the details of contract farmers with the garden valley export corporation and the method of coding practiced for individual farmers and their audited acreage under chilli. The average area in cultivation of chilli in Peraiyur village of Ramanathapuram district is 1.13 acres and their coding system did not change over the cropping periods. In the coding system – 'GVEC / PYR/ 01', The first 4 alphabets stands for the organization who promotes export from India was designated as GVEC; The next three alphabets 'PYR' indicates the village in which the chilli was cultivated and the code '01' stands for the farmer and his name "Andiappu". Implementation of effective traceability systems improves the ability to implement the verifiable safety and quality fulfilment programmes. Effective traceability systems significantly reduce the response times by providing more rapid access to relevant and reliable information. In these circumstances, care has to be taken to document the traceability aspects of information with utmost care. The coding practices in each farm with respect to application of inputs, time of application, methods of application, sanitary and health care aspects practiced, time of harvest, quantity harvested, methods practiced in processing etc. have to be documented for ensuring effective traceability aspects. However, with regard to traceability, the records were not exposed by the chilli growers welfare association because of the strict advice extended by the garden valley export corporation, Virudhunagar. The field supervisors are also reluctant in furnishing the information on traceability aspects. However, the farmer level traceability can also at best be enhanced by using a software designed for the purpose. The following information may be a vital one for ensuring farmer level traceability.

Traceability details of the farmer:

– Farmer code: GVEC - PYR - 01

– Name of the farmer: Andiyappu

– Father's name: V. Kaliannan

– Date of birth: 1 – 10 – 1962

– Address line 1: S/O. V. Kaliannan

– Address line 2: North Street, Peraiyur, Kamuthy Taluk

– Name of the village: Peraiyur

– Name of the district: Ramanathapuram district

– Name of the state: Tamil Nadu

– Country: India; Pin: 628 252

– Mobile number:

– Bank name: State Bank of India

– IFSC code:

– Address of the Bank: Kamuthy, Ramanathapuram district

– Manager / supervisor in engaging the farmer: Mr. Mahendran

– Company code: GVEC

– Regional office: Virudhunagar.

Details of field traceability of the farmer:

The field traceability also requires certain basic information which are also to be recorded using the software and made available online. They are:

– Farmer code: GVEC - PYR - 01

– Farmers' name: Andiyappu

– Size of holding available to the farmer: 3.50 acres

– Name of the chilli growing area: Peraiyur

– Area under chilli cultivated per annum: 02.00 acres

– Soil type: Black soil

– Cultivable unit: Acres

– Ownership of the land: Owned land

– Address for communication:

Mr. K. Andiyappu S/O V. Kaliannan, North Street, Peraiyur, Kamuthy Taluk, Ramanathapuram district

– Name of the village: Peraiyur

– Soil fertility status: Moderate to good

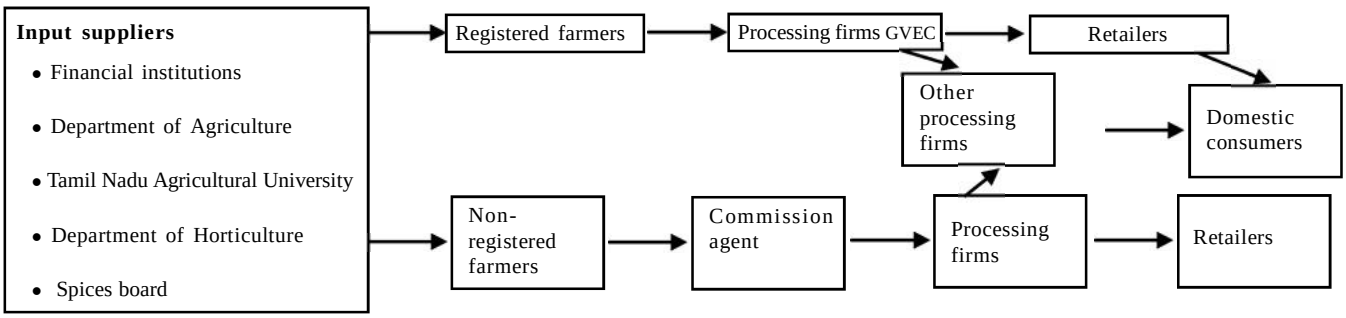

Fig. 2 : Domestic value chain in practice for red chilli

– Type of inputs used: Organic inputs

– Number of field demonstration conducted: 04

– Date of conduct of field demonstration:

– Number of pickings made: 12

– Quantity of red chilli harvested: 2.23 tonnes per Ha

– Medium used for drying: Black coloured Tarpaulin, Sundrying

– Date of testing of quality by GVEC:

– Date of packaging:

– Number of bags: 14.

All the above information are to be entered in the computer using appropriate software for ensuring better Traceability at farmer level. Another aspect under the head traceability is "Traceability in Transaction" has to be studied and analyzed. For that the company proforma invoice may be the ideal one to document. In these circumstances, the copy of the proforma invoice of the company is furnished in Fig. 2.

Traceability information system in chilli :

Traceability system records and follows the products and materials that come from the supplying sources and are processed at the processing ends. Here the processing is carried out by the garden valley export corporation, Virudhunagar. They used to get the import permit from different destinations and their choice of product preference. Accordingly the products are packed and sent to those destinations with their label as indicated in the packaging process. In the case of value added products like chilli powder, chilli paste and oleoresin, how the garden valley export corporation is doing processing and packaging for dispatch to foreign destinations is not known as they are highly reluctant to deliver those informations. In practice, traceability systems are record keeping system that show the path of chilli output suppliers through the intermediaries like wholesalers to the consumers.

The basis of all the traceability systems is the ability to identify things that move along the supply chain or the value chain. In this system, the following activities are to be recorded. They are:

– Identification of Batches of products sent abroad

– Registration of information on when and where the units or batches are sent abroad or transformed to get a value added output and

– Linking these data and transferring all relevant traceability information with the product to the next step of processing.

Traceability System with in a value chain requires all stakeholders involved to link the physical flow of chilli output with the flow of information about the product. External traceability requires unique product identification number and the batch number or the lot number. This lot number and or the batch number depicted in the packaging should be communicated to the importing authority through the phytosanitary certificate or in the health certificate or through electronic communication using the internet facilities. This type of linkages of physical products with the information requirements needed for the importer fulfills the traceability. The external traceability allows the tracing back (supplier traceability) and tracking forward (client traceability).

Internal traceability takes care of the processes maintained within an enterprise to link the finished output of chilli powder or paste manufactured by garden valley

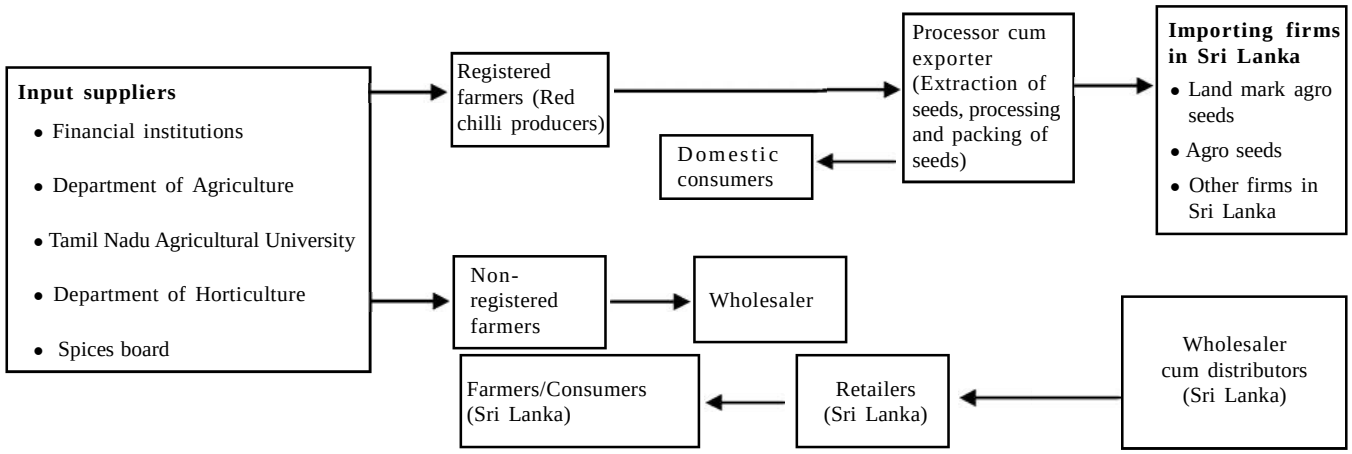

Fig. 3 : Export value chain of chilli seeds

export corporation. A label showing the Lot number of the traceable input item should remain on the packaging until that entire traceable item is depleted or converted. Farm to Fork traceability requires that the processes of internal and external traceability be effectively conducted. Each traceability partner should be in a position to identify the direct source and direct recipient of traceable output of chilli.

Mapping of red chilli calue chain :

A value chain is referred to a sequence of related business activities from the supply of specific inputs for realizing a quality output to the process of production, transformation and marketing so as to reach the ultimate consumers. Value chain analysis included costs, value addition at each stage, secondary services important to each stage, constraints and players along the value chain and their role are to be discussed. The value chain analysis for chillies are presented in the following sections.

– Domestic value chain partners

– Export value chain actors including role of core processes and actors

– Governance, co-ordination, regulation and control of value chain

– Linkages and relationships between the value chain partners.

Domestic value chain partners:

Domestic market based value chains were found to be the dominant one in respect of red chilli. It also decides the value and volume of chillies marketed. Domestic value chain of red chillies and chilli powder is presented in Fig. 2.

Value chain analysis demands participation of all the stakeholders in taking the produce safely to the end consumers from the producers or the manufacturers. The major players in chilli value chains were the input suppliers to the farmers who produce the chilli. The input suppliers may be of a farmer or the wholesaler or the retailers or the exporters or the contracting agency. Here the input supplies are effected by the fellow farmers and the contracting agency (GVEC) who establish a central nursery in each district and they do supplies to the farmers. The contracting agency provide the certified seeds and seedlings along with subsidized inputs like manures, pump sets and bio-control inputs.

On realization of output by the registered farm households, the garden valley export corporation (GVEC) made arrangements for procuring the output of chilli at a market price. GVEC acts as a processing firm and it also meets the local market distribution of chilli powder and chilli through the retailers. Whereas, the non-contract farmers or non-registered farmers sold majority of their chilli output to the commission agents or village traders who either sold to another intermediary or sold directly to the wholesaler. Some of the wholesalers are having processing facility also and hence they were designated as processing firms for conversion of chilli powder and are packed in their own brands and sold to the retailers and then it reaches the consumers through consumer packs in a branded form.

The domestic suppliers of chilli powder opt for certification following the standards of AGMARK and FSSAI (Food Safety and Standards Authority of India). However, the firms supplying unbranded small provisions to domestic market did not opt for any quality certification. These uncertified and unapproved or unauthorized brands should be periodically checked by the food safety authorities and made them to opt for quality certification. Surprise checks should be made in the retail outlets for selling such unbranded and unauthorized food packets be confiscated and the shops should be sealed for ensuring quality certification.

Export value chain actors :

The exporters of red chilli were the members of the spices board and they are also the members in all India spice exporters forum had obtained the import export code (IE code) for involving in the export trade of spices. The consignments of red chilli is mainly exported to the neighboring country, the Sri Lanka. Besides this, red chilli export is also made to Malaysia, Bangladesh, United States of America, Nepal, Mexico, United Arab Emirate, Indonesia and China. Export value chain of chilli seeds is given in Fig. 3.

Chillies were exported to different destinations in various processed forms like chilli seeds, red chilli, chilli powder, chilly pickles, chilli paste, curd chilli, chilli oleoresin etc. The chilli production system for export and domestic markets varied in quality significantly. The export channel had to concur to stringent standards often set by the importing country. Whereas, the domestic channels followed a more liberal approach. The processing firms had played a major role in value chain of chillies. Particularly, they receive the red chilli from

farmers who opted for trial plots, do extraction of seeds, purification of seeds by removing the dusts, do germination test and do packing of chilli seeds in the company packs of branded nature to form TFL seeds and then it will be ready for export to Sri Lanka. There were two majors available in Sri Lanka whom are importing the produce of chilli seeds for further distribution in Sri Lanka. In the process of export of chilli seeds, the processor cum exporter was extracting the seeds from the quality output of red chilli and the remaining chilli was converted in to chilli powder and the same was packed in consumer packs and redistributed in the domestic market by the processing firm. Here, the seed processing firm is Griffin crop sciences Private limited based at Coimbatore.

Immediately after the import, the consignment was received and the consumer pack lots have been distributed to the wholesaler cum distributor in Sri Lanka and then the chilli seed lots have been received by different retail traders or the input stores and then the farmers were accessing the chilli seeds for sowing, transplanting and other production related activities. Besides chilli seeds, the export of red chilli is also effected to Sri Lanka. The route through which the red chilli is exported and distributed is furnished in the Fig. 4.

Fig. 4 revealed that the registered farmers with the export corporation was receiving both physical and technical inputs from different input providers and raise the crop in the farm field and take bio-control and promote plant growth regulators from plant origin to enhance the productivity of red chilli.

The red chilli was then received by the processing firms for performing grading and coding of the produce and then it was sent to the wholesaler cum distributors of Sri Lanka who had the import permit with purchase order from India will be receiving the consignment of red chilli and they do all the quality checks at the instance of plant quarantine office of Sri Lanka and then the produce will be released if the consignment is free from Aflatoxin and pesticide residues within the prescribed limit. The received produce from the customs will be redistributed to the different retailers in Sri Lanka and then it reaches the ultimate consumers in Sri Lanka. According to Mugadza during the year 2014, traceability of retailers are only partially traceable. According to Sekhar (2015), there were 11 firms who are actively involved in importing of value added curd chilli and they were spread across USA, Austria, Malaysia and Qatar. Number of firms participated in supplying of curd chilli was arrived at 63 and the number of firms buying the value added product of curd chilli were arrived at 81 revealed that the value added curd chilli was commanding higher demand like red chilli. It is evident from that some of the suppliers do have the required aspects in place but it is not uniform throughout the supply or value chain. In this circumstance, the researcher has felt that the importance of documenting the cost involvement in the value chain of chilli seeds and hence special effort has been taken to discuss with the exporters of chilli seeds and the results are presented in Table 7.

Table 7 has highlighted the cost involvement for Producer of chilli seeds and exporter of chilli seeds. Here, the producer is incurring cost for the good agronomic practices, conducting trials drying, grading, sorting and packing of red chilli from the farm. For that, the farmer is incurring a total cost of INR 12654/. Which is accounted for 83 per cent to the total cost of getting one kg of quality seed for export. In that the cost involved for getting 400 kg of raw dry chilli is arrived at INR 10776/- which is accounted for 71 per cent to the total.

The processor cum exporter is the next recipient of the commodity of red chilli and he process the red chilli to extract the seeds. After the extraction process, the same seeds were subjected to germination tests, purity

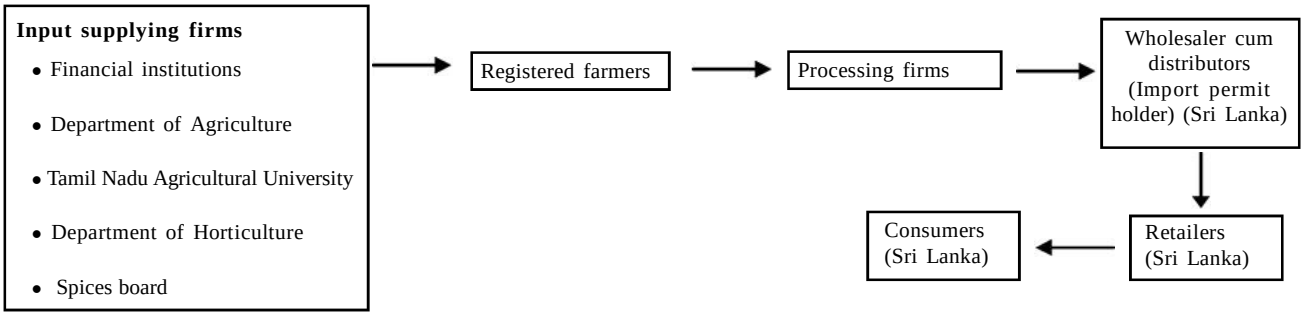

Fig. 4 : Export value chain of red chilli

tests, fumigation test, Product certification, shipping and logistics. For these activities, the processor cum exporter is incurring INR 2510/-. Put together, the total cost of extracting the chilli seeds in the value chain is arrived at INR 15164/-. However, the processor cum exporter is distributing the seeds to Sri Lanka where the value chain ends is priced at INR 36000/- per kg of chilli seeds. After deducting the cost involved in the process of extraction of seeds, the net gain is arrived at INR 20836/- which is accounted for 58 per cent consumer seed price per kg of seeds. From that one could infer that the processor cum exporter is capable of earning 58 per cent share over the gross price which is appreciable and hence the process can be continued for economic advantage to the stakeholders.

Linkages and relationships between value chain actors:

Linkages and good relationship should exist among the role players in the value chain to promote the commodity from farm to fork. When compared to the registered farmers, the unregistered farmers were not having much linkages in the value chain. The role players may be banking personnel, the institutions whom are providing technical and other support, the input supplying firms, extension agencies, commission agents and the processor cum exporters. These players should have appropriate linkage to facilitate the export trade. In this situation, the nature of relationship that exist between the value chain partners are analyzed and the results are delineated in Table 8.

Table 8 revealed the details of linkages that exists between different stakeholders. Banks provided working capital for chillies cultivation. Institutions like spices board and Tamil Nadu Agricultural University has organized training programmes on good agricultural practices in chillies cultivation and post-harvest handling to the farmers. The input providers sold seeds, fertilizers and bio-control mechanisms (*Trichoderma viride or Pseudomonas fluorescens*) to chilli farmers at subsidized rate. Almost cent per cent of the registered farmers had sold the produce to the contracting agency. However, this is not prevalent among the unregistered farmers operating in that environment. They sold the produce to different traders like commission agents based on the offer price per unit of the produce produced by

Table 7: Cost of value addition across different actors of value chain for chilli seeds

Sr. No.	Participants and their role	Cost of value addition in INR / kg of seeds	Percentage to total cost
	Registered producer	12654.00	83.45
1.	Good agronomic practices including research and development effort to develop hybrid variety	10776.00	71.06
2.	Sun drying / Solar drying	126.00	
3.	Grading of red chilli	102.00	
4.	Packing of red chilli in gunny bags @ one man day plus one women day)	700.00	
5.	Miscellaneous charges	950.00	
	Processor cum exporter	2510.00	16.55
1.	Assembling of red chilli bags	120.00	
2.	Extraction of seeds	72.00	
3.	Cleaning for purity	23.00	
4.	Packing materials and packing	320.00	
5.	Conduct of germination test and truthful labelling	50.00	
6.	Product certification charges	100.00	
7.	Fumigation charges	25.00	
8.	Shipping and logistics	600.00	
9.	Miscellaneous charges	1200.00	
10.	Total cost involved per kg	15164.00	100.00
	Importers' price per kg of chilli seed	36000.00	
	Net margin to the exporter per kg of seed	20836.00	57.88

the farmers.

To sum up, in the traceability process from farm to fork, the practice of good agricultural practices, Processing methods, packaging methods and distribution of the commodity through the partners of the value chain and their linkages were established to have an overall understanding of traceability. Any adoption process should have created some impact to the stakeholder farmer and hence, an effort has been taken to assess their socio-economic status on practice of traceability.

Socio-economic changes made due to traceability:

Implementation of traceability system has also made some changes in the life style of the farm families because of higher output generation resulted in higher income generation due to attractive price possibilities per unit of the produce. In these circumstances, what exact changes have been made in the sample farm households were analyzed and the results are presented in Table 9.

Table 9 revealed that the farmers in the study area had acquired the land for cultivation from the non-contract farmers on lease basis. This practice was prevalent among the 23 farm households whom are accounted for 19 per cent to the total followed by outright purchase of land and purchase of other assets including jewels prevalent in 19 households each of which are,

Table 8: Linkage and relationship that exists between the actors of the value chain

Sr. No.	Name of the stakeholders	Purpose	Nature of linkage
1.	Financial institutions like banks	Provision of working capital for cultivation of chillies	Regular customer visit
2.	Technical institutions like department of horticulture	Imparting GAP to the farmers	Spices board supports the training programmes through TNAU
3.	Input providers	Purchase and guidance on input application	Relationship establishment
4.	Extension functionaries /agencies	On farm demonstration of technologies	Transfer of technology and advisory
5.	Commission agents	Providing market support and facilitating pricing of the produce	Long term trading relationships
6.	Processor cum exporters	Farm gate procurement Provision of best price for the produce	Well known field staff informal credit facility trust

Table 9: Details of socio-economic changes made in the sample farms

Sr. No.	Details of changes made	Number of farmers reported	Percentage to total
1.	Improvements made in the existing house	12	10.00
2.	Purchase of new consumer durables	14	11.67
3.	Increase in the frequency of intake of non-vegetarian dishes	11	09.17
4.	Better linkage developed with department of horticulture officials	07	05.83
5.	Enhanced participation with the farmer producer company	15	12.51
6.	Purchase of cultivable land	19	15.83
7.	Acquiring leased-in land	23	19.16
8.	Purchase of other assets including jewels	19	15.83
	Total farm households	120	100.00

Table 10: Details of entrepreneurial initiatives made by the farm households

Sr. No.	Details of initiatives made	Number of households	Percentage
1.	Establishment of vegetable nursery	54	45.00
2.	Establishment of commercial nursery as business	12	10.00
3.	Establishment of input stores	13	10.83
4.	Production and distribution of vermi-compost	18	15.00
5.	Hiring services of farm accessories	07	05.83
6.	Erection of petrol bunk	06	05.00
7.	Farm consultancy services	10	08.34
	Total number of households entered into the venture of business	120	100.00

respectively accounted for 15.83 per cent in each case. The farmers have also shown an active participation in the farmer producer company activities established by them accounted for 12.51 per cent to the total.

Purchase of new consumer durables was prevalent among the 14 households and the improvements made in the existing house was prevalent among the 12 households which are, respectively accounted for 12 per cent and 10 per cent to the total farm households. Because of the traceability system and its contractual agreement with the farmer, the farmer could be able to maintain a good linkage with the officials of Department of Horticulture and Plantation Crops and the Spices Board. From that one could infer that the technology transfer like schemes implemented in the farm households, capable of enhancing their socio-economic status in general and the enhanced yield in particular.

Entrepreneurial initiatives made by the sample farm households:

Consulting firms are many in the arena to support business development process by giving entrepreneurial ideas and its stage wise implementation to the students, business personnel and agribusiness promoters and finally even to the farmers if they are willing to set up unrelated business. Farmers normally initiate business on their own if they get an investment opportunity. Traceability system has infused the contractual agreement in cultivation of Chilli which has paved way for small savings in their home and hence many of the farmers have set up the related and unrelated business in their farm or home environment. These details were analyzed and the results are presented in Table 10.

Table 10 has outlined that 45 per cent of the farm households have established vegetable nursery as their business in the farm environment followed by production and distribution of vermi-compost as their business according to 15 per cent of the sample farm households. Establishment of input stores were dearer to 11 per cent of the farm households. Commercial nursery where ornamental, fruits and flower nursery is quite common was established by 10 per cent of the farm households followed by hiring of farm accessories prevalent among 6 per cent of the households. These are the related business to agriculture and allied sectors. Whereas, few of the farmers have entered into the unrelated business diversification owing to their socio-political environment and its support have permitted to erect petrol bunks as their business. This was prevalent among the 5 per cent of the total farm households. From that one could infer that if the opportunity knocks the door of the farmer, they are ready to establish whether a related business to their farm profession or unrelated business to their farm, they perform well and are running with care to earn higher income. Due to that many developmental initiatives have been taken up both in the farm and home environment.

Summary and conclusion:

The backbone of traceability systems is tracing the farmers (backward) with regard to adoption of good agricultural practices (GAP) and ensuring the quality produce that reaches the consumers (forward) which are free from pesticide residues and Aflatoxin. While tracing the flow of the commodity, one has to map the value chain players and their activities in ensuring the GAP and supplying of quality output. For that the method of production, processing, value addition, packing and distribution of the commodity are discussed as part of the traceability systems. With regard to the farm level traceability, the coding system practiced were identified and the important records which are to be maintained by the farmer were highlighted and in respect of consumer level traceability, the value addition and supply of the output to the consumers were presented following the value chain practiced between Indian producer-processor-consumer (Sri Lanka). While tracing the flow of the commodity, it is found that the plant quarantine office establishments are not available in the district level and are available only in the port terminus which has become an impediment to the traders and hence, the plant quarantine offices may be established in different regions of Tamil Nadu.

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