

# RESTRUCTURING OF SUPPLY CHAIN OF MEDICINAL PLANTS AND ITS TRACEABILITY THROUGH CONTRACT FARMING

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**Abstract:** This conceptual paper brings forth the analysis of supply chain in medicinal plant sector, taking Kerala as a case. Rising demand for Ayurveda has paved the way for numerous manufacturing units in Kerala, and medicinal plants form the significant raw material used in these ayurvedic industries. The medicinal plants are mostly cultivated by rural farmers, and it is a vital source of livelihood for many farmers in Kerala. The supply chain of medicinal plants often consists of multiple levels with many players including primary collectors, private traders, agents, wholesalers and final consumers. The collectors (rural farmers) in the medicinal plant supply chain are in a vulnerable position. As it is difficult for collectors to sell the plants directly to the ayurvedic industries, they usually depend upon other players in the supply chain, and this puts collectors in a weak bargaining position. It finally results in collectors receiving prices lower than those prevailing in the wholesale market. The illegality and exploitation of collectors in medicinal plant sectors can be minimised through the restructuring of the supply chain by contract farming agreement. Contractual agreement helps in traceability of medicinal plants within the supply chain which is an important criterion to ensure its quality in exports. However, despite the importance and size of supply chain in medicinal plant trade, very few studies have been conducted in this area. The objective of this paper is to analyze the concepts of supply chain management and traceability of medicinal plants through contract farming agreement.

**Index Terms - Supply chain, Traceability, Contract Farming, Medicinal Plants.**

## I. INTRODUCTION

The opening of the global economy has set great opportunities for the Ayurvedic industry in India. Kerala has been at the forefront of the Ayurvedic revolution, endowed with rich biodiversity and its natural topography comprising of all three biomes like hills, plateaus and coasts. Ayurveda is considered as a source of positive health which took the lead in promoting health tourism which has been equally popular among Indian as well as foreign tourists. Demand for Ayurveda is growing in both developed and developing countries even with the revolution in antibiotics because consumers are becoming disillusioned with modern health care due to its side effects and expense (WHO,2002) [1]. Rising demand for Ayurveda has paved the way for too many manufacturing units in Kerala. According to the Report of Kerala Ayurvedic Manufacture Association, there are about 750 registered Ayurvedic manufacturing units and 1000 unregistered units in Kerala. Medicinal plants form the major raw materials for the growing Ayurvedic industry. The growth of the medicinal plant sector's importance cannot be alienated from the growth of the ayurvedic industry since the demand for medicinal plants is a derived demand of the latter. In Kerala, the annual sale of Ayurvedic medicine is about 150 crores. For the preparation of 500 types of Ayurvedic medicines 400 plant species are used. Therefore, the demand of medicinal plants is growing substantially in Kerala (Chandranth et al., 2001) [2].

According to a study done by Food and Agriculture Organization (FAO,2003) [3], increased demand of medicinal plants is met by two sources 1) Medicinal plants collected from the forest and 2) Medicinal plants collected from cultivated land. These two sources have the extended supply chain which contributes lower price to primary collectors. As collection from the forest is more common than cultivation, considerable variations in the quality of medicinal plants occur. The variation happens in the medicinal ingredients of plants based on where they were grown, what parts of the plants are being used, how the plants were harvested and how they were stored. Medicinal plants were often adulterated, as the collection from the wild cannot guarantee uniformity in plants (Mebrantu et al., 2016) [4]. So, this has made tracing supply chain of medicinal plants as a difficult task. Currently, Contract farming helps to trace the medicinal plants and thereby restructure the supply chain in such a way that to benefit the primary collectors.

## II. SUPPLY CHAIN ANALYSIS OF MEDICINAL PLANT TRADE IN KERALA

In Kerala, there are two broads categorize of supply chain in the medicinal plant trade - one for fresh plant part and other for dried plant parts. In the first case, the involvement of too many players in the supply chain will hamper the freshness of the plant, so there arises the need for a direct contract between primary collectors and ayurvedic industries. In the second case of supply chain, the number of players involved is many because the plant is in the dried form. Therefore, the rate of exploitation is also huge when compared to the first case (Sunil Kumar ,2009) [5]. The collectors are usually rural poor who depend upon medicinal plant cultivation as a source of livelihood. Cultivation of medicinal plants is a labor-intensive activity which involves preparation of land, planting and weeding, collection of plants, drying, harvesting and processing, packing, transporting and selling of plants.

There is no correlation between the price paid to collectors and actual wholesale price prevailing in the market. The collectors of the medicinal plants get only a fraction of the amount paid by the end users (ayurvedic industries). It is very much evident that this is because of many players involved in the supply chain. The traders in the supply chain usually increase their profit margin by purchasing the medicinal plants at a lower cost because of the less bargaining ability and ignorance of collectors about the market price. So, this will ultimately end up in the exploitation of primary collectors in the supply chain. Starting from the primary collectors there involves multiple players in medicinal plant supply chain and price of these plants varies when it passes from one hand to another. Major players in the supply chain consist of primary collectors/cultivators, private traders, Commission agents, wholesalers and final consumers



The primary collectors are mostly rural farmers who depend upon medicinal plants cultivation as a source of livelihood. In recent years, the price of ayurvedic medicines is increasing highly due to its raw material cost. The medicinal plants form the major raw material in ayurvedic industries which cost 40 to 45 per cent of total production of the firm (Sunil Kumar, 2009) [5]. Even though there is a price hike in medicinal plants, it has not improved the standard of living of the primary collectors. The second node in the supply chain is the private traders who have a direct connection with primary collectors. They inform and collect the required quantity of medicinal plants from primary collectors and supply medicinal plants to next player in the supply chain. The third node in the supply chain is commission agents who collect medicinal plants from private traders and sell these plants to wholesalers by charging a commission from them. The fourth node in the supply chain is wholesalers who sell the required quantity of medicinal plants to the final consumers. The last node in the supply chain of medicinal plants is end users, they mostly are Ayurvedic manufacturing units who use these herbs for producing Ayurvedic medicines.

Table 1. Price received by each player for different medicinal plants.

Medicinal Plant	Price at which the medicinal plants sold by				Share of the primary collector in final price (in %)
	Primary Collector	Private Trader	Commission Agent	Final Consumer	
Kadukka	4-5	8	14	22	18-23
Thanikka	3-4	8	10	15	20-27
Nellikka	8	28	50	30	10
Gulgulu	25	65	475	525	5
Thippali	52-55	152	350	425	12
Chittamruthu	10-15	18	20	40-50	25-30
Vizhalari Parippu	65	135	160	175	37
Thrikopakonna	20	100	185	220	9
Kaiyunniam	15-40	25-65	40-85	65-110	23-36
Elavarnam	40	65-70	100-110	135	30
Kattarvazha	6-10	25	40	85	7-12

(Source: Thesis on Economics of Ayurvedic Medicine Manufacturing Industry in Kerala, Sunil Kumar, 2009) [5]

The above table shows the price received by each player for different medicinal plants traded. The difference between price paid to the primary collectors and wholesale price prevailed in the market is considered. For instance, Thippali sold at Rs 52-55 by primary collectors is purchased by the final consumer (ayurvedic companies) at Rs 425 which means the collectors get only 12 per cent share of the final price. Hence it is clear that the existence of the middlemen hampers the prospects of primary collectors in the supply chain. So, restructuring of the supply chain is essential to secure a fair and fixed price for primary collectors. From the point of view of profitability of the ayurvedic firm also, the restructuring of supply chain is needed because more than half of the total expenditure of the firm constitutes the raw material cost, so it can be reduced only if the chain is restructured.

Therefore, illegality and exploitation of primary collectors in medicinal plant sectors and excess expenditure of ayurvedic firms can be minimised through the restructuring of the supply chain by contract farming agreement. Such an agreement also helps in traceability of supply chain of medicinal plants which is an important criterion to ensure its quality in exports.

### III. RESTRUCTURING OF SUPPLY CHAIN OF MEDICINAL PLANTS THROUGH CONTRACT FARMING

The Agricultural Produce Marketing Committee (APMC) acts restricted the farmers from dealing directly with companies and required them to sell their cultivated material through intermediaries in the supply chain. Such acts aimed to give fair remuneration to farmers for their produce [6]. But this act grew into an inefficient system in which farmers get only a fraction of the amount paid by the end users, and it was very much evident that this is because of a large number of intermediaries involved in the supply chain. Due to lack of market information, farmers do not get a fair price and the middlemen get a major share in profit [7]. As a result, the supply chain is lengthened, farmers are not able to realize high price, and they are forced to rely on intermediaries causing inefficiency in supply chain (Kearney, 2006) [8]. Therefore, direct purchase by companies is suggested as a way of reducing the length of the supply chain and to give better remuneration to small farmers. For this state must amend their APMC legislation to permit contract farming and allow direct purchase of cultivated material by companies.

Contract farming is generally defined as "Farming under an agreement between farmers and a firm for the production and supply of agricultural products under forward agreement often at pre-determined prices (Paty B.K, 2005) [9]. The basis of the relationship between the parties is a commitment on the part of the farmer to provide a specific commodity in quantities and in quality standards determined by the purchaser and an undertaking of the firm to support the farmer's production and to purchase the commodity".

By entering into contract farming agreement, the farmers ensure to cultivate medicinal plants according to specified quantity and quality standards stipulated by the company. The company will get supplies of cultivated material of uniform quality which is otherwise difficult in case of normal farming. In return, collectors receive a fixed remuneration from the company at the time of delivery. It provides the farmers with an assured market at a pre-agreed price. The contract contains clauses which provide inputs like planting material, fertilizers, monetary incentives and training from experts. This will increase their yield in substantial quantity and thereby collectors could sell the plants directly to ayurvedic companies without depending on traders. Thus, the supply chain of medicinal plants can be restructured through contract farming by reducing the number of players in the medicinal plant market and thereby this benefits both, the farmers through increased yield and the corporate, who can source the same quantity from lesser suppliers.

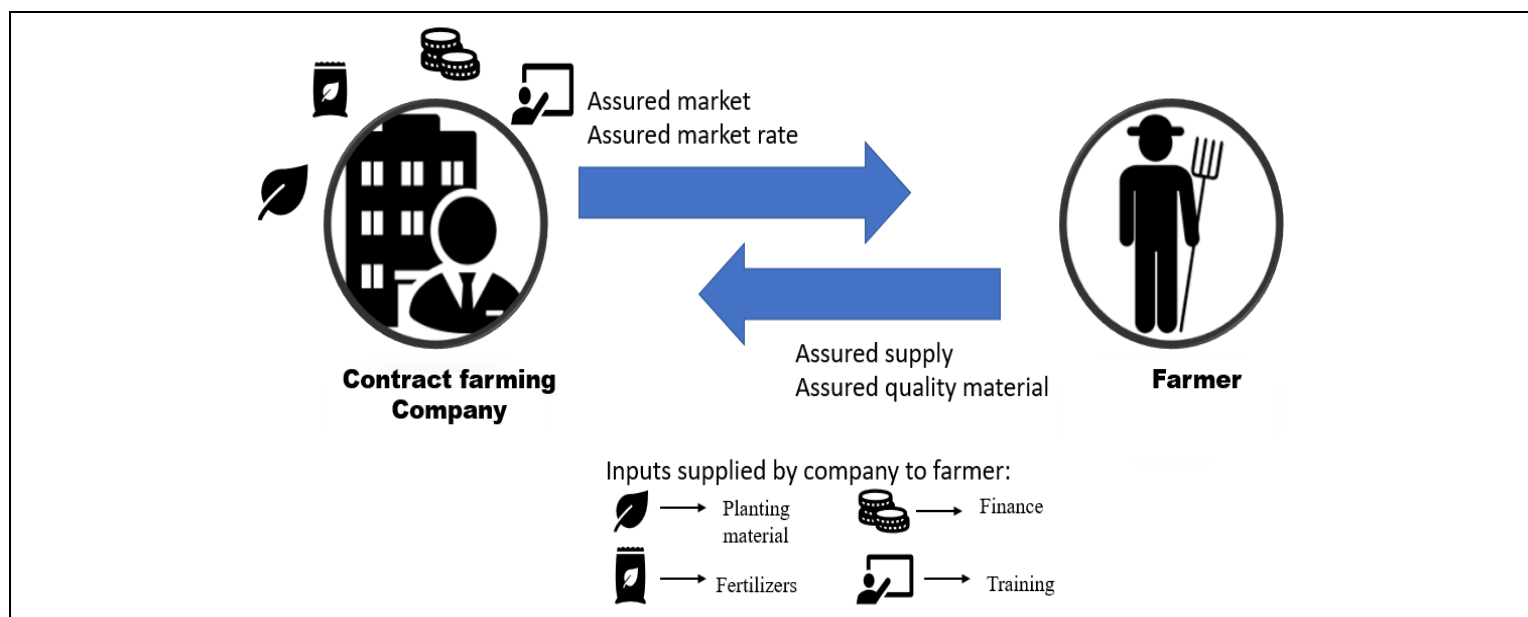


Fig.1. Restructuring of Supply chain of Medicinal plants through Contract farming Process

#### IV. SIGNIFICANCE OF CONTRACT FARMING IN TRACEABILITY OF MEDICINAL PLANTS

Traceability refers to documentation of all the information related to supply chain process in such a manner that provides the guarantee to the consumers about the origin, location, storage and other data related to the product to ensure its safety and quality. It helps to identify from where the cultivated material was grown, and the source of input used, as well as the ability to track the location of the product in the supply chain using verifiable records. It prevents the incidence of safety hazards by tracing the batch of product affected, specifying when what and where it occurred in the supply chain and identifying who is responsible (Opara et al., 2001) [10]. Traceability adds value to the supply chain by meeting the customer expectation of quality and safety of the product.

##### 4.1 NEED FOR TRACEABILITY IN MEDICINAL PLANT SUPPLY CHAIN

Increased demand for medicinal plants is met by two sources 1) Medicinal plants collected from the forest and 2) Medicinal plants collected from cultivated land. As collection from the forest is more common than cultivation, considerable variations in the quality of medicinal plants occur. The variation happens in the medicinal ingredients of plants based on where they were grown, what parts of the plants are being used, how the plants were harvested and how they were stored. Medicinal plants were often adulterated, as the collection from the wild cannot guarantee uniformity in plants. To prevent such adulteration and to improve the quality of medicinal plants, traceability is often needed (Mebrahtu et al., 2016) [4].

Various studies have indicated that the cultivators are not able to supply substantial quantities of medicinal plants from the wild for the companies due to depletion of resources. So ayurvedic industries buy medicinal plants from traders and wholesalers rather than collecting directly from primary cultivators. This makes traceability nearly impossible when medicinal plants are sourced from different places and has passed through many players in the supply chain. For this reason, direct sourcing of medicinal plants is required. Currently, contract farming is the only practical method for those ayurvedic industries who require traceability for medicinal plants. Contract farming helps ayurvedic industries to collect stipulated quantity of medicinal plants directly from the cultivators as per the agreement and avoid unnecessary players in the supply chain. The contractual agreement allows a direct relationship with collectors which enable companies to identify from where the cultivated material was grown, and the source of input used, as well as the ability to track the location of the product in the supply chain using verifiable records. It prevents the incidence of safety hazards by tracing the batch of product affected through field visit, specifying when what and where it occurs in the supply chain and identifies who is responsible.

##### 4.2 TECHNOLOGICAL IMPLICATIONS OF TRACEABLE AGRICULTURAL SUPPLY CHAINS.

Well managed contract farming arrangements can help establish not only quality traceability system but also supervision system among farmers. Ayurvedic companies doing contract farming hire the service of professors in agricultural universities and other experts to train the collectors about medicinal plant cultivation. They also conduct field visit with the help of extension staff from companies to ensure the quality of plants by checking the inputs used, harvesting techniques and grading of product. As it is difficult to supervise a large number of farmers manually, technological innovations are needed for identifying the origin of medicinal plants, the source of inputs used, harvesting and

packing, as well storage and transportation (Linus,2002) [11]. Today, many contract farming companies started using a newly developed application called CropIn for tracing the agricultural supply chain.

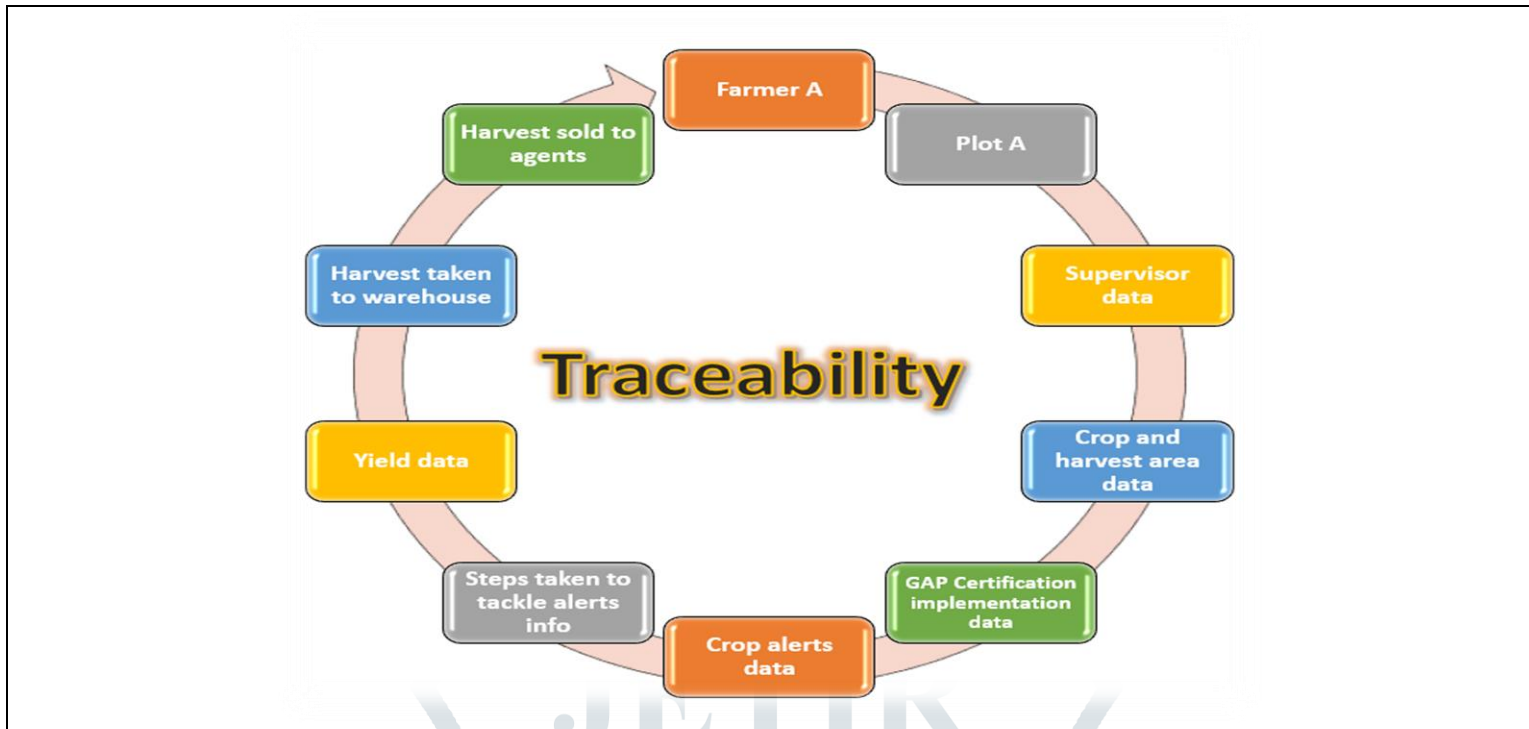


Fig.2. Different stages showing traceability of agricultural supply chain through CropIn.

CropIn is a modern technological innovation which is developed to trace products route from sowing to selling. It captures complete and real-time data across the supply chain so that the company supervisors can monitor the entire stages on a single interactive dashboard. The first data collected by CropIn will be seeding and farm input information. It helps to monitor which seeds and how many are being sown in which plots. It will then capture information about various inputs used throughout the harvesting period such as fertilizers, machinery etc. So that company can easily check if farmers are using inputs other than prescribed by them. With the help of geo-tagging facility daily task and schedules of farmers can be easily traced and thereby filed staffs can ensure that all the farmers follow the best practices on time.

CropIn satellite pictures will show the management how the cultivated crop is faring across the total area under harvest, and it will also predict the estimated yield of entire cultivation area. That is, the crop is being tracked from sowing to selling and maintain all the information by uploading data on the system software. At last, when the crop reaches the exporter, they will have all the comprehensive data on inputs, harvesting, storage, package, yield and every other aspect which is required to achieve internationally accepted certification. Using the unique barcode, the end customers can trace back the farmers who had sown the crop and thus it achieves complete traceability in the supply chain [12].

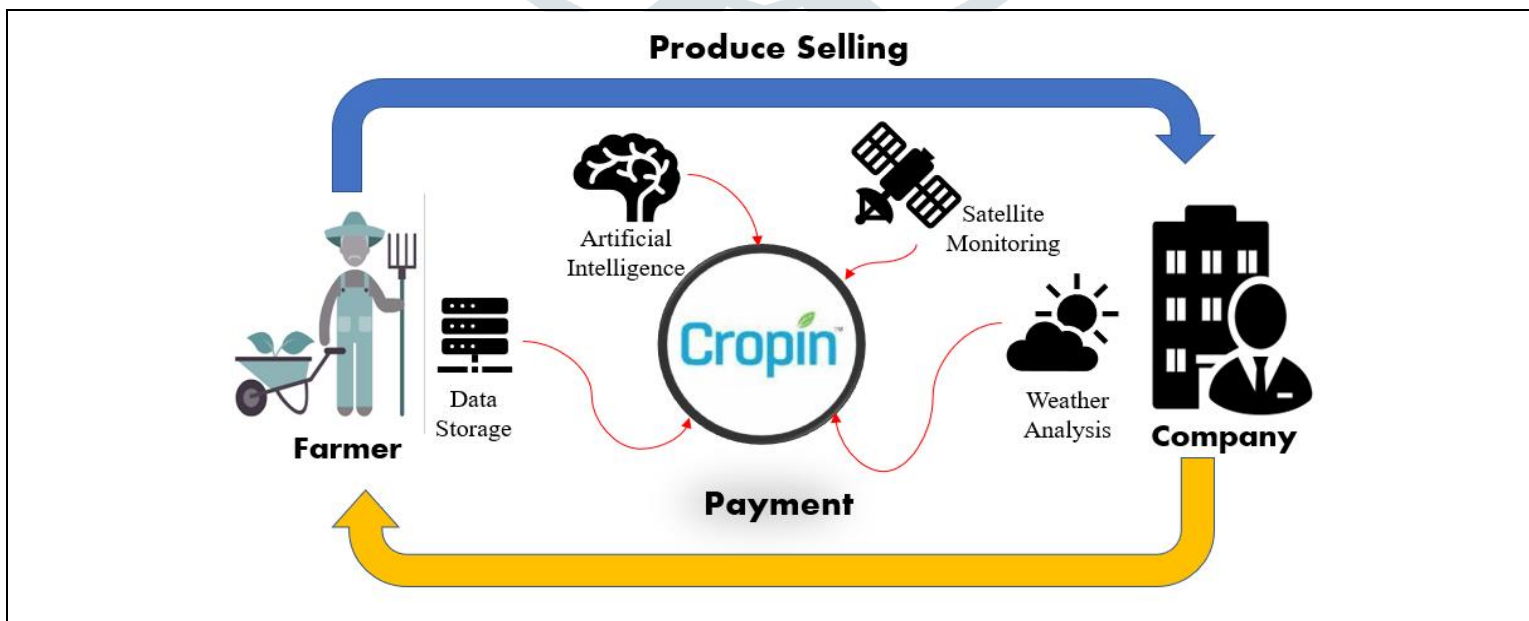


Fig.3. Working model of traceability of agricultural supply chain through CropIn.



## Benefits of CropIn

Field Archive	Get a detailed report on each plot along with pictures of crop type, acreage, sowing etc from any device like mobile or computer.
Crop Stage Management	Geo-tagging technology ensures accurate prediction and updates to track various stages of the crop. It gives timely alerts and visual confirmation on how crops are performed by input, region etc.
Remote Activity Monitoring	Track and trace all the daily tasks and schedules of farmers.
Yield Health Advisory	Pest and disease incidences can be quickly addressed through regular checkups which help to optimize supply chain and reduce losses.
Micro to Macro Optimization	Weather prediction and advisory service strengthened by artificial intelligence adjust harvest rate to soil productivity, so that it controls overspending on inputs.

In Kerala, one of the largest spice extractions firm Synthite, has adopted this application for tracking the crop cycle right from sowing until they are sold to the customer. They maintain all the information by uploading data on the system software. With the help of geo-tagging facility in CropIn app, daily task and schedules of farmers can be easily traced. It captures all the real-time data across the supply chain and supervisors can monitor where the cultivated material was grown, and the source of input used. It also facilitates tracking the location of the product on a single interactive dashboard (Survey data). As they have all the comprehensive data on inputs, harvesting, storage, package, yield and every other aspect which is required for quality assurance it was easy for them to achieve the internationally accepted certification called GAP (Good Agriculture Practices).

In case of medicinal plants, collection from the forest is more common than cultivation, which cause considerable variations in the quality of the plants collected. The variation happens in the plants based on where they were grown, what parts of the plants are being used, how the plants were harvested and how they were stored. Medicinal plants were often adulterated, as the collection from the wild cannot guarantee uniformity in plants. The absence of a system to track the sourcing of raw materials is often cited as a reason for the inability to identify such adulterations and their prevention. Thus, CropIn app can be used to ensure the traceability of medicinal plants. The information collected through the app can be utilized to identify and reject defective raw materials, thus maintaining the quality standards of the company. Any deviations from the required quality standard can be rectified by giving timely feedbacks to the farmers which contributes towards maintaining the quality of the entire supply chain.

## V.CONCLUSION

The supply chain of medicinal plants often consists of multiple levels with many players including primary collectors, private traders, agents, wholesalers and final consumers. As it is difficult for collectors to sell the plants directly to the ayurvedic industries, they usually depend upon other players in the supply chain, and this puts collectors in a vulnerable position. From this study it is clear that the existence of the large number of players hampers the prospects of primary collectors in the supply chain. So, restructuring of the supply chain is essential to secure a fair and fixed price for primary collectors. From the point of view of profitability of the ayurvedic firm also, the restructuring of supply chain is needed because more than half of the total expenditure of the firm constitutes the raw material cost, so it can be reduced only if the chain is restructured. Illegality and exploitation of primary collectors in medicinal plant sectors and excess expenditure of ayurvedic firms can be minimised through the restructuring of the supply chain by contract farming agreement. By entering into contract farming agreement, the collectors ensure to cultivate medicinal plants according to specified quantity and quality standards stipulated by the company. The company will get supplies of cultivated material of uniform quality which is otherwise difficult in case of normal farming. In return, collectors receive a fixed remuneration from the company at the time of delivery. This will increase their yield in substantial quantity and thereby collectors could sell the plants directly to ayurvedic companies without depending on traders. Thus, the supply chain of medicinal plants can be restructured through contract farming by reducing the number of players in the medicinal plant market and thereby this benefits both, the farmers through increased yield and the corporate, who can source the same quantity from lesser suppliers. Such an agreement also helps in traceability of supply chain of medicinal plants which is an important criterion to ensure its quality in exports. In case of medicinal plants, collection from the forest is more common than cultivation, which cause considerable variations in the quality of the plants collected. The variation happens in the plants based on where they were grown, what parts of the plants are being used, how the plants were harvested and how they were stored. Medicinal plants were often adulterated, as the collection from the wild cannot guarantee uniformity in plants. The absence of a system to track the sourcing of raw materials is often cited as a reason for the inability to identify such adulterations and their prevention. Thus, CropIn app can be used to ensure the traceability of medicinal plants. The information collected through the app can be utilized to identify and reject defective raw materials, thus maintaining the quality standards of the company. Any deviations from the required quality standard can be rectified by giving timely feedbacks to the farmers which contributes towards maintaining the quality of the entire supply chain.

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