Value Chain Analysis of Chilli in Project Villages of Bargarh and Sambalpur Districts of Odisha

An Initiative in Creating Sustainable Livelihoods for Small and Marginal Farmers through Agriculture Interventions in Bargarh and Sambalpur Districts of Odisha

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1. Value Chain Analysis of Chilli in Project Villages of Bargarh and Sambalpur Districts in Odisha

After analyzing the agro-climatic condition, the cropping pattern, and the market potential and feasibility of various crops, the project has identified two crops viz. Chilli and Millet with an aim to promote the commericial cultivation and enhance income of the farmers through i) establishing a Chilli cluster at Jamankira block of Sambalpur and Bhatli Block of Bargarh District; and ii) implement a special program for promotion of Millets in Bhatli and Ambabhona Block of Bargarh District. Thus, an attempt was made in the study to conduct a detailed value chain analysis of these two selected products (Chilli and Millet) in the project area. Data collected as part of this value chain analysis are analysed and presented in this report. This chapter presents the value chain analysis of Chilli conducted in the Jamankira block of Sambalpur and Bhatli Block of Bargarh District of Odisha.

Product Name: Chilli

1.1 A Brief Introduction about the Product

Originated in Mexico in South America, Chilli is considered as one of the most important commercial spice crops and is widely used as universal spice, named as wonder spice. It is extensively used in traditional Mexican food, and is a huge part of Mexican culinary and culture. Although it originated in Mexico, Chilli is cultivated around the world, with Peru holding the highest cultivated capsicum diversity.

Chilli was introduced in India by the Portuguese in Goa during mid 17th century. India has around hundred varieties of Chillies growing across the country. Different varieties are cultivated for varied uses like vegetable, pickles, spice and condiments. It is an essential part of various cuisines and added to all dry vegetables, curries, and stews for taste. Chilli can be eaten in both raw and cooked forms. India is a major producer, exporter and consumer of Chilli. Indian Chillies reach over 90 countries in the world, Bangladesh, Baharain, Canada, Italy, Israel, Japan, Malaysia, Netherlands, Philippines, Singapore, Spain, Sri Lanka, Saudi Arabia, USA and UAE being the leading importing countries[1]. It is grown in both tropical and subtropical areas up to 2,000 m above mean sea-level. As a rain fed crop, it is grown in areas receiving an annual rainfall of 75-100 cm. Excessive rainfall causes defoliation and rotting. Its commercial cultivation takes place in states like West Bengal, Tamilnadu, Karnataka, Telengana, Maharashtra, Punjab, and Uttar Pradesh. However, almost 50% of India's total Chilli produce comes from the southern state of Andhra Pradesh alone.

Chilli (botanically known as Capsicum annuum L.; Capsicum frutescene L.), also called red pepper belongs to the genus capsicum, under the solanaceae family. The Chilli plant is a white flowered, dark green or purple leaved plant that grows up to 1.5 m in height. It is also called as hot pepper, cayenne pepper and sweet pepper etc. As many as

[1] Financing Chilli Value chains in Odisha, Prof. Prasun Kumar Das, School of Management, KIIT University, India

five species of capsicum are under cultivation, though a number of wild species have been identified recently. In India, only two species viz. Capsicum annuum and Capsicum frutescens are known and most of the cultivated varieties belong to the former species. There are a lot of varieties of Chilli that grow in specific parts of India.

1.2 Purpose & Objectives of Value Chain Study

The purpose behind conducting the value-chain analysis is to help the project to strengthen the existing value chain of Chilli by integrating more and more farmers into the same. The study findings would enable the project with the required information to develop strategy and roadmap for promotion of Chilli clusters through appropriate institutional arrangements, market linkages and capacity building strategies so that the income of the local farmers in the project areas can be enhanced. It would help the project devising interventions to overcome bottlenecks and constraints in the production process and marketing system of value chain of Chilli.

More importantly, the study findings would help the project to diagnose points of ineffectiveness for corrective actions and would help to garner deep understanding on each step that adds or subtracts value for developing the value chain of Chilli. It would enable the project to develop a value chain framework that enhances cost efficiency of farmers by upgrading their position within a viable value chain by increasing the production and marketing efficiency of the local farmers so that they can gain maximum value incurring the least possible cost.

Keeping in mind the above, the objectives set for conducting the value chain analysis are to:

i) Analyze the trends in area under cultivation, production and productivity of Chilli at state, national and international level;
ii) Assess the capacity of primary producers of Chilli in the intervention area and suggest primary measures to enhance the productivity and maximise the returns for the producers at the bottom of the value chain;
iii) Depict a clear picture of value chain of Chilli in the project areas with specific input from primary producers in intervention area through interaction with Value Chain actors and facilitating & supporting organizations working towards realisation of better value for the primary producers;
iv) Assess the credit, technology and infrastructure requirement for the value chain development of Chilli;
v) Identify, understand and document the market structure of Chilli including the role of and relationship between different stakeholders/drivers in the value chain of Chilli from producer to consumer in selected markets within the district and state;
vi) Analyze spread of price across the stakeholders in the value chain from primary producer to the consumer within the district and state;
vii) Provide a larger picture of trade by primarily interacting with producers, middle men, small traders, input suppliers, retailers and supporting organisation working to enhance the potential of sub-sector;
viii) Identify major bottlenecks and constraints in the Chilli value chain and ways to strengthen the chain with the aim of minimizing price volatility and improving productivity; and
ix) Recommend measures for the project to develop and sterngthen value chain of Chilli.

1.3 Area, Production and Productivity

1.3.1 Indian Scenario

While Chillies were introduced to India very late after they were discovered, the delay couldn't lessen this country's love for this so popular flavouring agent. Indians adopted Chillies ever since it was brought into the country and it became an integral part of the Indian culture. Till today many superstitions are related with Chillies and it is hanged up at the door with a few lemons as it is considered that this act will guard the house from the evil. Currently, Chillies are produced through the length and breadth of the country making the most dominating player in the world market. This crop is cultivated in almost all the states of the country, Andhra Pradesh being the leader of all. The varieties of Chilli produced by India are Sannam, LC 334, Byadgi, Wonder Hot, Jwala etc.

Chilli is cultivated in most of the states of the country for various uses e.g. green Chilli are used as vegetables but the commercial cultivation of red Chilli for drying purpose are being cultivated in some of the states.

Table 1 State wise area under Chilli (dry) crop in India (in '000 Ha)

Sl. No.	States	2013-14	2014-15	2015-16	2016-17	2017-18	State Share in 2017-18 (in %)	CAGR (in %)
1	Andhra Pradesh	131.32	134.96	156.06	209.35	209.35	27.85	12.37
2	Karnataka	89.56	88.97	95.45	102.29	127.60	16.98	9.25
3	Madhya Pradesh	54.41	72.13	72.13	85.00	90.98	12.10	13.71
4	Tamilnadu	50.67	41.40	81.60	126.00	73.78	9.82	9.85
5	Odisha	75.00	75.00	75.00	71.70	71.70	9.54	-1.12
6	Uttarakhand	2.00	2.00	65.12	65.12	65.12	8.66	138.88
7	Assam	18.92	21.01	21.41	21.63	21.70	2.89	3.49
8	Tripura	2.35	2.35	13.55	13.55	13.64	1.81	55.22
9	Gujarat	43.40	19.05	14.72	15.20	11.35	1.51	-28.49
10	Mizoram	9.02	9.14	9.14	9.24	11.20	1.49	5.56
11	Uttar Pradesh	13.77	13.28	9.00	9.00	9.00	1.20	-10.09
12	Punjab	10.60	10.60	12.32	11.13	8.06	1.07	-6.62
13	Manipur	6.50	6.50	6.50	6.50	6.50	0.86	0.00
14	Chhattisgarh	5.01	4.92	4.92	5.06	4.24	0.56	-4.09
15	Arunachal Pradesh	2.50	2.50	2.96	2.96	2.96	0.39	4.31
16	Telangana	78.94	73.27	2.35	2.35	2.77	0.37	-56.72
17	Rajasthan	6.72	9.67	44.37	44.18	2.53	0.34	-21.67
18	Maharashtra	99.50	99.50	99.50	17.32	2.34	0.31	-60.84
19	Meghalaya	2.01	2.01	2.25	2.32	2.32	0.31	3.65
20	Haryana	2.43	2.43	2.43	2.20	2.20	0.29	-2.46
21	Kerala	1.34	1.58	1.58	1.71	1.72	0.23	6.44
22	Bihar	2.90	2.90	2.90	1.60	1.51	0.20	-15.05
23	Himachal Pradesh	0.63	0.44	0.55	0.60	0.66	0.09	1.17
24	Jammu & Kashmir	0.56	0.56	0.62	0.62	0.62	0.08	2.58
25	Nagaland	0.80	0.80	6.81	5.58	0.18	0.02	-31.13
26	West Bengal	63.60	63.60	0.40	0.40	0.07	0.01	-81.79

Table 1 State wise area under Chilli (dry) crop in India (in '000 Ha)								
Sl. No.	**States**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**State Share in 2017-18 (in %)**	**CAGR (in %)**
27	Others	0.41	0.41	7.50	7.50	7.50	1.00	106.81
	India Total	**774.87**	**760.98**	**811.14**	**840.11**	**751.61**	**100.00**	**-0.76**
Source: Ministry of Agriculture, Govt. of India								

As per the available data, it is clear that top 10 Chilli producing states of the country is covering almost 93% of the area under this crop as evident from Table 1. Among all the states in the country, Odisha occupies 5th position in terms of quantum of area brought under Chilli cultivation, which is 9.54% of the total Chilli crop area in 2017-18 in India. Ironically, over the last five years, there is a net decline in the area under Chilli cultivation in Odisha. The Compounded Annual Growth Rate (CAGR) is -1.12, which means that there is a significant decline in the area under Chilli cultivation. Although there are 15 states in India having positive CAGR, overall at the country level the CAGR is -0.76 that shows a decline in the area at national level under cultivation of Chilli. There is a decline of 0.76% of average area under production of Chilli on year to year basis.

The Table 2 below depicts the picture of Chilli production in the country. The top 10 states in country contribute to around 97% of total production. Andhra Pradesh is the leading state both under covered area (27.85%) and production (46.20%).

Table 2 State-wise production of Chilli (dry) crop in India (in '000 MT)								
Sl. No.	**States**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**State Share (in %)**	**CAGR (in %)**
1	Andhra Pradesh	601.99	739.62	618.42	992.90	992.90	46.20	13.33
2	Telangana	279.78	253.26	3.70	3.70	340.80	15.86	5.06
3	Karnataka	111.55	114.15	118.49	103.24	260.14	12.10	23.58
4	Madhya Pradesh	93.57	132.44	132.44	135.53	244.55	11.38	27.15
5	West Bengal	100.00	100.00	0.64	0.63	100.34	4.67	0.08
6	Odisha	70.00	70.00	70.00	69.17	69.17	3.22	-0.30
7	Gujarat	68.53	33.30	26.91	25.32	22.07	1.03	-24.67
8	Assam	16.48	18.38	19.12	19.38	20.61	0.96	5.75
9	Punjab	17.70	17.70	18.22	18.78	14.08	0.66	-5.56
10	Rajasthan	11.28	12.81	19.55	21.48	13.34	0.62	4.28
11	Uttar Pradesh	11.11	10.95	7.20	7.20	12.58	0.59	3.16
12	Mizoram	8.21	9.33	9.33	9.33	10.92	0.51	7.39
13	Arunachal Pradesh	4.40	4.40	8.29	8.29	8.29	0.39	17.16
14	Uttarakhand	7.20	7.20	100.34	100.34	7.20	0.34	0.00
15	Tripura	3.70	3.70	10.26	10.26	6.31	0.29	14.28
16	Maharashtra	45.60	45.60	45.60	35.88	6.20	0.29	-39.28
17	Haryana	4.22	4.22	4.22	4.00	4.00	0.19	-1.33
18	Manipur	3.90	3.90	3.90	3.90	3.90	0.18	0.00
19	Bihar	3.00	3.00	3.00	2.05	2.73	0.13	-2.33
20	Meghalaya	1.56	1.56	2.08	2.24	2.35	0.11	10.79
21	Tamilnadu	23.06	11.29	227.61	461.00	1.90	0.09	-46.42
22	Kerala	1.29	1.49	1.49	1.60	1.62	0.08	5.86

Table 2 State-wise production of Chilli (dry) crop in India (in '000 MT)								
Sl. No.	**States**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**State Share (in %)**	**CAGR (in %)**
23	Chhattisgarh	1.65	4.40	4.40	4.32	1.50	0.07	-2.35
24	Nagaland	1.00	1.00	50.39	40.89	0.81	0.04	-5.13
25	Jammu & Kashmir	0.54	0.54	0.35	0.35	0.35	0.02	-10.27
26	Himachal Pradesh	0.20	0.15	0.36	0.24	0.24	0.01	4.66
27	Others	0.62	0.62	14.08	14.08	0.33	0.02	-14.59
	India Total	**1492.14**	**1605.01**	**1520.39**	**2096.1**	**2149.23**	**100.00**	**9.55**
Source: Ministry of Agriculture, Govt. of India								

It is evident from calculation of CAGR for production above that at country level there is an increase of 9.5% average production on year on year basis even though there is a steady decline in the areas brought under Chilli cultivation. In Odisha the production of Chilli is almost constant or rather it is slightly at a declining trend over the past five years with the CAGR at -0.30.

1.3.2 Scenario in Odisha State

Table 3 below presents the status of Chillies crop area, yield and production in the last 10 years in Odisha. It appears from the table that over the years the total area brought under Chilli cultivation in the state shows a declining trend (CAGR -0.64) whereas the production (CAGR 1.49) and productivity (CAGR 0.85) shows a steady increase.

Table 3 Status of Chilli production, productivity and area under Chilli (dry) production in Odisha			
Year	**Odisha**		
	Sum of Area ('000 Hec)	**Sum of Yield (Kg/Ha)**	**Sum of Production ('000mts)**
2009-10	75.53	852	64.32
2010-11	76.01	926	70.39
2011-12	77.10	960	74.03
2012-13	77.01	965	74.33
2013-14	76.71	969	74.37
2014-15	76.02	968	73.58
2015-16	71.69	956	68.57
2016-17	71.70	966	69.28
2017-18	71.72	967	69.37
2018-19	71.28	973	69.39
CAGR	**-0.64**	**1.49**	**0.85**

1.3.3 Scenario in the Project Intervention Districts

It is encouraging to note that over the years the area under Chilli cultivation has been steadily increasing in the project intervention districts namely Bargarh (CAGR 0.50) and Sambalpur (CAGR 1.51), though the total increase in the last 10 years is marginal (Table 4). Similar trend is observed in the total Chilli production and productivity in the Bargarh and Sambalpur districts. The increase in the total production and productivity in Sambalpur district (CAGR 5.18 and 3.62 respectively) is found to be higher than Bargarh district (CAGR 1.57 and 1.06 respectively).

Table 4	Status of Chilli production, productivity and area under Chilli (dry) production in project districts					
Year	Bargarh			Sambalpur		
	Sum of Area ('000 Hec)	Sum of Yield (Kg/Ha)	Sum of Production ('000mts)	Sum of Area ('000 Hec)	Sum of Yield (Kg/Ha)	Sum of Production ('000mts)
2009-10	2.42	880	2.13	4.23	879	3.72
2010-11	2.42	913	2.21	4.38	1240	5.43
2011-12	2.64	939	2.48	4.89	1258	6.15
2012-13	2.64	939	2.48	4.88	1240	6.05
2013-14	2.64	939	2.48	4.88	1240	6.05
2014-15	2.58	962	2.48	4.88	1240	6.05
2015-16	2.52	952	2.40	4.84	1211	5.86
2016-17	2.52	971	2.45	4.84	1210	5.86
2017-18	2.52	968	2.44	4.84	1213	5.87
2018-19	2.53	968	2.45	4.84	1211	5.86
CAGR	**0.50**	**1.06**	**1.57**	**1.51**	**3.62**	**5.18**

1.4 Study Methodology

The value chain analysis study was conducted applying qualitative research method. Qualitative data collection techniques like Focus Group Discussion (FGDs) and Key Informant Interviews (KIIs) were applied for collecting data from various key informants and stakeholders. In consultation with the Mahashakti Foundation, two sample clusters located within the project geographies (i.e. one cluster in Jamankira block of Sambalpur district and other one in Bhatli Block of Bargarh District) were selected and covered in the study for conducting the value chain analysis of Chilli. Six villages in two sample clusters (3 villages in each cluster) were visited. In each of the six villages, FGD with 10 to 15 farmers was conducted. Overall, 6 FGDs (3 each in Bhatli and Jamakira block) were conducted with the farmers in the project areas, who were either engaged in Chilli cultivation or had interest in cultivating Chilli crop.

Table 5	FGDs conducted with Chilli farmers in the project geographies			
District	**Block**	**Cluster Type**	**Village Name**	**No. of FGDs**
Bargarh	Bhatli	Chilli	Bichhuan	1
			Narangpur	1
			Jhikjhiki	1
Sambalpur	Jamankira	Chilli	Arjunpali	1
			Sarbejal	1

Table 5 FGDs conducted with Chilli farmers in the project geographies				
District	**Block**	**Cluster Type**	**Village Name**	**No. of FGDs**
			Kadalimunda	1
			Total	9

Apart from FGDs, the study conducted one-to-one interviews with other important stakeholders and key informants involved in Chilli production, value addition, and marketing of the product. Since Bamra Chilli is cultivated by the farmers in the project villages, the study team also interviewed farmers and key informants in Bamra and Kuchinda blocks (where large number of farmers are engaged in Chilli production) to get a deep understanding of the Chilli value-chain. The various stakeholders and key informants interviewed in the study include farmers, seed sellers, input wholesalers, traders, commission agents, and functionaries from Odisha Rural Development & Marketing Society (ORMAS), Department of Horticulture, Tribal Development Cooperative Corporation (TDCC), and Producer Companies based in both inside and outside the project blocks. In total, 15 KIIs were conducted to get a detailed information for value chain analysis of Chilli.

Table 6 In-depth Interviews conducted with key-informants and stakeholders			
District	**Sl. No.**	**Study Participants**	**No. of KIIs**
Baragarh	1	Deputy CEO, ORMAS	1
	2	Asst. Director of Horticulture	1
	3	CEO, Chirasabuja Producers Company Ltd, Bijepur	1
	4	Fertilizer Wholesaler	1
	5	Pesticides Wholesaler	1
	6	Seed Wholesaler	1
	7	Chilli Commission Agent, Barihapali, Padampur	1
	8	Chilli Commission Agent, Barihapali	1
	9	Petty Seed Seller, Urduna (interviewed at Bichhuan weekly Haat)	1
	10	Chilli Trader, Rengali, Bijepur	1
	11	Chilli Commission Agent, Piplipali, Sohela	1
Sambalpur	12	Deputy Director of Horticulture, Sambalpur	1
	13	Branch Manager, TDCC	1
	14	Chilli Farmer, Belmunda, Bamra Block	1
	15	Chilli Trader, Kuchinda	1
		Total	**15**

1.5 Crop Varieties and Methods of Chilli Cultivation

Chilli cultivated in the project areas are of both hybrid and native varieties with high levels of pungency and high demand in the market. A hybrid variety is simply a cross between two different varieties. There are many hybrid varieties of Chilli, which were successfully introduced and are now being cultivated on a large scale for commercial use. The farmers of Jamankira block in Sambalpur district give priority to cultivating a local variety called 'Bamra Chilli' and Ankur 2239 which are sold in dry form whereas the farmers in Bhatli block in Bargarh district prefer to cultivate Krishna, 151, 305, Apsara, and Bullet for high yield. The farmers in Bhatli block mostly sell Chilli in its raw form or without drying them.

1.5.1 Bamra Chilli: Production Process & Methods (Package of Practices - PoPs)

Bamra Chilli belongs to the genus Capsicum under Solanaceae family, and Species Capsicum annum. Bamra Chilli derives its name from the princely state of Bamra or Bamanda in which it is was first introduced during the reign of King Sudhaldev of Bamanda (1868-1903), a horticulture enthusiast. Since then, it is being cultivated by the local indigenous farmers as a cash crop by means of traditional and organic farming methods in present-day regions of Bamra, Kuchinda and Jamankira.

Bamra Chilli is cultivated in the Rabi season. The Chilli plant is herbaceous or semi-woody with an average height of 70-80 cm. The leaves are thin and green in colour. White medium-size flowers are borne solitary or in cluster in the axils of the leaves. Each plant bears 400-500 flowers and yields 250- 300 fruits per season. The fruits are 5-7 cm long and have an average diameter of 1cm. The fruits are of thin skin. The Chilli is most particularly known for its pungency (average pungency ~45,000 SHU).

The production of Bamra Chilli remains geographically confined to the Bamra, Kuchinda and Jamankira blocks of the Kuchinda subdivision of the Sambalpur district in Odisha. Bamra was a part of the erstwhile Bamanda Feudatory state and it is presently a block of the Sambalpur District. In Jamnakira block, Bamra Chilli is cultivated in the villages namely Sirid, Bhojpur, Sarda, Gundruchuan, Tikilipada, and Katarkela.

- Bamra Chilli is known specifically for its pungency. It is hot and spicy with average pungency of around 45,000 SHU.
- The Capsaicin content is about 0.28%.
- The Chilli has a thin outer covering and higher number of seeds.
- The Chilli is deep brown in colour with ASTA colour value of around 40. Because of thin outer cover and higher number of seeds, the processed Chilli powder loses its red clour and it becomes deep brownish colour.
- Chilli powder made from this variety of Chilli has higher shelf life. It can be stored for longer duration as it does not attract insects, pests.
- It is traditionally grown organically by the local tribal farmers, though some large-scale farmers are now

also using fertilizers to realize higher yields.
- The Chilli finds use in medicinal purposes for the treatment of bronchitis, cough and cold.

1.5.1.1 Seed Collection

The seeds of Bamra Chilli are not available in the market. The seeds are collected from the previous Chilli crop. Mostly the red, ripe and mature fruits are chosen by the farmers for the collection of seeds. The fruits are broken manually by hand or placed in bags and beaten in order to separate the seeds.

1.5.1.2 Land Preparation

Sandy loam and clay loam soil are the most suitable soils for the cultivation of the Chilli which is readily available in Jamankira Block. Proper drainage is required for cultivation as standing water/ water logging damages the crop. The land is prepared by ploughing 2-3 times (bullock cart drawn plough) and clod crushing after each ploughing. Cow dung/ goat compost @10-15 cart loads is applied during the land preparation. Goat compost is preferred for Bamra Chilli cultivation as is it is said to promote flowering and fruiting along with increasing the pungency of the Chillies. Neem and Karanj by-product are applied to the soil to protect the crops from wild ants and other soil pests.

Seed rate: 400 g/acre
Spacing: 60 cm X 60 cm for flooding irrigation that can accommodate 10,000 seedling/ acre
75 cm X 75 cm for drip irrigation that can accommodate 7000 seedlings/acre

1.5.1.3 Sowing

Normally the seeds are sown in the nursery beds in months during the period from August to September. For raising seedlings, the nursery beds (5m x 1.5m) are prepared with the application of cow dung/ goat compost with neem and Karanja leaf. The seeds are sown line by line and after sowing the beds are covered with paddy straw for better retention of moisture to facilitate germination. Simultaneously watering is done by rose cane.

1.5.1.4 Transplanting

Transplanting is done 40-45 days after sowing of the seeds during the period from September to October. For transplantation, 6-8 weeks old or 15-20 cm height seedlings are selected. Intensive care is taken to prevent root injury during uprooting of seedlings. The transplanting is done at evening hours. During transplanting time 50 kg DAP & 15 kg MOP is applied per acre followed by irrigation.

1.5.1.5 Irrigation

Controlling the quantum of water provided to the crops is the key variable for successful cultivation of Bamra Chilli. Both deficient and excess water are harmful for the crop. For this purpose, proper drainage is provided during land preparation to prevent standing water from damaging the crop. Ridge and furrow method of irrigation is followed. As the Chilli plant can't withstand heavy moisture, so irrigation is provided when it is highly required. Heavy irrigation causes lanky, vegetative growth and flower drop. Flowering and fruit development are most critical stages of water requirement. Stagnation of water should not be allowed in nursery and field as it causes fungal infection.

1.5.1.6 Flowering and Fruiting

Mostly Bamra Chilli bears hermaphrodite white colour flowers. The flowers are borne solitary or in cluster in the axils of the leaves. Sepals and petals are usually five in number, stamens are five in general, sometimes six. The stigma is clubbed shaped, and the ovary is superior with 2 to 4 or more locules. Flowering begins 45 days after transplanting and fruiting commences 15 days after flowering.

1.5.1.7 Manuring and Fertilizers

Application of Nitrogen@25kg in form of Urea@55kg/acre, Phosphorus@12kg in form of Single Super Phosphate@75kg and Potash@12kg in form of MOP@20kg/acre are recommended. Half dose of Nitrogen and full dose of Phosphorus and Potash at time of transplanting. Remaining amount of nitrogen and CAN @ 10 Kg per acre is applied after 40-45 after transplanting.

N:P:K- 19:19:19 @ 2 g/ litre of water can be used as foliar spray at fortnight interval. Micronutrient mix can also be used to increase the qualitative and quantitative parameters.

Liquid manures can be used consisting of freh cow dung, neem leaf, pongamia leaf, calotropis leaf, urea decomposed for 5-7 days in earthen pot covered by the lid. After 7 days, the decant is diluted by 5-7 times and then applied in the root zone at every fortnight interval.

Growth regulators: To control flower drop and to get good quality fruit, NAA (naphthalene acetic acid)@4ml/15 ltr of water at flower initiation stage is applied. To increase fruit set having good quality Triacontanol growth regulator at 1.25ml/Ltr sprayed on 20,40,60 and 80th day of transplanting.

1.5.1.8 Weeding

Manual weeding is generally used to remove the weeds from the fields by means of axe and khurpi.

1.5.1.9 Pests and their Control

a) **Fruit borer**: Caterpillar eat leaves of the crop and afterwards it enter into fruit and cause heavy loss in yield management.
   i) Pheromone traps for Helicoverpa armigera or Spodoptera litura at 5 nos./acre.
   ii) Six release of Trichogramma chilonis @ 50,000/ha per week coinciding with flowering time.
   iii) Spray Ha NPV/ Spodo NPV at 1.5x 1012 POB (Polyhedral Occlusion Body)/ha alongwith cotton seed oil300 g/ha to kill larvae
   iv) To manage pod borer poison bait balls made up of bran- 12.5 kg, Carbaryl-1.25kg, Jaggery- 1.25 kg and water- 7.5 lit/ha are applied (TNAU,2016).
   v) If infestation of fruit borers is observed. Chlorpyriphos + Cypermethrin (Nurel-D/Amla) @30 ml+Teepol @0.5 ml is sprayed in 12 Ltr of water with power sprayer.
   vi) Emamectin benzoate 5% SG @4 gm/10 Litre of water or Flubendiamide 20 WDG@6 gm/10 litre of water is sprayed to manage the pest

b) **Green Peach Aphid (Myzus persicae)**: They attack mostly in winter season and later stage of crop. They suck sap from the leaf. They excrete honey like substance and develop sooty mould blackish colour fungus on the calyx and pods thus deteriorate quality of product. Aphids also work as important insect vectors for Chilli mosaic. Mosaic disease transmitted by aphids cause 20-30 percent loss in yield.
   i) To manage, Acephate 75 SP @5gm/Ltr or Methyl demeton 25EC@2ml/Ltr is sprayed. Soil application of granular insecticides viz Carbofuran, Phorate@4-8kg/acre on 30 and 60 days after transplanting were also effective.

c) **Chilli Thrips (Scirtothrips dorsalis)**: The infested leaves develop crinkles and curl upwards. Further the symptoms are- elongated petioles, buds become brittle and drop down. Early stage infestation leads to stunted growth, and flower production and fruit set arrest.
   i) Growing of maize as border crop
   ii) Avoid Chilli and onion mixed cropping
   iii) Seed treatment with imidacloprid 70%Ws @ 12g/kg seed.
   iv) To check severity of thrips incidence, keep blue sticky traps @6-8 per acre.
   v) Also to reduce the incidence spray Verticillium lecanii @5gm/Ltr water.
   vi) 3 nos Spray Neem oil@ 40-50 ml + Imidacloprid@ 3ml in 10 litre of water in 15 days interval.
   vii) Spray neem oil@ 5ml/litre at weekly interval in nursery as well as in main field.
   viii) If incidence of thrips is more, then of Imidacloprid or Fipronil@1ml/Ltris sprayed with water or Fipronil 80%WP@2.5ml/Ltr of water or Acephate 75% WP@1.0gm/Ltr or do drenching of Thiamethoxam 25% WG@1.0gm/Ltr of water.

d) **Chilli mite (Polyphagotarsonemus latus)**: the damaging symptoms are characterized by downward curling and crinkling of leaves. Leaves with elongated petiole and stunted growth of plant
   i) Apply phorate 10% SG @ 10 kg/ha.
   ii) Spray Diafenthiuron 50% WP @ 8 g/10 lit water.

1.5.1.10 Diseases and their Control

a) **Powdery Mildew**: Patchy, White powdery growth appears on lower side of leaves. With corresponding chlorotic patches on the upper surface of leaves. The whitish powdery growth are the conidiophores of the fungus- Leveillula taurica which parasitize the plant by withdrawing nutrients from the plant. It commonly occurs on older leaves just before or at fruit set. But it can develop at any stage of crop development. In severe infestation it causes defoliation.
   i) For control, avoid water logging condition in the field. Keep field clean.
   ii) 2 Spraying of wettable sulphur @ 2.5 g/lit. at 10 days interval can manage the disease.
   iii) 2 Foliar spray of AQ-10 (Ampelomyces quisqualis) @ 10-20gm/ litre at 10 days interval

b) **Damping** off (Pythium aphanidermatum)and Seedling blight (Phytophthora spp.):
   i) Moist and poorly drain soil causes damping off disease. It is soil borne disease. Water soaking and shrivelling of stem occurs. Seedlings killed before emergence. If it appears in nursery the entire lot of seedlings may get destroyed.

ii) To manage wilt, drench nearby soil with Copper oxychloride@ 3 g/litre of water as profilatic/preventive measure
iii) Soil application of (T. viride + P. fluorescens + FYM): Mix Trichoderma viride @ 2.5 kg + Pseudomonas fluorescens @ 2.5 kg in 10 kg FYM and store it under shade for 10-15 days in moist condition. After 10-15 days when the bioagents multiplied itself, mix it with requisite FYM to be applied in the main field and and apply it to soil during transplanting.
iv) Soil drenching with Metalaxyl + mancozeb @ 2.5 g/ litre in nursery as curative measure.

c) **Anthracnose**: It is caused by the fungi Colletotrichum piperatum and C.capsici and is promoted by warm temperatures and high moisture. It is characterised by black spots that are formed on infected parts. Spots are usually circular, water-soaked and sunken with black margins. The fruits with many spots drop off prematurely resulting in heavy loss of yield. If infestation of Anthracnose is observed then spraying with Propiconazole or Hexaconazole @1ml/ltr of water should be done.

d) **Fusarium** Wilt (Fusarium oxysporum f.sp. capsici): It is characterized by wilting of the plant and upward and inward rolling of the leaves. The leaf droops and dries up. Vascular discolouration symptoms are observed when the lower stem and root of the plants are examined.
i) Seed treatment with carbendazim@ 1.5g/kg seed reduces the initiation of the disease
ii) Seed treatment with Trichoderma viride @ 5 g/kg seed is an organic method of disease management.
iii) Seedling root dip with Trichoderma viride or T. harzianum @ 5 g/litre of water for 30 minute .
iv) Seed treatment with Pseudomonas fluorescens @ 10 g/kg seed.
v) Seedling root dip with P. fluorescens @ 10 g/litre water for 30 minute, enhances the disease resistance ability in plants by inducing ISR (Induced Systemic Resistance).
vi) To manage the disease, soil drenching with Bordeaux mixture @ 1% or Vitavax power@ 2 g/litre of water.

e) **Cercospora leaf spot (Cercospora capsici)**: It is characterized by typical cicular lesion or spot with greyish centre with brown coloured margin. The spots coalaces and produced blighted leaf surface that destroy the photosynthetic area of leaves.
i) To manage the disease, spray of mancozeb + carbendazim@ 2 g/litre followed by Chlorothalonil @ 2g/litre at 10-15 days interval.

1.5.1.11 Harvesting

Flowering occurs at 50-55 days after transplanting. Kuchinda Chill is g enerally harvested in two stages green or red & ripe stage depending up on the purpose of consumption and market demand. For local market it is harvested in green stage (60 DAT i.e. first pick) and dry Chilli harvested when fruits are of red in colour (70-75 DAT i.e. first pick). Chilli use for drying purpose is harvested at full ripe stage. Usually for dry Chilli three pickings are done, each at 70-75 DAT. After first picking fertigation is provided so that new flushes comes and is ready for second picking and so also for third picking. But for green Chilli, two pickings done per month. So, in total eight pickings are done throughout the crop season.

1.5.1.12 Yield

The yield of Kuchinda Chill is approx. 10-12 quintals (Dry) per acre.

1.5.1.13 Drying and Storage

For dry Chilli purpose the fruits are harvested at fully red and ripe stage during Jan-Feb. The harvestedChillies are dried for 4-5 days under the Sun. Farmers can also dry the Chilli with the help of Solar drier.

1.5.2 Other Varieties of Chilli: Production Process & Methods (Package of Practices - PoPs)

Chilli is a profitable and a regularly used spice. This adds taste and color to the food. Our country India is first in its cultivation, production, use and export all over the world. It has many medicinal properties.

1.5.2.1 Climate

In our statemid weather during its growth period and dry climate during the harvesting period. The Chilli cultivation is done up to 2,000 meters from the sea level. Above 20-22 degree Celsius the plant grows well.

1.5.2.2 Soil

In well drained, loamy, fertile soil with pH level 6-7 is usually good for the Chilli cultivation. In acidic soil, Gypsum (100 kg/acre) needs to be added 1 month before the plantation.

1.5.2.3 Variety

i) **Improved Varieties**: Pusa Jwala, Pusa Sadabahar, Suryamukhi, Sinduri, KA1,Utkal Abha, Arka Lohit, Pant C1, Pant C1.

ii) **Hybrid Varieties**: HCH 9646, Kanti, Sindura, Sujata, Surya, Jyoti, Tejaswini, Agnirekha, Roshni.

iii) **Wilt Resistant Varieties**: Utkal Abha, Utkal Rashmi.

1.5.2.4 Seed

For 1 acre of land, about 400-600 grams (Hybrid seeds 80 to 100g) of seeds are required. Seed treatment should done with Carbendazim (Bavistin 1g) of and Thiram (2g) for one kg of seeds, 6 hours before sowing. These fungicides should be mixed with 1 litre of water and seeds to be soaked in it for 2 to 6 hours for early germination.

1.5.2.5 Sowing and Nursery Development

Seeds should be sown 4 to 5 weeks before transplant. About 40 m² nursery area is required for transplantation in 1 acre field. The land should be ploughed 15 days prior to transplantation. A nursery bed of size 3m long, 2m wide and 15-20cm height should be prepared. Compost - 5 kg, NPK- 15:15:15 50g and Chloropyriphos 100g per metre square should be mixed 7 days before the soil. Root rot can be avoided by applying organic fungicides (Sanjeevani) 10g per metre square or Thiram mixture (3g per litre and 5 litres per metre square) two days before planting. The straw should be removed immediately after germination from the bed area within 6-10 days. Weeding should be done in between and irrigation should be stopped 7 days before transplanting for hardening of seedlings. Urea (10g per litre) and mixed micronutrients (3g per litre) should be sprayed for growth of seedlings. Fifteen days before transplanting, Carbofuran (furadon 50g per metre square) should be applied.

1.5.2.6 Transplanting

Field should be ploughed 4 to 5 times and then planking should be done. At the time of last ploughing, 8 to 10 tons of dry cow dung manure or compost should be mixed per acre and bed should be prepared. Seedlings of 4 to 6 weeks should be uprooted and the root portion should be dipped in one litre of water with Copper Oxychloride 50% WP (2.5g), Plantomycin (1.5g) and Carbofuran 3% G (Furadon 4g) mixture for 30 minutes and transplanted in the afternoon according to the variety with row to row distance 30 to 90cm and plant to plant distance 30 to 35cm. This helps in preventing wilting disease. After transplanting urea, single super phosphate and muriate of potash (2:1:1 g per litre) should be mixed in water and applied 300ml per sapling for healthy growth.

Fertilizer	At transplanting	After 20-30 days	After 50-60 days
Nitrogen	25-30	10-12	10-12
Phosphorus	20	--	__
Potassium	40	--	__

1.5.2.7 Fertilizer

Fertilizer should be applied per acre in the following manner. After the 3rd Nitrogen application, 10 to 12kg more Nitrogen should be sprayed at 15 days interval 3 to 4 times (10g Urea per litre). In acidic soil, to increase the weight and heat of the Chilli, Sulphur and Zinc EDTA (250 g per acre) for colour should be used. Single Super Phosphate should be used for Phosphatic fertilizer.

1.5.2.8 After Care

New plants to be planted in the empty part of the soil within 10 days of transplanting. Weeding should be done at the time of fertilizer application. Irrigation should be done in the field at 7 to 10 days interval. Chemical herbicide Pendimethalin (Stomp 2 litre per acre) should be applied in soil at 25 days interval to control the weed infestation. Mulching is beneficial. Raddish should be grown as intercrop with Chilli.

1.5.2.9 Hormone

NAA (Planofix) 200 mg per litre should be applied at the time of flowering and then 2 times at 30 days interval should be applied for better quality of harvest.

1.5.2.10 Insect pest management-

i) **Damping off disease**: In nursery, at the soil level, the stem of the plants turns grey-black colour and tilt downward and rots.
Remedy: the nursery should be changed every year. Seed treatment should be followed. Mancozeb (Dithane M45 3g per litre) or Carbendazim Mancozeb (saaf 2g per litre) should be sprayed over the plant and soil.

ii) **Fruit rot and leaf spot**: The leaves and fruits bear red-violet dark spots with a yellow ring around. The fruit rots and drops eventually.
Remedy: Seed treatment should be done. Copper Oxychloride (blitox-50 3g per litre) or Metalaxyl - Mancozeb (Ridomil 2.5g per litre) should be sprayed at 8-10 days interval.

iii) **Die back and anthracnose**: The branches droop and dry. Dark spots with pink dots are found on the branches and fruits. The plant becomes leafless.
Remedy: Disease free seeds should be sown. Other remedies should be done like in case of fruit rot disease.

iv) **Leaf curl disease**: The leaves wrinkle, becomes small and turn yellow in colour. This disease incidence increases in cold weather.
Remedy: Same as in case of fruit rot. Tolerant varieties like Pant c-1, Pant c-2 should be used.

v) **Chilli tripes**: The leaf develops crinkle and curls either upward or downward and turns light colour. The veins enlarges. Scale insects are seen below the leaves.
Remedy: New nursery and field should be chosen for cultivation. Well decomposed compost should be used. Seed treatment and seedlings treatment should be done. Irrigation should be limited. The wilted plants should be uprooted along with the soil and burnt and a ring should be created around it. After 15 days of transplanting apply 10kg Furadon or 6kg Caldan powder per acre. Ten days after transplanting, mix Copper Oxychloride (2.5g) + Streptocyclin (0.1g) or Casugamycin (Kasubi 2ml) in one litre of water and apply at 15 days interval to the plant base 2 to 3 times. Plant marigold in between. Tolerant varieties like Utkal Abha, Utkal Rashmi should be used.

vi) **Powdery mildew**: There is white powdery growth on the upper and lower side of leaf.
Remedy: Apply Wettable Sulphur (Sulfex 5g per litre).

vii) **Wilt complex**: At the time of flowering and fruiting, the lower leaves turn yellow and drop and the plant wilts. The stem at soil level rots and fugus growth is seen. The roots also rot. This may be caused due to fungus, bacteria or nematodes. In case of nematodes wilt, galls are observed in the roots.
Remedy: New area for nursery and field should be chosen. Well decomposed compost should be used. Seed treatment and seedlings treatment should be done. Irrigation should be limited. The wilted plants should be uprooted along with the soil and burnt and a ring should be created around it. After 15 days of transplanting apply 10kg Furadon or 6kg Caldan powder per acre. Ten days after transplanting, mix Copper Oxychloride (2.5g) + Streptocyclin (0.1g) or Casugamycin (Kasubi 2ml) in one litre of water and apply at 15 days interval to

the plant base 2 to 3 times. Plant marigold in between. Tolerant varieties like Utkal Abha, Utkal Rashmi should be used.

viii) **Aphids**: Small, green-black coloured insects such sap from plant near tender twigs, fruit, flower, etc. The leaf edge turns downward.
Remedy: Dimethoate or Methyl Demeton (Metalaxyl 2ml per litre) or neem based insecticides (Nimazil 2ml per litre) should be sprayed 3 to 4 times at 10 days interval.

ix) **Mealybugs**: White coloured small insects are found below the leaves and suck the sap by scrapping. The leaf folds downwards.
Remedy: Dicofol (2ml per litre) or Wettable sulphur (sulfex 2g per litre) should be applied.

x) **Yellow mite**: It is a lice like insect with serrated wings and it sucks sap from the leaves and fruits. The leaves fold upwards. Leaves and fruits curves.
Remedy: Dimethoate or Methyl Demeton (metalaxyl 2ml per litre) or neem based insecticides (nimazil 2ml per litre) should be sprayed 3-4 times at 10 days interval.

xi) **Fruit sucking insects**: Smooth, green coloured caterpillar are found in fruits and flowers and cut holes in it. Half of their body remains outside fruit while eating.
Remedy: Plant 40 days old tall yellow variety of marigold in line and 25 days old tomato at a same time. Apply Endosulfan (2ml per litre) or neem based insecticides (NSKE 50ml per litre) at 28 and 35 days after transplanting. If insect is observed at fruiting stage, spray malathion (2ml per litre). Heliothis NPV (Helicide 2ml per litre of water) is sprayed on crops.

xii) **Whitefly**: Light yellow colour small insects and scale like caterpillars are found sucking on the tender twigs and yeh plants turns yellow.
Remedy: Endosulfan (2ml per litre) or Triazophos (tarzon 2ml per litre) should be sprayed 2 times at 10 days interval.

1.5.2.11 Harvest

Green Chillies are harvested 2 months after flowering. Red Chilli should be harvested at 1 to 2 weeks interval. After harvesting, like colors are obtained when kept in shade for 2 to 4 days. Afterwards, they are dried for 3 to 4 days under sunlight to evaporate 10% water vapour. After that they are packed into sacks and kept in dry place with distance from the walls. Generally, 40-50 quintal of green Chillies or 12 to 18 quintal dry Chilli can be harvested from one acre of land.

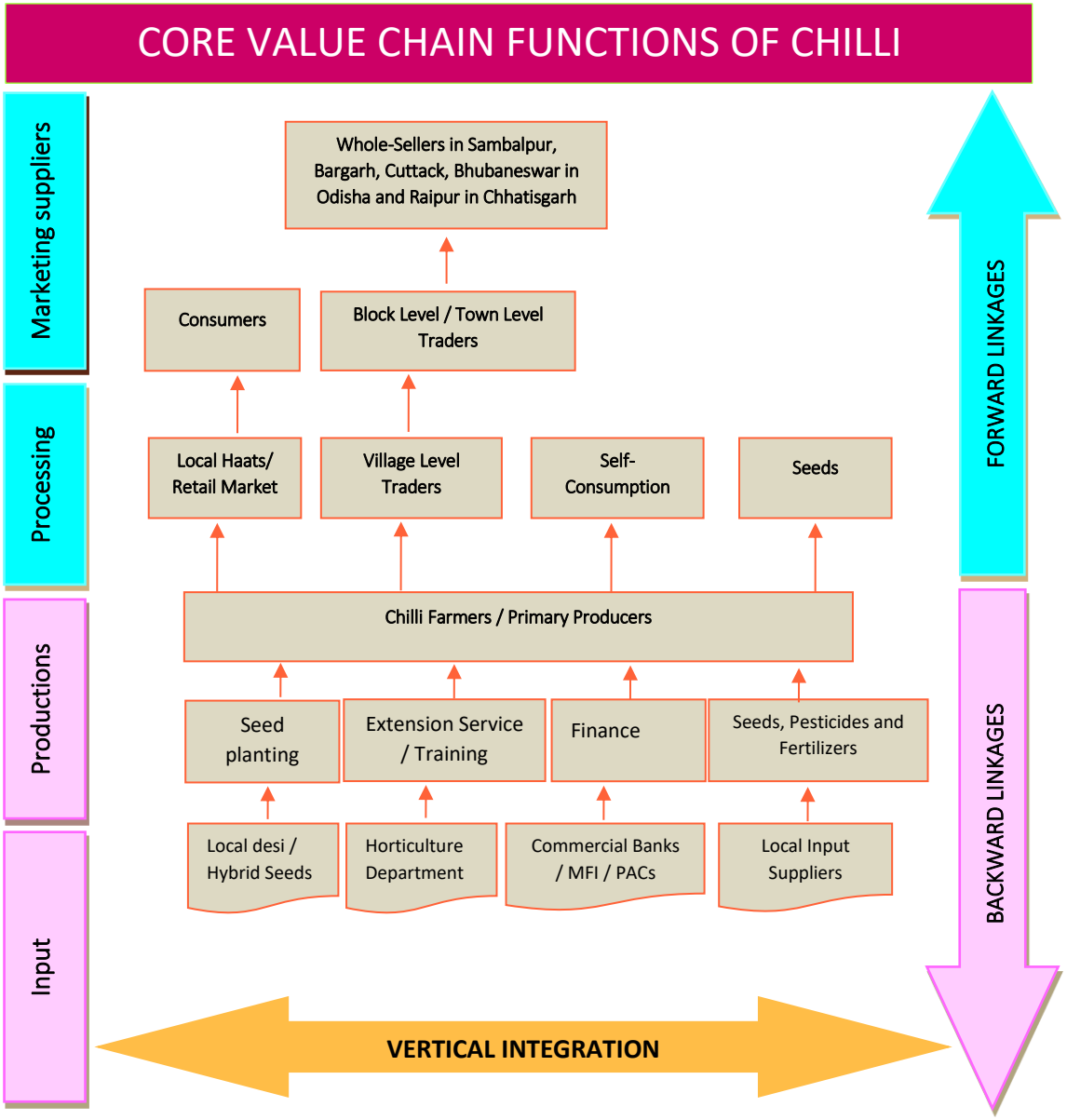
1.6 The Chilli Market System

Chilli marketing, storage, branding, product diversification and processing have remained an area of concern in the study Blocks. The production has been low as majority of the farmers are giving priority on paddy as well as other vegetable cultivation. The farmers are in an under motivated kind of situation, but they are willing to come forward and take Chilli cultivation as they had been doing it in small scale over last so many years.

1.6.1 Core Value Chain Functions

The major functions involved in Chilli sub-sector are input supply, production, and local processing at the farmers level; storage, domestic trading, and tapping international market at traders' level; and processing and manufacturing for value addition at the processors level. In a value chain, the actors include value chain operators and operational service providers together. Those functionaries who are directly involved in transactions or directly support the actors involved in transactions are the value chain actors.

The core structure of value chain for Chilli is presented as below:



1.6.2 Input Suppliers

Farmers in Bhatli block in Bargarh district prefer to cultivate Krishna, 151, 305, Apsara, and Bullet for high yield. But farmers of Jamankira block give priority to and cultivate a local variety called “Bamra Chilli” and Ankur (2239) which are sold in dry form. The Chilli is highly pungent with strong taste and high heat. Farmers collect and keep the seeds for next crop which is cheaper than the hybrid one. Farmers are converting their produce into dry form and selling them in market. However, farmers do not process dry Chilli into powder form.

The farmers in the project areas procure the inputs like seeds, fertilisers and pesticides from their village itself or from the nearby area. In Bhatli block, the farmers purchase seeds from their nearby block and GP level sellers. The farmers who require more quantity of seeds, buy seed from shops located at district headquarter. The farmers, who are doing Chilli cultivation in small scale, buy seeds from the local weekly Haat. The farmers of both Bhatli and Jamakira blocks use Hybrid Chilli seeds for better yield. But it is observed in Jamankira Block that some farmers preserve and use the local variety of seeds called “Bamra Chilli’. In both the blocks, majority of the farmers procure fertilisers and pesticides from the local suppliers on credit and repay after harvesting of the produce. During the interaction with the farmers, the study found that the small and marginal farmers do not get technical support from the Govt. Agriculture and Horticulture departments as the extension services from the Govt. departments are not intensive.

As compared to Sambalpur district, the study found that there are many input suppliers at the district, block and village level due to high agricultural potential in Bargarh district. Farmers are mainly dependent on these input suppliers for procurement of seeds, fertilizers and pesticides. A list of input suppliers collected by the study team in Bargarh and Sambalpur districts is presented in the table below.

Table 7 Local Input Suppliers at Bargarh and Sambalpur District Headquarter

Sl. No.	Bargarh district		Sambalpur District	
	Agency Name	Deals In	Agency Name	Deals In
1	Bhulaxmi Seeds	Seeds only	Kanakalaxmi Store	Pesticides only
2	Susivita Trading	Seeds, Fertilizers	Indian Enterprises	Seeds, Fertilizers and Pesticides
3	Prakash Store	Seeds only	Nanda seeds	Seeds only

Table 7 Local Input Suppliers at Bargarh and Sambalpur District Headquarter				
Sl. No.	Bargarh district		Sambalpur District	
	Agency Name	Deals In	Agency Name	Deals In
4	Sairam Fertilizers and Pesticides	Pesticides and Fertilizers	Padmalaya Store	Seeds, Fertilizers and Pesticides
5	Venketeswar Agency	Seeds and Fertilizers	Krushi Seva Kendra	Seeds, Fertilizers and Pesticides
6	Sairam Traders	Seeds and Fertilizers	Mahakul Fertilizers	Fertilizers and Pesticides
7	Jatin Fertilizers	Fertilizers and Pesticides	Bijay Store	Seeds only
8	Choudhary Fertilizers	Seeds, Fertilizers and Pesticides	Arun Traders	Fertilizers and Pesticides
9	Suriya Pesticides and Fertilizers	Pesticides and Fertilizers	Anima Seeds	Seeds only
10	Maheswari Seeds and Fertilizers	Seeds and Fertilizers	Poonam Seed Store	Seeds only
11	Dash Enterprises	Seeds, Fertilizers and Pesticides	Subham fertilizers and Pesticides	Fertilizers and Pesticides
12	Janasahayak	Seeds, Fertilizers and Pesticides		
13	Indian Seeds Sales Center	Seeds, Fertilizers and Pesticides		

1.6.3 Productions from the Market Perspective

The producers in the value chain have a special place as the actual movement of the products starts from the primary producers who produce Chilli in their respective land. Although the percentage of labour and hard work of primary producer is more compared to other stakeholders, they are getting less margins among the others. In the entire value chain, the role of the primary producers is only restricted till production.

Low productivity: Although both Sambalpur and Bargarh districts are in good position in terms of national average productivity due to natural advantage of suitable agro climatic, the yield variation is very high across the different locations of production. This is stemming from the traditional variety of seeds and old production techniques followed by the farmers in both the study blocks.

Cultivation practices: Chilli farming in Jamankira and Bhatli is predominantly traditional, rain fed and cultivated in upland with conventional practices. This results in high per unit cost of production and low returns. Over and above, very few farmers have their own borewells for irrigation in Bhatli block, which adversely affects their production. Although there are improvements suggested by concerned department in cultivation practices, use of seeds and plant protection measures, farmers in region are slow to adopt these measures.

Practice on post-harvest handling: In order to make Chilli competitive, post-harvest handling practices like drying, sorting, grading, and storage are prerequisites and can be done with little improvement in skills of primary producers. Even though these activities are simple and executable at farmers' level, these practices are lacking in both the study Blocks in Bargarh and Sambalpur district. Moreover, there is no storage facility in region and this deprives them from taking up even primary value addition.

Collective marketing practices and low bargaining power: Collective bargaining increases the power of producers during procurement of inputs as well as when selling the goods. It also helps to increase the volume of Chilli during

each transaction and decreases the transaction and transportation costs. However, the farmers sell their Chilli individually in the absence of formal and informal groups. Apart from that, farmers are devoid of reliable and timely market information. As such, they are losing the bargaining power with their respective buyers.

1.6.4 Primary Processing and Storage

Lack of drying and storage facility: Farmers prefer to cultivate Krishna, 151, 305 (VNR), Apsara, Ankur (2239) and Bullet varieties of hybrid seeds for high yield where as few farmers of Jamankira block give priority to cultivate local variety called "Bamra Chilli". As mentioned before, the farmers in Bhatli block sell fresh Chilli whereas the Bamra Chilli cultivated by the farmers in Jamakira block is dried and sold in the market. From the market perspective, the quality of Bamra Chilli the farmers are cultivating in Jamankira block are considered superior, and is highly pungent with strong taste and high heat but due to lack of drying facilities, Chilli lose the specific smell and colour. Green Chilli is a perishable produce but there is no cold storage in Bhatli block to support the farmers to store their harvest to save themselves from distress sale and emergencies.

Non availability of processing technology: Dry Chilli is the major processed product made out of fresh Chilli. Chilli during drying gets exposed to dirt, insects and pollutants, which reduces the quality. The farmers require concrete drying yards and solar dryers. The Government Department should support the farmers to add value through primary processing machinery to be made available at cluster level in production intensive regions of the districts. Other products like higher level of processing into sauce to enhance value of products are worth exploring and investment.

1.6.5 Marketing

The farmers in the Bhatli region sell green Chilli whereras the farmers in Jamankira block sell both dry and wet red Chilli to village level traders. After procurement of wet red Chilli the village level traders then dry it and sell to the intermediate traders. The intermediate traders then sell the lot to regional wholesaler. From the intermediate traders, part of the dry Chilli goes to the processors. The processors then process, pack, brand and sales it to the wholesalers then to retailers and finally it comes to the consumers.

As mentioned before, the farmers in Bhatli block prefer to cultivate VNR 377 (Krishna), 151, and Bullet for high yield. Krishna and 151 Chillies are mostly preferred by the traders of outside markets because these varieties are suitable for long distance transportation. Everyday these varieties of Chilli are sent to Rourkela, Bhadrak, Cuttack, Bhubaneswar, Berhampur, Aska, Nayagarh, Kalapathar inside the state and Simdega in Jharkhand.

But farmers of Jamankira block give priority to a local variety called "Bamra Chilli" which is sold in dry form. This variety of Chilli has high demand in local market as well as outside the state due its pungency. Deputy Director of Horticulture, Sambalpur said the Bamra Chilli has high demand in the market. The Chilli is highly pungent with strong taste and high heat. Farmers collect and keep the seed for the next crop which is cheaper than the hybrid one. Siam Hot (Monsonto Holding Pvt. Ltd.), NBH-Apsara (Noble Seeds, Sonipat, Haryana) and SPS-302 (I & B Seeds Pvt. Ltd, Bengaluru) are popular hybrid varieties which are very good in productivity are cultivated by the farmers and sold in dry form. Farmers are converting their produce into dry form and selling them in market. However, the farmers do not process dry Chilli into powder form. Major markets for the product are Kuchinda, Jharsuguda, Rourkela, Sambalpur, Raipur and Bilaspur in Chhatisgarh and Ranchi and Tata Nagar in Jharkhand.

Village hat is a main platform for the local farmers to sell their produce. Farmers sell their produce to the consumers as well as hat level/daily market shopkeepers. After fulfilling their consumption requirement, the surplus produce is sold in the village Hat. also purchase produce from the farmers while keeping margin targeting local market price.

Village Level Traders and Local Traders: The village level /local traders have contact and rapport with the farmers. They assess the volume of production, producer, and quality of production during different times of the season. They negotiate separately with the farmers and after negotiation on the rate, they purchase and collect Chilli from the field itself and village level collection points. The rate varies from farmers to farmers depending upon the quality of produce, bargaining capacity and urgent needs. The village level traders grab the benefits by exploiting the farmers. They are collecting the product from farmers as per the demand of the nearest town level traders. They also act as commission agent of the town level traders. They fix the price for purchase keeping a margin of Rs.1-2 per kg for weighing, checking the quality of the products, packaging and arrange loading and transportation.

Table 8 Seasonality of Chilli Production vs. Trading

Name of the Product	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dry Chilli (Jamankira area)	C	C	C					C	C	C	C	C
				T	T	T	T	T				
Green Chilli (Bhatli area)										C	C	
	T	T	T	T	T							T

C: Cultivation; T: Trading

Block/ Nearby Town traders/Intermediary Traders: Intermediate traders are the person who resides and operates from the nearby towns like Bhatli, Sohela, Bargarh, Bijepur, etc. town in Bargarh district who procure green Chilli from the farmers in Bhatli block . Traders from Kuchinda and Jamankira purchase dry Chilli from farmers in Kuchinda and Jamankira area. They are the interface between the wholesaler and the village level traders and commission agents. They procure the lot from the traders and with a primary value addition i.e. drying, sorting, grading and packaging they captured a substantial margin. They even store the lot in their godowns and sell it in the Mandi. They aggregate the produce from village traders as per demand of their market. Then, they supply the produce to the large townships and nearest terminal market immediately after collection it.

Table 9 Profile of traders procuring Chilli from the farmers in the project areas

Sl. No.	Trader	Address
1	Mr. Shiba Narayan Sahu	Kuchinda Mobile No: 9437534831
2	Mr. Karam Sahu	Laumunda, Bijepur Mobile No:9668087965
3	Mr. Guna Sahu	Bhatli, Bargarh Mobile No : 9937753777
4	Mr. Chirantan Sahu	M/s- Gobinda Sahu Fertilizer Whole seller, Canal Avenue Mobile No: 9438160761

Table 9 Profile of traders procuring Chilli from the farmers in the project areas		
Sl. No.	**Trader**	**Address**
5	Mr. Bijay Kumar Sahu	Bijay Traders, Pesticides Whole seller, Back side of Private Bus stand, Bargarh Mobile No:9437219518
6	Mr. Baleswar Saha	Indian Seed Sale Centre Seed Whole seller, Canal Avenue, Bargarh Mobile No:8895042750
7	Mr. Sibu Agrawal	Main Market Jharsuguda
8	Mr. Mahesh Kukreja	Danumal Traders Kirana Merchant and Commsison Agent Gudhiyari, Raipur, Ph.No +91-9827178919, +91- 93005-11834, 9826118434 maheshkukreja@yahoo.com
9	Mr. Sandeep Agrawal and Mr. M P Agrawal	Kirana Merchant and Commission Agent, Gudhiyari, Raipur-09(CG) Mobile No: 9826116616

Regional Hubs/Terminal Market/Regional Wholesaler: The trades of regional hubs/ terminal market players are operating from large townships like Sambalpur, Jharsuguda, Raipur (Chhatisgarh), Bhubaneswar, Berhampur, Simdega (Jharkhand) and Cuttack . The Mandi are not being regulated and controlled by the Govt Departments. The regional wholesaler holds the entire monopoly and bargain capacity to purchase the lot. Then they procure the produce and stored it in the cold storage. As per the price suitability they sell it.

Organized wholesaler: During our discussion, the farmers revealed that there is hardly any effort made for organised wholesaling of Chilli in both the study blocks. It was observed that the farmers' participation in the governance of the value chain is low resulting into low return to the farmers.

1.7 Policy, Rules, Regulations and Business Environment

In the study area, business environment for Chilli and other agricultural products are more or less similar in relation to availability and quality of inputs and services; government extension system; land leasing system; infrastructures and farmers organization are largely governed by need and requirement of the area than any policy and regulations.

A brief profile of the public and private stakeholders is given below who plays pivotal role in policy formulation, formulating the rules, regulations and creating appropriate business environment.

Table 10 Profile of Potential Public and Private Stakeholders	
Stakeholders	**Role and Responsibilities**
Deputy Director of Horticulture	The Deputy Director of Horticulture is the district level body to provide assistance to farmers in enhancing production of vegetables and fruits.

Table 10 Profile of Potential Public and Private Stakeholders	
Stakeholders	**Role and Responsibilities**
Chief District Agriculture Officer (CDAO)	The Chief District Agriculture Officer (CDAO) is the apex District level officer to provide assistance to farmers in enhancing production of agriculture and supply of input services.
Agriculture Technology Management Agency (ATMA)	It is a district level registered society responsible for technology dissemination at district level. It imparts training on technical know-how and cultivation practices.
Nationalized Banks and Regional Rural Banks (RRB)	Nationalized and Rural Banks are providing loans/credit to the farmer at the time of cultivation
National Bank for Agriculture and Rural Development (NABARD)	NABARD is the facilitating Agency for credit flow to the farmers for promotion and development of agriculture.
Tribal Development Cooperative Corporation Ltd (TDCC), Department of SSD, GoO	It procures millet from farmers through Farmers Producers Company (FPOs)/FAs to revive millet in farms and millet cultivation remuneration. The millet procurement system is streamlined through online system in which the growers get their money through online transfer to their respective accounts.
Farmers Producers Organisation / Producers Group	Farmers Producers Organisation/Producers Groups are encouraged to form and act as the catalyst for supporting the farmers and provide handholding support in cultivation, processing and marketing of the products.
Odisha Rural Development and Marketing Society (ORMAS) / DSMS	Provides and facilitates critical linkages for marketing of rural products. It extends marketing support to the farmers through SHGs. It organizes district and state level exhibitions and festivals to demonstrate rural products and promote sales.
Private Inputs Traders	Farmers purchase their inputs like seeds, fertilisers, pesticides and implants from private traders located at district, block, GP and village level. Mostly village level traders are lending credit to the farmers at the time of cultivation.
Private Traders/Commission Agents	Private Traders and commission agents are procuring Chilli from the farmers and often providing credit to the farmers. The farmers get price of their product in two to three days depending on the traders and quality of their product.

1.7.1 Quality and Timely Availability of Input

Quality and timely availability of input are two prime reasons among the various reasons for declining farmers' interest in cultivation of Chilli. It has been found that input suppliers in the local market are operating without any hassles and are able to extract prices which suit their own convenience. In most of the cases it was seen that fertilisers, pesticides and other financial inputs are also provided by these small input traders in both the study Blocks. In turn, they extract their investment from farmers in the form of raw Chilli during harvest and high interest rates. In Jamankira area, in the absence of any quality input supplier and their belief in local seeds some farmers uses traditional seeds which are resulting into low productivity. This is an area where immediate attention of technical service providers will be required to promote a cluster in the intervention area.

1.7.2 MFIs/Financial Institutions and Credit Availability

Availability of timely and adequate finance for the Chilli growers and the other players in the value chain is a major constraint for smooth movement of the product along the value chain. The farmers are not getting any facilities of Kisan Credit Cards (KCC) particularly for growing Chilli as the cost of cultivation is much higher than the cost of cultivation table available with the bank. The farmers generally get KCC for cultivation of Paddy which they divert for the cultivation of Chilli as Chilli requires higher resources. The commercial Banks in the vicinity do not have any product suitable to the requirements of the small and marginal farmers who are involved in growing Chilli.

The other actors in the value chains are not availing banking facilities as they do not pay the funds to the farmers immediately after sourcing from them. The mechanism as observed is that the local traders collect the Chilli from the farmers and sell it to the medium size traders who usually pay them after 15 days and the local traders pay the farmers after another 7 days. In fact the farmers get their payment after 21 days of their delivery of products.

There is an urgent need of designing proper financing mechanism for the small and marginal farmers and the other value chain actors for smooth movement of the product from one node to the other.

1.7.3 Land Leasing and Ownership Status

Poor, small and marginal farmers hardly have access to land and, therefore, limited ability to expand production. In addition, the poor cannot afford to experiment (precisely because their access to land is constrained) and have difficulties in obtaining government support. Some farmers cultivating other person's land in share cropping mode as tenant who can not avail loan and crop insurance facility and avail other government support as the land is not on their name.

Although agricultural land in district is mainly governed by a similar kind of contract agreement between land owners and tenant, there is some specification that is followed in case of Chilli cultivation as this a cash crop. There are 3 types of land leasing system mainly followed in district which are as follows:

System-1: If Land owner share 50% of the cultivation cost, gets half of the share of total Chilli produced.

System-2: If Land owner do not share cultivation cost, gets 1/3 parts of total commodity produced.

System-3: Farmer cultivates lands in agreement with land owner and pay Rs.6000/acre for one crop. Apart from this the farmer has no obligation to divide the produce after harvest. The leasee farmer stops cultivation if the land owners demands for renewed rent for the land after one season. Otherwise the farmer will continue production until the land owner continues the same rent for subsequent seasons.

1.8 Challenges in Production of Chilli

Chilli is famous for its uniqueness in taste, colour, pungency and hotness. The only demerit of the Bamra Chilli cultivated in Jamankira area is high seeds with less skin, the color of which after grinded becomes deep brownish instead of red colour, which reduces its marketability. Farmers of this region prefer to grow the same variety

because of its high weight due to high seeds content. The size of the Chilli is smaller than other Hybrid Chilli. Majority of the farmers go for selling of Dry Red Chilli which fetches high prices.

1.8.1 Challenges in Production

Quality deterioration due to same seed rotation: The quality of the produce is gradually deteriorating because of continuous use of the Farmers own seeds and lack of infrastructure for post-harvest processing. Due to the genetical problems the Chilli produces are not uniform and also smaller in size with high seeds and less skin content which is mostly preferred for direct selling by the farmers.

Low yield due to unavailability of assured irrigation & Skills: As per the farmers opinion the average yield of the Chilli is 10 to 12 Qt per acre (dry Chilli) with traditional farming and normal irrigation. But in some cases there are farmers who have proved better yield up to 18 to 20 Qt (it ranges from 35-40 Qt in case of green Chilli) per acre with advance technology and assured irrigation. So, the productivity of this region could be enhanced through technology dissemination and improving irrigation facilities.

Low quality seedlings due to traditional methods: In the traditional methods, farmers develop their nursery without seed shorting and seed treatment which resulted to pest and fungal attack. The advanced way of nursery preparation by adopting standard package & practices will bring quality seedlings which ultimately increase productivity.

1.8.2 Post-Harvest Challenges

The post harvest losses of Chilli at producer level are estimated at 25% to 30% of the total production. Chilli like all other agricultural commodities invariably contains high moisture content (60% to 85%) at the time of harvest, which must be brought down to 8-12% moisture. The majority of Chilli produced is dried upon open space and mud field. The major loss was due to poor drying practice, which amounted for 15% to 20% of total weight of the pods.

Table 11 Estimated Post-Harvest Losses of Chilli at Producer's level

Sl. No.	Causes	Loss (% to total production)
1	Moisture	15-25%
2	Spoilage in Field	01-10%
3	Farm to assembly	05-10%
4	Assembly to distribution	02-05%

Source: Marketing of Chillies in India, 2002, D.M.I., Nagpur

The other major post-harvest challenges faced by the farmers in Chilli production are as follows:

Drying

- In traditional way of drying, fresh produce dried on open spaces like roadsides and remain exposed to weather for the entire drying period (5-15 days) causes contamination with dust and dirt, damaged by rainfall, animals, birds and insects. The loss ranges between 40-50% of total quantity due to this method.
- Traditional method of harvesting and sun drying involved poor handling of fruits results in bruising and splitting.

- Bruising causes discoloured spots on pods, splitting leads to an excessive amount of loose seeds in a consignment, and there is a considerable loss in weight and then in price.

Grading

- Since in this region the produce is preferred for direct selling rather processing Grading is an important component.
- Lack of awareness on importance of grading at Farm Level.
- Lack of knowledge on "Proper Grading" at farmers level also resulting low price and couldn't attract the buyers.

Packaging

- Lack of knowledge among producer for improved packaging.
- Poor packaging resulting to loss of produce which may bound the buyers to pay less
- Poor quality of packaging also resulting to increase in transportation cost.

Transportation and Storage

- Unavailability of infrastructure for storage and transport facilities to carry the produce to bigger centres or Mandis resulting to immediate sell of the produce.
- Immediate sale of the produce due to lack of storage facilities resulting to distress sale by the farmers.
- Absence of well maintained storage units in the market yard resulting to low bargain power of the farmers with buyers.

Processing and Value addition

- In spite of being a high producing belt there is no arrangement of value addition and processing unit.
- Lack of awareness among the producer for value addition and processing of Chilli.

1.9 Value Chain Analysis

1.9.1 Average Cost and Income from Green Chilli Production

The cost of cultivation of one acre of green Chilli is Rs.56,100/- which does not included the computed cost of the family labours and the marketing cost. The farmers purchage fertilisers at high rate than the approved rate during the time of need. Average production in the surveyed area was 65 quintal per acre. The average price the farmer realized was Rs.2,000/- per quintal (rate and production varies from time to time). Total value of sales from 1 acre of Chilli was Rs.1,30,000/- which gives an average net profit of Rs.73,900/- (if the farmer undergoes proper care and management within the one acre of green Chilli farm for about six month). Whereas the farmers engaged in paddy cultivation gets an average net return of Rs.20,000/-. The profitability of Chilli cultivation is higher the paddy.

Table 12 Average Cost and Income from Green Chilli Production (per acre) in Bhatli Block of Bargarh District

Sl. No.	Particulars	Quantity	No of times Used	Total Quantity	Price per unit (Rs.)	Total Cost (Rs.)
1	Seed (VNR305/ Krishna610)	100 grams	1	100g	Rs.400per 10g	4000
2	Ploughing					

Table 12 Average Cost and Income from Green Chilli Production (per acre) in Bhatli Block of Bargarh District						
Sl. No.	**Particulars**	**Quantity**	**No of times**	**Total**	**Price per**	**Total**
	By tractor	2 hours	1	2 hours	@1200 per hour	2400
3	Labour					
a)	Seedling plantation	10 (female)	1	10	150	1500
b)	Weeding	15 (female)	1	15	150	2250
c)	Fertilizer application	2 (male)	3	6	200	1200
d)	FYM application	2 (male)	1	2	200	400
e)	Pesticides	2 (male)	8	16	200	3200
f)	Harvesting	15 (female)	8	120	150	18000
4	Irrigation (ridge & furrow for irrigation)	12 (4 male and 8 female labors)	1	12	200	2400
5	Farm Yard Manure	1 tractor trolly	2	2 trolly	2000	4000
6	Fertilizer					
a)	Ammonia	1000+100+100	300kg	300kg	Rs.900/50Kg	5450
b)	Potash	25+50	75kg	75kg	Rs.1100/50Kg	1650
c)	DAP	100+100	200kg	200kg	Rs.1200/50Kg	4800
d)	IFFCO Fertiliser	50	50kg	50kg	Rs.1200/50Kg	1200
7	Pesticides	1/2 litre	8	4 litre	600	2400
8	Vitamin	5pkt	1	5pkt	250/pkt	1250
	Total Cost					**56,100**
	Total Value of Production					**1,30,000**
	Net Income					**73,900**

1.9.2 Average Cost and Income from Dry Chilli Production

In case of dry Chilli, a farmer spends on an average Rs 49,150/- per acre. Average production of dry Chilli per acre is 10 quintal (minimum) where the farmer sells @ Rs.1,200/- per quintal and earns Rs.1,20,000/ and thus gets a net profit of Rs.70,850/-.

Table 13 Average Cost and Income from Dry Chilli Production (per acre) in Jamakira Block of Sambalpur District						
Sl. No.	**Particulars**	**Quantity**	**No of times**	**Total**	**Price per**	**Total**
			Used	**Quantity**	**unit (Rs.)**	**Cost (Rs.)**
1	Seed (local/Hybrid seed)	100 grams	1	100g	Rs.400per 10g	4000
2	Ploughing					
a)	By tractor	2 hours	1	2 hours	@1200 per hour	2400
3	Labour					
a)	Seedling plantation	10 (female)	1	10	150	1500
b)	Weeding	10 (female)	1	10	150	1500
c)	Fertilizer application	2 (male)	3	6	200	1200
d)	FYM application	2 (male)	1	2	200	400
e)	Pesticides	2 (male)	6	12	200	2400
f)	Harvesting	30 (female)	3	90	150	13500

Table 13 Average Cost and Income from Dry Chilli Production (per acre) in Jamakira Block of Sambalpur District						
Sl. No.	**Particulars**	**Quantity**	**No of times Used**	**Total Quantity**	**Price per unit (Rs.)**	**Total Cost (Rs.)**
g)	Drying	2 (male)	3	6	200	1200
4	Irrigation (ridge & furrow for irrigation)	12 (4 male and 8 female labors)	1	12	200	2400
5	Farm Yard Manure	1 tractor trolly	2	2 trolly	2000	4000
6	Fertilizer					
a)	Gromore	1000+50	150kg	150kg	Rs.1800/50Kg	5400
b)	MoP	50	50kg	50kg	Rs.800/50Kg	800
c)	DAP	100+100	200kg	200kg	Rs.1200/50Kg	4800
7	Pesticides	1/2 litre	4	2 litre	600	1200
8	Vitamin	6pkt	1	6pkt	250/pkt	1500
9	Biodin	1kg	1	1kg	950/kg	950
	Total Cost					**49,150**
	Total Value of Production					**1,20,000**
	Net Income					**70,850**

Very few farmers cultivating Chilli keep records of their input, production and labour costs, and calculating the average profit margins from collector to retailer is difficult to establish. The information was collected during a discussion with the farmers.

1.10 Gender Analysis

It was observed that women are mostly engaged in preparation of seeds for sowing, plantation and Mulching after regular intervals. Women played role in harvesting and post harvest management in a major way. However selling of produce and expenditure related decisions are always made by men. The following matrix indicates the details of the same.

Table 14 Matrix of participation of women in production of Chilli											
Particulars	**Extent of participation (in %)**										
	0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
1. Preparation of land	■										
2. Cleaning of land		■	■	■							
3. Purchase of seeds	■										
4. Purchase of fertilisers	■										
5. Selection of land	■										
6. Agreement with the input suppliers	■										
7. Ploughing field	■										
8. Mulching		■	■	■	■	■	■	■	■		

Table 14 Matrix of participation of women in production of Chilli											
Particulars	**Extent of participation (in %)**										
	0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
9. Irrigation											
10. Harvesting											
11. Transportation											
12. Post Harvest management											
13. Selling to village traders											
14. Selling in local Haats											

1.11 SWOT Analysis of Chilli Sub-sector

Analysis of risk and opportunities examines Chilli transactions at local, districts and state level in order to determine the nature of the challenges the sub-sector face and areas for intervention many be carved out to make tangible impact. This analysis identifies strengths, weakness, opportunities, and threats where strengths and weaknesses refer to the internal factors governing the vegetable sub-sector, while opportunities and threats encompass the external factors influencing the larger business environment.

Table 15 SWOT Analysis of Chilli Sub-sector	
STRENGTHS	**WEAKNESSES**
○ Government of Odisha gives higher priory to support horticulture sector. ○ Sambalpur is well connected with Railway as well as National Highway. NH 55 (previously NH 42) connecting sambalpur with Cuttack and NH-6 (Kolkata to Mumbai) passes through the districts. ○ Bargarh is well connected with Railway as well as National Highway NH 53 which connects Hajira in Gujrat and Paradeep Port in Odisha and NH 6 which connects Bargarh with Sambalpur. ○ Easy to sell locally produced in the local and regional markets ○ Less dependency on irrigation as the average rainfall is very high ○ Sufficient upland available for promotion of Chilli cultivation during wet season ○ Agro climatic factors support the cultivation of Chilli. ○ Short crop production cycle and small gestation period for rotation etc. ○ Demand for Chilli in the nearby districts and high demand of Chilli in the region compared to others	○ Although Bamra Chilli is famous for its uniqueness in taste, colour, pungency and hotness, the only demerit of the Bamra Chilli is, it has high seeds with less skin, the color of which after grinded becomes deep brownish instead of red colour, which reduces its marketability. ○ Unavailability of organized Chilli cluster in the region and primary producers group for Chilli. ○ Limited availability of local expertise in Chilli production ○ Poor technical knowledge, skills and experience in Chilli growing ○ Farmers rely on conventional techniques for Chilli production ○ Irregular and inadequate supply of necessary inputs and technology ○ Low productivity and loss of yield from insects, 'pests and disease ○ Improper use of chemical fertilizers and pesticides on farms ○ Unavailability of timely market information, lack of access to sufficient capital for investment in Chilli production ○ Small plot sizes for Chilli cultivation in the wet season and insufficient irrigation water in dry season ○ Poor skills in land planning and management Inadequate/improper handling of crops and post-harvesting processes ○ Lack of quality inputs ○ Farmers have limited knowledge in high yielding Chilli cultivation techniques and skills

Table 15 SWOT Analysis of Chilli Sub-sector	
○ Potential to create jobs and employment, especially for poor farmers	○ Unavailability of reliable irrigation system ○ Post-harvest losses in Chilli production even in cases up to 25-30 % due to inadequate harvesting, storage, packaging and transportation methods.
OPPORTUNITIES	**THREATS**
○ Because of high seeds with less skin in Bamra Chilli, the colour of which after grinded becomes deep brownish instead of red colour, which reduces its marketability. Hence, there is an opportunity for the project to introduce and replace the Bamra Chilli with other cultivated variety e.g. Ankur (2239) having thick skin and less seeds in the project areas, which would provide deep red colour powder and other byproducts processed from Chilli and would also enhance the marketability of the same. ○ High demand for Chilli in the region and other nearby markets ○ Good reputation and social acceptance for locally produced Chilli ○ Road connection to local and regional market is fairly good ○ Sufficient scope and sale for locally produced ○ Availability of financial institutions ○ Scope for value addition in both green and dry Chilli and set up of processing units	○ Limited high land for Chilli production in the wet season ○ Absence of collaborative effort among the Chilli value chain actors ○ Price fluctuations for Chilli and mainly controlled by local traders in the absence of market access and information sharing to farmers ○ Climatic conditions, specially rainfall play truant at times in the study blocks ○ Majority of commercial banks and RRBs are unwilling to design loan products for Chilli cultivation ○ Limited availability and high labour cost ○ Uncertain and unorganized market and price fluctuations of Chilli ○ No storage facility at village level and cold store facility for the farmers even at Block level ○ Lack of use of modern technology in post harvest processing like Solar dryers, concrete drying yards etc.

1.12 Measures to Achieve Sustainable Outcomes

The small, marginal and landless farmers are highly dependent on production of Chilli as one of the cash crop. Due to low productivity, uncertain market and no storage facility quite a few of them have given up cultivation of Chilli. They expressed their willingness to undertake cultivation once again if there will an improved storage and processing mechanism, provision of irrigation facility, loan for the crop and linkages with market can be established on a sustainable basis.

The following vision for outcomes can be set in order to augment Chilli production and strengthen the value chain of Chilli in the study districts.

1.12.1 Input Supply

1.12.1.1 Good Demand of Quality Inputs

There is good demand for quality seeds and effective plant protection measures from Chilli farmers. This is a clear opportunity to develop a seed supply chain that can benefit this sector. Farmers face the shortage and high cost of required fertilisers during the time of need.

The study found that Bamra Chilli is famous for its uniqueness in taste, colour, pungency and hotness, but the only demerit of the Bamra Chilli is that it has high seeds with less skin, the color of which after grinded becomes deep brownish instead of red colour, which reduces its marketability. Hence, there is an opportunity for the project to introduce and replace the Bamra Chilli with other cultivated variety e.g. Ankur (2239) having thick skin and less seeds in the project areas, which would provide deep red colour powder and other byproducts processed from Chilli and would also enhance the marketability of the same.

1.12.1.2 Good Demand for Training and Skill Upgradation

There is good demand among the farmers about changes required in production mechanism and post harvest primary processing. Training and capacity enhancement of farmers on quality seeds and effective production techniques needs to be imparted in order to enhance the Chilli production. There is a clear opportunity to invest in irrigation facility of the small holders in upland which will fetch good benefits for them

1.12.1.3 Improved Post-Harvest Practices

Storage, cleaning, and grading are the basic post-harvest handling practices which can be easily adopted at farmers' level. These simple practices can add value to the product resulting in higher revenues. Training, skill up gradation is required in order to achieve improved storage and sustainable post harvest management.

1.12.1.4 High Scope to Increase Area and Productivity

All the upland and fallow land available in the region are suitable for Chilli cultivation, and therefore there is great potential to increase the area of cultivation. Similarly, productivity can be significantly increased by introducing assured irrigation sources and improved cultivation practices like use of quality seeds, proper mulching, weeding, and plantation management.

1.13 Processing

1.13.1 Product Diversification

It would require that value added products be innovated and developed within the district at different value chain points of Chilli for better market penetration and economic gain of the primary producers. A market study would explain as to what kind of products are in greater demand and accordingly the processing units may be suggested. In the discussion with farmers it was evident that a processing plant for Chilli sauce as well as Chilli powder would

benefit the farmers immensely and will fetch good return for locally produced commodity. Tomato and Chilli sauce are famous and are used extensively across the country. With liasioning and support of corporate players like Kissan India Private Limited, Reliance Group, ITC Food Division etc would be an effort can be made to enhance the value of Chilli and tomato, both are cultivated on scale in the region.

Processing Plant Set-up for Kuchinda Chilli

With a Chilli processing plant being set up at Kulangjor village in Tainsar panchayat under the tribal dominated Kuchinda block, the famed red Chillies of Kuchinda are likely to get their due place in the market. The plant would not just help in value-addition but also increase marketibility of the distinct Chilli variety, helping farmers earn better. The plant, set up by the Integrated Tribal Development Agency (ITDA), Kuchinda, along with a packaging unit, has capacity to produce 10 quintal Chilli powder per month. At the plant, Chilli produce will be processed into powdered form while whole dried Chilli too will be packaged for marketing. Marketing of the produce will be done by Odisha Rural Development and Marketing Society (ORMAS).

1.14 Marketing

1.14.1 Value Addition through Cleaning, Grading & Sorting

To make the products competitive in regional markets, simple activities like cleaning, grading, sorting, and proper packaging can be done. These activities would increase the shelf life of the products and help generate premium price in the markets.

1.14.2 Market Diversification

The 12 major trading centres of Chilli and Chilli powder in India are given in the following table. It is quite clear from the table that there is no place of Odisha in trading of Chilli although it supplies more than 3% of the total production.

Table 16 Major trading centres of Chilli and Chilli powder in India

1. Guntur – largest Chilli market in the world (Andhra Pradesh)	2. Warangal (Andhra Pradesh)	3. Khammam (Telengana)
4. Hindpur (Andhra Pradesh)	5. Raichur (Karnataka)	6. Bellary (Karnataka)
7. Unjha (Gujarat)	8. Chennai (Tamil Nadu)	9. Kolkata (West Bengal)
10. Mumbai (Maharashtra)	11. Delhi	12. Ahmedabad (Gujarat)

Most of the Chilli is sold in local market at regional, district and state level. It would be important that the shelf life of Chilli be increased through storage, packaging and transportation to fetch more value for the organic Chilli. A more aggressive market diversification would be required to ensure that demand of Chilli is managed in a sustained manner and it is important to stabilize the price to certain extent as well.

The farmers of the study area have most access the nearby market and do not have access to the organized market which reduces their possibilities of higher price realization. The following factors generally influence the Chilli market:

- Seasonal price fluctuations
- Overall production in the region and state
- Demand within the contry
- Stock available in cold storages and warehouses
- Hedging among the various varieties of Chilli

Farmers in Odisha's Kuchinda Lose Interest in Bamra's Fiery Chilli

Distress sale and lack of market linkage are forcing farmers of Kuchinda to give up cultivating 'Bamra Chilli', which has earned a distinct identity like Guntur Chilli over the years. Bamra and villages nearby under Kuchinda block are popular for growing the special variety of Chilli which has a distinct flavour, and high pungency. In the past, traders from across the country camped at Kuchinda to procure Bamra Chilli. However, Agriculture department's apathy towards promoting, procuring and marketing support for farmers has been resulting in distress sale year after year, forcing growers to rethink. When the state government opened a mandi to facilitate sale of Chillies in the sub-division in 2016, farmers hoped for a fair price that would at least protect their interest if not assure high returns.

Farmers got registered with the regulated market committee (RMC) and procurement took off well, but it got derailed in the due course. Farmers have accused the RMC of mismanagement which has forced them against the wall. Until five years back, the price farmers got by selling their produce in open market varied between Rs 100 per kg and Rs 130 a kg. But, ever since they started selling it through the market yards, the price came down to Rs 60 to Rs 80 per kg.

Local traders are given first preference in the process and there is restriction on the quantity of Chillies that traders from outside can procure. As a result, traders from other states have stopped procuring Bamra Chilli and local traders are cashing in on the situation by buying them at low prices.

Farmers said that government should also set up a processing plant for Chillies. Although the horticulture wing has a scheme for setting up Chilli processing unit with provision of subsidy from government, farmers are not aware of it due to lack of promotion.

Procurement Roadblock

- Chillies are now being sold at Rs 60-80 per kg against Rs 100-130 per kg five years back
- Locals traders are given preference over those from other districts
- There is restriction on the quantity of Chillies that outside traders can procure

Source: The New Indian Express, April 29, 2022, Available at https://www.newindianexpress.com/states/odisha/2020/feb/25/farmers-in-odishas-kuchinda-lose-interest-in-bamras-fiery-Chilli-2108191.html

The seasonal variation in price is also visible in the study area. Th farmers generally fetch better price in the crop harvested during December till March. With the more arrival during the month of April and May, the price of the Chilli crops gets reduced to 60% of the price what they received during the previous months.

The major market share is in the hands of the local traders who purchase the Chilli produce directly from the farmers at different rates depending on the moisture content. However in the entire marketing process farmers of the region are facing following constraint.

- Less bargain power of farmers due to no aggregation of produce.
- Big private players are not being attracted due to low volume of produce and it's disperse nature.
- Unorganized nature of the market and absence of linkages with the private sector.
- Absence of Community Based Organisation/Groups at farmer's level to aggregate the produce.
- Local intermediaries/moneylenders exploit the farmers. These middlemen have a good understanding of the local mandi and the prevailing market rates, and after assessing the land area and the crop health, they fix a rate for the entire crop, which usually fetches them a 50-60% margin.
- Absence of regulated marketing control on Chilli.
- Absence of linkages with spices company and processing units.

GI Tag Push for Kuchinda/Bamra Red Chilli

Eyeing the Geographical Indication (GI) tag for the famous Kuchinda red Chilli, the Sambalpur administration has initiated steps to get the recognition. Kuchinda red Chilli, popularly known as 'Bamra Chilli', has earned a distinct identity like Guntur Chilli over the years. Earlier, traders from across the country camped at Kuchinda to procure the Chilli, but lack of promotion and marketing facilities forced farmers to opt out of cultivating it. In a bid to encourage farmers to continue cultivation of Bamra Chilli, the district administration has started the process for getting GI tag.

1.15 Possible Intervention Strategies: Recommendations

In terms of future of Chilli to be considered as commercial production it is suggested that formation of primary producer's clusters, saving and credit for these groups formed, drying and storage facility would result in improved return on investment in the intervention area. Efforts should be given to tap the opportunity to further augment process of enhancing production by investing in social, natural and physical capital to achieve desired level of output of Chilli for small and marginal excluded community.

Further, there are no integrated efforts to link up all the stakeholders in value chain system with assurance of critical support for achieving standards. The demand and supply scenario is to be synchronised in order to formulate a closely knitted value chain and achieve a win-win situation for primary producers as well as the stakeholders involved in the storage, processing, marketing functions in the value chain.

Based on detailed analysis of value chain, market system and demand for Chilli, following recommendations are suggested for enhancing benefits to primary producers:

1.15.1 Social Mobilization and Institution Building

The first and foremost task before the project is to conduct sensitization cum awareness meetings in the Bhatli block in Bargarh and Jamakira Block in Sambalpur district to develop community understanding among the farmers on the dynamics of production and productivity of appropriate variety of Chilli; and its advantages in terms getting higher income from the same. Such interactions with the farmers at the initial stage of the project would help to create an acceptance among the farmers and facilitate their decision to cultivate Chilli as a commercial crop. That would also enable the project to identify the farmers showing interest to cultivate Chilli and also help identifying the protential leaders among the farmers, who would act as a bridge between the project and the farmers in the operational villages.

In the next step, the project may facilitate and organize the interested farmers to form Farmer Producer Groups (FPGs) at the village or Gram Panchayat level, which may be then federated and registered as a Farmer Producer Company (FPC) at the Block level. The study strongly recommends that one FPC per block should be formed so that the farmers do not face any problem due to the distance between blocks for accessing the services from their FPC. After the formation of FPC, the project may take steps to provide training and exposure to the members on the functioning and management of the FPC.

To make the project implementation realistic, the project needs to plan for a target based gradual increase in the number of farmers brought into the fold of FPC. Keeping the project duration in mind, the project should target organising maximum of 600 farmers per FPC, which would help the project to have a realistic plan to cater to the farmers' requirements for taking up Chilli as a commericial crop. Adding the two blocks, a total of 1200 farmers in Bargarh and Sambalpur districts may be provided support for Chilli cultivation under the project. Further, to achieve the target of 600 farmers per FPC, the project may take gradual steps by setting a target of achieving 200 farmers per FPC in the 1st year of project implementation followed by 400 farmers in the 2nd year and then, 600 farmers by the end of 3rd year of project completion.

1.15.2 Production Management

1.15.2.1 Development of Location Specific Package of Practices (PoPs)

Location specific Package of Practices (PoPs) should be developed, demonstrated and supported for the production and marketing of Chiili focussing on the farmers in the project areas. The PoPs should incorporate the best practices in the region with improved varieties/hybrids and fertilizes.

1.15.2.2 Training on PoPs

Farmers follows traditional ways of farming learnt from their forefathers. In order to raise their income, they need to adopt modern methods of agriculture. They need training and exposure on commercial farming for higher yield and adopt irrigation system without wastage of water and application of plant machinery and use of fertilisers and pesticides. So, after the development of the PoPs, the project needs to train the farmers on how to execute the PoPs for better production, processing and profitable marketing of their products. Exposure/training on technical aspects of sustainable Chilli cultivation (e.g. soil treatment, inter-cropping, de-cubing, drying, storage, etc.) should be imparted to the farmers.

1.15.2.3 Demonstration Applying Farmer Field School (FFS) Approach

The project may plan for adopting the Farmer Field School (FFS) approach to build farmers' capacity to analyze their production systems, identify problems, test possible solutions, and eventually encourage the participants to adopt the practices most suitable to their farming systems. FFS is an approach based on people-centred learning which is participatory in nature and enable farmers to learn by doing. The package of practices, which the project is going to develop, may be demonstrated to the farmers applying FFS approach. Applying the same approach, the project may take efforts to organise field demonstrations to showcase the yield potentials of high yielding varieties with a package of nutrient management and production including the technology demonstration may be organized for the farmers in the project areas.

1.15.2.4 Adoption and Scale-up of PoPs

Farmer Field School (FFS) approach of training and demonstrations would help the most interested farmers in the project areas adopting the PoPs through learning by doing. The farmers, who are based in the neighbouring villages of the demonstration sites, may be invited to observe and learn the skill required for adopting the correct method of production outlined in the PoPs, which would enable the project to encourage them for adoption in their agriculture field. As a result, the knowledge and skill about the improved practices will gradually diffuse to other farmers in the project areas and will help the project achieving scale-up by bringing more and more farmers under its umbrella of supports.

1.15.2.5 Inputs Demand Estimation and Facilitate Supply of Quality Inputs

Before the adoption and scale-up of PoPs, it is important for the project to train farmers on how they can carry out inputs demand estimation (e.g. estimation of seeds, fertilisers, pesticides requirements as per the land size) before 2 to 3 months of an agriculture season. After the demand estimation of inputs is completed by the farmers, the project may further facilitate how those farmers can access timely and quality inputs.

1.15.2.6 Mechanization Support (Custom Hiring Center)

Mechanization support to the farmers is required for various agricultural activities, especially weeding, harvesting, threshing, and dehulling, which would help improving the productivity of labor engaged in agriculture. Apart from implements like e.g. sprayer, weeder, threshers, power tillers, etc., the farmers also need machinery for harvesting (e.g. harvest scissors) and cleaning of the produce. Hence, the project may plan and facilitate establishment of Custom Hiring Center at the Farmers' Producer Company. Effort should be made to equip the centers with all the required equipments, which would help the farmers to easily access the equipments at the time of their needs. The establishment of Custom Hiring Center would enable the farmers to hire the equipments on a rental basis, which in turn would provide an income to the FPC for bearing its management and maintenance cost. So, simultaneously, at the time of training and demonstration to the farmers, the project may facilitate setting-up of Custom Hiring Center so that the farmers can access the equipments that are required for adopting the improved practices demonstrated under the project.

1.15.2.7 Financial Support

The project may facilitate providing financial support to the farmers by organizing them into producer's groups and companies and then linking the same to various government schemes of KBK, TDCC, and line departments; commercial banks; MFIs; etc. so that the farmers in the project areas can avail loan and other benefits specifically for the production, processing and marketing of Chilli. Thus, it is important for the project to coordinate with the KBK, line departments, and other players for convergence and dovetail resource support to the farmers from these agencies.

1.15.2.8 Promotion of Soil Testing

Since soil testing is not practiced by the farmers in the project areas, the project may plan for promoting soil-testing among the farmers in the project areas, which may be also demonstrated at the demonstration sites to show how it is done and the benefits of doing soil testing and doing land treatment based on the soil testing result. So, it is important that the soil testing should be conducted at individual farmer level to know the Nitrogen, pH level, sulphur and potash content, and micronutrient level. Therefore, the project may facilitate introduction of soil testing kits, moisture testing machine, and land treatment carried out by farmers based on the soil testing report.

1.15.2.9 Soil Health Improvement (Land Treatment)

Based on the soi-testing result, land treatment should be done by individual farmers by applying proportionate doses of lime powder, neem cake and organic manure. Also the farmers should adopt treatment of seed before sowing. For taking up these activities, the project may facilitate the farmers availing financial incentives under government schemes. In this regard, soil health mapping is required for improving crops productivity and accordingly, the crop wise recommendations for fertilisers applications may be carried out by the farmers on the basis of the result of soil analysis. As Chillies need moisture for growth, it has been found that black soil which retains moisture is ideal in case they are grown in rainfed crops. Under irrigated conditions, the crop needs well drained sandy loam. pH of soil should be between 6.5 and 7.5. So farmers should be made aware for soil testing through private individuals/entrepreneurs who would be trained on testing and efficient application of fertilizer and pesticides.

1.15.2.10Sensitization to the Farmer to Take-up Seed and Soil Treatment

Intervention on cultivation process should include efficient application of fertilizer, pesticide and soil and seed treatment. Soil testing should be conducted at individual farmer level to know the Nitrogen,pH level, sulphur and potash content, and micronutrient level. Accordingly, soil treatment would be done by applying proportionate doses of lime powder, neem cake and organic manure. Also they should adopt treatment of seed before sowing and for taking up these activities they should be given incentives. Soil health mapping is required for improving crops productivity and thereby the rural livelihood of those depending on the agrarian economy . Crop wise recommendations for fertilisers applications are carried out on the basis of the result of soil analysis.

1.15.2.11Encouraging Farmers for Organic Farming

Introduction of organic fertilizer and pesticides for "organic farming" may be promoted under the project as there is a huge demand of the organic Chilli in the international market. For which, "Organic certification" is required and a proper strategy to be developed so that the necessary requirements could be fulfilled to attract export market. So looking at the growing demand for the organic products, the project may plan for promoting and introducing the practice of organic farming among the interested farmers. By definition, a produce can be called organic if it is certified to have grown on soil that had no prohibited substances applied for three years prior to harvest. Prohibited substances include most synthetic fertilizers and pesticides. Hence, one of the challenges for organic farming is to keep the agriculture field barren for at least 3 years, which would be difficult to adopt by the small and marginal farmers. Hence, the project may identify interested large and medium farmers who can afford to keep some portion of their land holdings barren for three years, which would enable them to get a certificate for their organic produce.

1.15.2.12Identification and Replacement of Current Seed Variety

Chillies are propagated from seeds. At the time of cultivation, disease-free, good quality seeds and high yielding seeds must be chosen taking in to consideration the soil type and irrigation facility. Replacing of low yielding varieties of seeds used by the farmers with high yielding varieties (e.g. Ankur 2239) should be made in the project areas. The project may plan to ensure that the farmers have a choice of Chilli varieties at their disposal. A two-pronged approach is required stressing, on the one hand, large scale organized seed channels for generally established and proven varieties; and on the other hand, local seed banks for niche varieties grown in the specific areas. Existing support mechanism for seed production should be extended to include well-performing local varieties.

Ankur (2239) Cultivation

The study found that Bamra Chilli is famous for its uniqueness in taste, colour, pungency and hotness, but the only demerit of the Bamra Chilli is high seeds with less skin, the color of which after grinded becomes deep brownish instead of red colour, which reduces its marketability. Hence, there is an opportunity for the project to introduce and replace the Bamra Chilli with other cultivated variety e.g. Ankur (2239) having thick skin and less seeds in the project areas, which would provide deep red colour powder and other byproducts processed from Chilli and would also enhance the marketability of the same.

1.15.2.13Care during the Harvesting of the Produce

There is an optimum time for harvesting Chilli, depending on the maturity of the crop and the climatic conditions. This has a significant effect on the quality of the Chilli during storage. Harvesting often begins before the Millet is ripe and continues until mould and insect damage are prevalent. From sowing, Chilli plants vary from about 80 to 120 days to fruit being ready. Many pods start to change color after 70 to 100 days. The Chillies do not begin to change color until the seeds are completely formed inside. The right time determines the quality of the harvest.

Most cases, Chilli ripens after about 80 days. Chillies first discolor at the top of the crown. If the Chilli starts to change color, it will be red, orange or yellow after a few days, depending on the variety. If the Chilli has changed color, the farmers should wait 5 days before picking. Giving it the time help to produce more fructose and capsaicin for the pungency. Longer than 10 days, the farmers should not let them hang, so that still further blooms and fruits are formed. Before, the farmers start cutting off the Chilli, they can try some Chillies and find out whether they have already built up a perfect aroma. By trying them, the farmers can determine the perfect time for the harvest. The best way to cut the Chillies is to use harvest scissors. This should be narrow at the front so that the branches can be handled without effort. Separate the stem in the first third so that two-thirds remains on the pod. A range of mechanised harvesting equipment suitable for the small-scale farmer should be made available at the Custom Hiring Center for the farmers to hire at the time of harvesting the Chilli. The farmers in the project areas may be sensitized and made aware on all the above-mentioned so that they can handle the harvesting of Chilli in an effective way. As the picking of the Chilli is manual, some technology could be introduced by the project to reduce the drudgery of the women who are working in the Chilli field.

1.15.3 Value Addition and Product Diversification

1.15.3.1 Drying, Grading, Sorting and Cleaning

Drying: Chillies on harvesting have moisture content of 65-80% depending on whether partially dried on the plant or harvested while still succulent. After each harvest, the pods are kept in heaps either indoor or in shade away from direct sun light for 2 or 3 days so as to develop uniform red colour. They are then dried in the sun to retain the colour and reduce microbial growth by spreading them on clean dry polythene sheets / tarpaulin sheets / cemented / concrete drying yards etc. Pods are spread out in thin layers for uniform drying with frequent stirring to prevent mould growth and discolouration. The dried pods are heaped and covered by clean gunny bags / polythene sheets. The moisture content of dry pods is kept at 8-10%. With high colour value coupled with 10-11% moisture level gets premium price. Drying by the conventional sun drying procedure takes 5-15 days depending on prevailing weather. Out of 100 kg of fresh fruits, 25-35 kg of dried fruits may be obtained.

Fresh produce dried on open spaces like roadsides remain exposed to weather for the entire drying period (5-15 days), and may cause contamination with dust and dirt, damaged by rainfall, animals, birds and insects. The losses may range from 70 to 80% of total quantity. Poor handling of fruits results in bruising and splitting. Bruising causes discoloured spots on pods, splitting leads to an excessive amount of loose seeds in a consignment. Improved drying system could be used to ensure cleanliness and uniform colour of the product.

Improved CFTRI method of drying Chilli

CSIR-Central Food Technology Research Institute (CFTRI), Mysore has developed a four - tier system of wire-mesh trays or a single tray of perforated aluminium. Solar drying of Chilli fruits in these trays takes 14 days to dry the fruits having a moisture content of 72-74% to reduce it to about 6% as against 3 weeks required for reducing the moisture content to 15- 20% by conventional solar drying method.

Drying in solar tunnel dryer: Drying Chillies from the initial moisture content of 77% to 9% in a solar tunnel dryer at 56ºC temperature required 39 hours as against the 57 hours required for open yard solar drying at 37ºC. The solar tunnel dried samples had less aflatoxin content as compared to open yard solar dried samples.

NIIST method of drying Chilli

If the high colour Chilli is currently processed in the traditional manner which result in loss of carotenoids during the sun drying operation. CSIR-National Institute of Interdisciplinary Science and Technology (NIIST), Thiruvanthapuram, Kerala has develope d a process that employs a fluid bed drier for bringing down the moisture to acceptable levels of fresh Chilli hygienically. The resulting end product will have a 10% increase in colour value when compared to the conventionally processed raw material. The raw material is washed, size reduced, dried in the fluid bed drier and then de-seeded. The contact time in the drier is less than 15 minutes, and the entire operation is automated. All the machineries are interlocked and the manpower requirements are marginal. High pressure steam is used as the heating medium and the plant is engineered to ensure high thermal efficiency. The facility can be set up at a cost of approximately Rs. 2.5 crore for a 20 MT/day fresh red Chilli processing unit. The unit can provide direct employment to 30 people and indirectly benefit a large number of farmers ensuring fair price for the produce.

The project may provide support for getting solar dryers and microwave dryer machines at the Custom Hiring Center on subsidy. Prevailing practice of drying the Chillies on earthen floor should be stopped which is unhygienic and time consuming. Sufficient numbers of common concrete drying platforms should be constructed to cater the need of the farmers depending on the production of dried Chillies in their village. As the moisture content is the most important criteria for getting better price for their produce, solar drying technology may be introduced which is self replicable and self reliant model. Solar dryers and microwave dryer machines should be given to the farmers on subsidy.

Grading and Sorting: The cleaned and well dried Chillies need to be graded to gain a premium price for high quality packaged products. Chilli should be graded at the farmers level. Sorting of Chillies at farmers level should be carried out by hand, where discoloured, white and spoiled Chillies are sorted out at the time drying before bringing it to markets. The damaged, discoloured and immature pods are removed depending on market demand.

Deep and bright red colour Chillies and Chillies with low seed content, generally fetch premium price, hence the same variety in place of Bamara should be cultivated. At the farmers level, the other important quality parameters considered for grading are moisture and stalks. Excessive moisture adds weight to the pods and gives room to various fungi to grow. Similarly, if the stalk of the pods is broken, it exposes the seeds, and the seeds may fall out. On the other hand, in absence of optimum moisture the pods may break and let off the seeds. Thus, the seed and pod ratio in a lot is also a valuable parameter of grade.

Apart from the apparent characters of colour, size, moisture and stalk of the pods, the features like, seed and fruit (pod) ratio, seed size and hardness, thickness of the skin of the pod, and pungency have weightage in grading Chillies. End users are mainly of two types - domestic retail users and industrial wholesale users. Industrial wholesale users who prepare Chilli powder gives preference for colour, pungency, fresh skin and less seeds. The domestic retail users also prefer same variety for different occasions.

Cleaning: Dried Chillies are cleaned to remove sand, small stones, dust particles, leaf, seeds, stems, broken pods. Vibratory sieves and rotary centrifugal screens are used for cleaning.

So, in order to fetch better market price to their produce, the farmers may be trained and demonstrated on how the Chiilies after harvested are dried, sorted, graded and cleaned. In order to reduce the post harvest losses, effort should be made that the drying, grading, sorting and cleaning activities are carried out by the famers near to their fields.

1.15.3.2 Packaging and Branding of Dried Whole Chilli

Packaging of dried whole Chilli is done to protect it from any damage during storage, transportation and other marketing aspects. Good packaging is essential to facilitate convenience in transportation and storage, and it also enhances the market price of Chillies. Packaging is required at every stage of marketing from producer to consumer.

At the producers' level, Chillies are packed in jute gunny bags. The capacity of gunny bags is generally 20-100 kg. Farmers use old gunny bags to pack Chillies before selling. The exporters can repack them in good new gunny bags and sometime in the gunny bags with polythene liner inside. Chillies can also be packed in polythene bags and cartoons.

Packing in 3,000 gauge low density polyethylene film pouches are done for 100 g consumer unit packs to give a shelf life of 3 to 6 months. Under tropical conditions, 200 gauge low and high density polyethylene films are suitable for packing of whole Chilli in units of 250 g. each. Such packs can be stored at a cool, dark, dry place for about a year. Dried Chilli can be made available in market in the packs of 5, 10, 15, 20, 25 and 40 kg.

Effort should be made that the materials used for packing should be properly leveled in the name of Mahashakti Foundation for branding of the product.

1.15.3.3 Transportation from Farm

Chillies can be transported in gunny bags (old or new). Transport of Chillies can be done in 2 phases, (i) from farm to aggregation points and (ii) from aggregation points to consuming markets / places. Head loads, cartloads, tractor trolley and truck loads may be used depending on the economic status and land holdings by the Chilli producers in the area. In case of dispatches from the aggregation points, trucks may be used as the main transport vehicles.

1.15.3.4 Good Storage and Cold Storage Facility

There are no common godown facility at village level so that the farmers can store their product and avoid distress sale during bumper crop. Green Chilli is a highly perishable product, so there should be cold storage/mini cold

storage facility at Panchayat level so that they can keep their product there for prolonging and preserving the shelf life of food without compromising on the nutritive value. As reported by the farmers on fluctuations in market price, the farmers will be benefit if good storage and cold storage facilities would be established.

As the storage is also a major problem of the dry Chilli and it could not be kept in standard store house, specialized store facilities in the vicinity of the Chilli growing cluster could be a better solution to it. For this purpose, the institutions like NABARD, APICOL etc; could be involved.

It is very important to store the harvested Chillies at proper place to maintain the pungency and red colour. The cold storage units with vapour compression refrigeration system maintained at a low temperature of 4-6ºC and 60-70% RH should be ysed to retain the colour and purity of Chillies for 8-10 months. Storing Chillies for longer period may lead to deterioration. Storing in cold storage units has also increased the oleoresin extracted from Chilli by about 30-40%. Dunnage should be provided to stack the packed bags to prevent moisture ingress from the floor. Care should be taken to stack the bags at 50 to 60 cm away from the wall. Insects, rodents and other animals should be effectively prevented from getting access to the premises where Chilli is stored. The farmers can also store Chilli in their houses for maximum about 5 to 15 days. The Chillies should be stored in gunny bags for a period of 1-6 months depending upon the market conditions.

1.15.3.5 Processing and Product Diversification

The product diversification of Chillies include the following points:

i) Supply freshly harvested Chillies to the local market on the basis of market requirement.
ii) For red Chilli production, it is a good idea to set-up processing unit for Chilli powder making, which the farmers can sale Chilli in bulk or large quantity.
iii) Dry Chilli productionis more profitable farming over the green because there is always great market demand for it. Producers can really make a big one from it.
iv) Dried Chillies are sold in market in different forms like the Chilli with stem, Chilli without stem, crushed dried red Chilli flakes and dried red Chilli powder. Chilli produced by the farmers can reache the global market after its processing in various forms like **dried whole Chilli (with and without stem), Chilli powder (ground and crushed), Chilli paste, Chilly Chutney, Chilli Flakes, Chilli seeds and Chilli oil (oleoresin).** It is also much sought-after in the oleoresin industry and the oleoresin extracted from it is used in the preparation of food and cosmetic products.

Chilli with stem, Chilli without stem, crushed dried red Chilli flakes, dried red Chilli powder, Chilli paste, Chilli chutney, Chilli seeds and Chilli oil (oleoresin) are the various processed products, which can be prepared from Chillies. The clean and dried Chillies with stem obtained after primary processing is used as the raw material for the production of all the products.



Chilli without stem: Stems of the clean dry Chillies are cut either manually using knife or mechanically in a Chilli stem cutting machine. The chilly stem cutting machine consists of a rotary hollow cylindrical drum with holes on the outer surface. The

dry Chillies when fed through the hopper, flows into the drum. As the Chillies flow inside the drum, the rotation of drum makes the stem to enter into the holes. The stems projecting through the holes are cut using a blade. The dried Chillies without stem flow out through the other end of the drum. Output capacity of the machine depends on the retention time of Chillies in the drum and the rotary speed of t he drum. The stem cutting efficiency varies in the range of 90-95% at the optimum operating conditions. Chillies without stem are used for making Chilli powder, paste, chutney and flakes.

Crushed dried red Chilli flakes: The clean dry Chillies are first roasted for 1 to 2 minutes till they turn into slightly brown colour and give off an aroma. Usually roasting is done in a thick-bottomed pan on low flame or in various types of ovens. The roasted Chillies are cooled to room temperature. The Chillies are then ground in spice grinder or a small hammer mill to get coarse flakes. The size of fla kes obtained depends on the duration of grinding. The flakes are blown into the cyclone separator and collected. The Chilli flakes are packed in printed flexible pouches, pouch in mono-carton boxes, high density polyethylene and Saran / Cello / Saran poly laminate pouches, and composite, plastic and glass jars.

Preparation of Crushed Dries Red Chilli Flakes

Clean dry Chillies → Roasting → Cooling → Grinding → Packaging

The Chilli flakes are widely used in the preparation of snacks, seasoning of pizzas and casseroles, and sometimes used for garnishing (10-30 mesh size).

Dried red Chilli powder: The stems of the clean dry Chillies are cut using the Chilli stem cutting machine or using a knife. Use of stem cutting machine generally reduces time and labour costs. The process of milling is commonly also known as grinding process. Hammer mill is commonly used for grinding. Either the crushed material is passed 2-3 times through the small hammer mills with centrifugal blowers, cyclone separator and sifting machine along with lump breaker between the hammer mills, or a large hammer mill is used to obtain the fine Chilli powder. Electric motor operated kandap machine which work on the principle of traditional pounding of Chillies is used obtain the Chilli powder with traditional aroma and quality. Sieving is done in Centrifugal sifter with fine mesh. The

Production of Dried Red Chilli Powder

Clean dry Chillies → Stem cutting → Crushing/ Milling (Coarse powder) → Conveying and Shifting → Grinding/ Milling (Fine powder) → Sieving → Vaccum Conveying → Packaging

internal shaft with rubber blades rotate to break the lumps along with it passing through desired size of fine mesh to get smooth fine Chilli powder.

The fine red Chilli powder is conveyed from one place to another within the premises using vacuum conveyor. Red Chilli powder with moisture content of less than 8% is for safe storage. The Chilli powder is packed in printed flexible pouches, pouch in mono-carton boxes, high density polyethylene and Saran / Cello / Saran poly laminate pouches, and composite, plastic and glass jars.

Chilli paste: The clean dry Chillies without stems are soaked in hot water for about 30-45 minutes. The softened Chillies are blended with vinegar and water to prepare the paste. Hot oil is poured and mixed with the paste. The paste is packed in glass jars or printed flexible pouches. The paste is suitable for consumption within one month if preserved under refrigerated conditions. Chilli paste is used in soups and sandwiches to add extra heat and flavour.

Production of Chilli Paste

Clean dry Chillies → Stem cutting → Soaking in hot water → Blending with vinegar and water → Addition of hot oil and mixing → Packaging

Chilli chutney: The clean dry Chillies without stems are soaked in hot water for about 30-45 minutes. The softened Chillies are blended with jeera seeds, tamarind, jaggery, salt and crushed garlic to prepare the chutney. Hot oil along with spluttered mustard seeds and asafoetida is poured and mixed with the chutney. The chutney is packed in glass jars. The chutney is suitable for consumption within one month if preserved under refrigerated conditions. Chilli chutney is used in regular breakfast and meals.

Chilli seeds: The Chilli seeds can be obtained from the clean dry Chillies without stem using Chilli deseeding machine. The machine has the blades and sieves. The blades cut the Chilli into pieces and pass them to the vibrating sieves. The Chilli seeds pass through the sieves and fall to the bottom. The Chilli pulp is sent to the next processing (oleoresin extraction) plant using belt conveyor. The Chilli seeds can be directly packed. The Chilli seeds are the best source of antioxidants. The consumption Chilli seeds stimulates digesting system, lowers cholesterol level and help in losing weight

Chilli oil (Oleoresin): Oleoresin is obtained by solvent extraction of pericarp (skin of Chilli) or pulp. The oleoresin contains a major pungency principle, capsaicin and colouring principles of capsanthin and capsorubin. The stems of the clean dry Chillies are removed and deseeded. The pericarp or pulp of the Chillies are ground to the size of 0.25 mm. Pellets are prepared from the powder. The Chilli oil or oleoresin is extracted in a solvent extraction machine. The main solvent used is liquid propane / butane / dimethyl ether / R134a / liquid ammonia. After the extraction, the solvent is removed. The Chilli oil or oleoresin is red viscous liquid with characteristic Chilli odour.

The equipment required for solvent extraction are, cabinet dryer, hammer mill, oscillator granulator, sigma mixer, screw elevator, condenser, desolventiser, steam generator, dacetone distillation unit. The oleoresin yield of around 15% of the total pulp weight can be obtained by solvent extraction method.

Techniques like use of super critical carbon dioxide and enzymes like Pectinases, Cellulases Hemicellulases and Xylanases which help in break open the cell wall, has also been studied with a view to increase the extraction of colour and oleoresin out of the Chilli powder. The enzymatic method increased the colour value by 15000 CU and capsaicin content by 0.79- 0.82% under optimized conditions. The oleoresin can be used to obtain deep red colour in any food that has a liquid / fat phase. The typical use levels are in the range of 10-60 mg/kg of finished food, calculated as pure colouring matter.

1.15.3.6 Packaging of Chilli Fruits and Powder

The methods of suitable packaging is described below which the project may facilitate to introduce at the processing unit.

Deteriorating factors: In order to select a suitable packaging material / type of package, it is essential to know the factors which affect the quality of dried Chillies / Chilli powder

Moisture content: Dried Chilli fruits and Chilli powder are hygroscopic in nature and picks-up moisture from the atmosphere resulting in sogginess and caking/ lumping of the powder. Pick-up of moisture also results in loss of free-flowing nature of the Chilli powder.

i) Loss of aroma / flavour Dried Chilli fruits and powder contains volatile oils, which impart the characteristic aroma/flavour to the product. Losses in the volatile oil content or oxidation of some aromatic compounds result in aroma and flavour loss.
ii) Discolouration Dried Chilli fruits and powder contain natural pigments. Light can affect the pigments resulting in loss or fading of colour and deterioration.
iii) Insect infestation Dried Chilli fruits and powder is prone to spoilage due to insect infestation, which can be further accelerated due to high humidity, heat and oxygen.
iv) Microbial contamination In high humidity condition of 65% and above, moisture absorption occurs. Beyond a certain level of moisture content, spoilage due to microbial growth sets in.

Packaging requirements of dried Chilli fruits and powder: In order to maintain the quality of the dried Chilli fruits and powder during handling, transportation, storage and distribution, the packaging material to be used is to be selected with care, keeping in mind the functional as well as the marketing requirements

The packaging requirements for dried Chilli fruits and powder, in general, are listed below:

i) To protect the product from spillage and spoilage.
ii) To provide protection against atmospheric factors such as light, heat, humidity and oxygen. The selected packaging materials should have high water vapour and oxygen barriers.
iii) The packaging material should have a high barrier property to prevent aroma/flavour losses and ingress of external odour.
iv) The volatile oil present in the spice product has a tendency to react with the inner/ contact layer of the packaging material, at times leading to a greasy and messy package with smudging of the printed matter. The packaging material should therefore be grease and oil resistant and compatible with the product.
v) Besides the above functional requirements, the packaging material should have good machinability, printability and it should be easily available and disposable.

Packaging materials for dried Chilli fruits and powder:

Bulk packaging: In bulk packaging, the current trend is to use Flexible Intermediate Bulk Containers (FIBCs) commonly known as Jumbo bags. These bags have a capacity of up to 1 MT. In general, these bags are made from cloth, but at present mainly from plastic (PP) fabric, which can be laminated or provided with an inner plastic liner bag. The PP fabric is stabilized against UV degradation. The bags are provided with filling and discharge spouts and slings for hanging during loading/ unloading operations.

The FIBCs offer various advantages such as:

i) Bags are flexible, collapsible and durable
ii) Can be used for packaging of granules, powder, flakes and any free flowing material
iii) Product wastage / spillage and tampering can be avoided
iv) Since the handling is mechanised, less labour is required
v) Saving in time for loading and unloading
vi) Bags are light in weight and, therefore, freight costs are reduced

Institutional packages: Institutional packs of capacities ranging from 2-10 kg are also used. The traditional materials that were used such as tinplate containers and jute bags are currently being replaced by materials such as laminated flexible pouches and plastic woven sacks. The sacks are usually BOPP multi-color Printed laminated PP Woven bags. These bags may be gussetted and have window and micro perforation.

Consumer packages: The options available to the traders / exporters of dried Chilli fruits and powder in the selection of a consumer pack for domestic and export market are quite wide. However, the selection / choice of the packaging material / system depend upon a number of factors, which are broadly listed below:

i) Shelf-life period i.e., the degree of protection required by the product against moisture pick-up, aroma retention, discolouration etc. (this is more critical in case of Chilli powder)
ii) Climatic conditions during storage, transportation and distribution
iii) Type/ sector of market
iv) Consumer preferences
v) Printability and aesthetic appeal

The package types generally used as consumer packs are:

i) Glass bottles of various sizes and shapes with labels and provided with metal or plastic caps. The plastic caps have added inbuilt features of tamper evidence, dispensing, grinding etc.
ii) Printed tinplate container with/without dispensing systems
iii) Composite containers with dispensers
iv) Plastic containers with plugs and caps with dispensing and tamper evidence features
v) Printed flexible pouches – pillow pouch, gusseted pouch, stand-up pouch.
vi) Lined cartons

The printed flexible pouches have recently become very popular due to their easy availability, excellent printability, light weight, machinability and cost-effectiveness. Depending upon the functional and marketing requirements, the laminate / film can also be tailor made to serve a specific need. The printed flexible pouches are generally laminates of various compositions. Some of the commonly used laminates are:

i) Polyester / metallised polyester/LDPE
ii) BOPP / LDPE
iii) BOPP / metallised polyester/LDPE
iv) Polyester / Al foil / LDPE

3 ply laminates such as 12µ PET / Print / 12µ Met. PET / PE can avoid delamination and prevents smudging and de-figuring of the print.

Polyester and BOPP based laminates are generally more popular for spice packaging due to certain advantageous characteristics of each of these two films.

Polyester used for lamination is generally 10 or 12µthick. The film is highly transparent with excellent clarity, gloss and printability thus enhancing the sales appeal. The film has very low moisture and gas permeability and, therefore, ensures prolonged shelf life of the contents with aroma, flavour and taste retention. The very high mechanical strength (tear, puncture, burst and flex) minimises damage to the contents during handling and transportation. The film has good machinability as well as printability. The latest printing technologies help in improving sales promotions. The film is free from additives and, therefore, does not impart any odour or taint to the sensitive spice product that is packed.

BOPP films may be heat sealable or non heat sealable. The film has high yields, is stable under climatic changes and has excellent moisture barrier. This film is smooth, glossy, crystal clear and has high mechanical strength and non-contamination property for food contact applications.

The types of sealing of pouches from flexible plastic based materials could be variable:

- Centre seal formation
- Three sides seal formation
- Four sides seal formation
- Strip pack formation

The vital link in the performance of the pouch is the seal integrity. The performance of the heat seal layer is very important. Even if the film structure has been designed with exceptional properties, with excellence in interlayer lamination, if the sealing of the pouch fails, the product may get contaminated and in some cases become unfit for consumption.

1.15.4 Marketing

Processing, branding and marketing of the Chillies are the most important components of the entire value chain development. Therefore, the process of marketing should be initiated from the day of inception of the project. The identification and empanelment of market players both at national and international level may be made, who would procure the Chillies produced by the farmers. The project needs to also plan for setting-up of large processing units and market outlets so that dried whole Chilli and various other prducts produced out of Chilli can be prepared and sold in the market. Exclusive web portal for the same may be developed for online marketing and ensuring wider outreach of these products like dried whole Chilli (with and without stem), Chilli powder (ground and crushed), Chilli paste, Chilly Chutney, Chilli Flakes and Chilli seeds. The project may also plan for proper packaging and branding of the product in the name of Mahashakti Foundation; and there should be continuous effort made through adverstisement of the products to reach out to the private players and individual consumers both at the national and international level. The project may also plan for engaging women SHGs and individual women entreprenuers to manage the processing units, preparation of various products, its packaging, branding and selling through web portal and market outlets. All these marketing intiatives would not only fetch better price for the farmers but also create employment opportunities and attract more and more farmers to start producing Chilli as a commercial crop.

1.15.4.1 Creating Market Awareness

Creating market awareness among the farmers about the Chilli and Chilli based products should be given high priority so that the farmers can understand the market channels and help them adopt appropriate marketing strategies to gain more income from selling Chilli.

Chemical fertilisers, pesticides, and fungicides are widely used in agriculture to improve crop yields. But most of the compounds used are synthetic and their overuse causes environmental pollution and heath problems. Now a days, more and more people people prefer organic fruits, vegetables and spices. Export quality of food products require compliance of certain standards. So farmers should be sensitized for optimal use of chemical fertliser instead of

overuse of the same, use of bio-fertilser and practicing organic farming so that the products could be of export quality.

1.15.4.2 Establishing Marketing Linkages and Transportation Facilities

The farmers sell their products to the village traders/commission agents in their village collection points but get the payment in late. Farmers also sell their produce at the local Haat on credit and get the price of their produce on weekly basis. Often they get the price immediately. Sometimes traders do their monopoly observing the supply-demand scenario. The product reaches finally to the consumers through three to four aggregators receiving commission. So there should be regulated market price and institutional support for procurement of Chillies from the producers directly so that they get the right price. Government marketing institutions like TDCC and ORMAS which can be tied-up with for continuous market linkage support and sustainability of the promoted product. Sustained institutional linkages with TDCC, ORMAS, Corporates etc. can help streamline systems. ORMAS, and TDCC are extending support for dry Chilli but not in large scale. The SHGs procure green Chilli for making pickles and dry Chillies for processing and making Chilli power. But they cannot procure in large quantity to the amount of product that are available.

As mentioned before, Chillies can be transported in gunny bags (old or new). Transport of Chillies can be done in 2 phases, (i) from farm to aggregation points and (ii) from aggregation points to consuming markets / places. Head loads, cartloads, tractor trolley and truck loads may be used depending on the economic status and land holdings by the Chilli producers in the area. In case of dispatches from the aggregation points, trucks may be used as the main transport vehicles.

1.15.4.3 Establishment of Aggregation Points for Procurement of Dried Whole Chilli

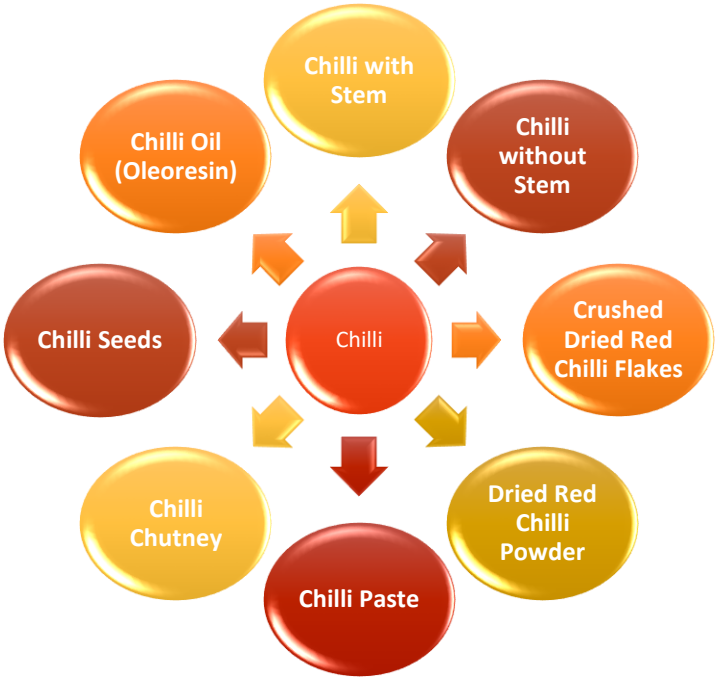
Procurement of Chillies should be oraganised and implemented in all Chillies cultivating project villages of the Bhatli and Jamankira Blocks on a relevant price fixation. Large scale procurement measures will help boosting the Chilli production in the area. The project may plan to establish aggregation points within the vicinity of each production cluster, which would help for large scale procurement from the aggregation point. Establishment of aggregation points may help individual farmers bringing their produce to the designated collection points – aggregation centers – where the crops are collectively marketed to the buyers. That would also help the buyers/companies visiting and procuring the produce from the aggregation points instead of buying it from the individual farmers. With the establishment of aggregation points and storage facility, effort may be made under the project to encourage more and more farmers to cultivate Chilli in all the three agriculture seasons viz. Kharif, Rabi and Summer seasons so that the buyers/companies can procure the product throughout the year as per their need.

1.15.4.4 Post-Harvet Processing, Branding, Packaging and Marketing of Chilli and its By-Products

Support is needed for post-harvest processing both for improving and disseminating technology. Lack of effective and affordable post-harvest technology adopted by the farmers in the project areas for Chilli is a major barrier to the proliferation of the crop. Hence the technological supports that are needed for cleaning, de-huling, de-stoning, sorting, grading and drying may be introduced, which would attract better commodity price in the market. Apart from which, required technological and machinery support should be provided for producing various by products from dried whole Chilli. Chilli with stem, Chilli without stem, crushed dried red Chilli flakes, dried red Chilli powder,

Chilli paste, Chilli chutney, Chilli seeds and Chilli oil (oleoresin) are the various processed products, which can be prepared from Chillies.

Apart from this, Mahashakti foundation should look for its own branding and marketing of the dried whole Chilli and other byproducts. The project may also think of setting-up of two selling outlets, one at the Bargarh district headquarter and other one at the State capital in Bhubaneswar. These two outlets may be opened in the name of Mahashakti Foundation. Apart from selling properly packaged dried whole Chilli, these outlets may also sale various byproducts listed in the earlier section of the report. Apart from this, a web portal may also be developed and linked to these outlets so that online supply can be made to various private players and individual consumers. Proper adverstisement of both the outlets and web-portal may be made to reach out to the individual consumers and private players. After the success of the outlets, opening up of more outlets may be planned under the project. Women SHGs or individual women entreprenuers may be engaged for processing, preparing, packaging, branding, selling at the outlets and handling of online selling of the products through web-portal. Such initiatives would fetch better market price for the farmers in the project areas. Marketing initiatives which aim to provide Chilli farmers with a higher income shape for their produce, like value chain integration, establishment of Producers Group (PG), Farmers Producers Organisation (FPO) and various value addition initiatives should receive support. There is a dire need for linking small and marginal farmers to online marketing platforms, such as the Electronic Agricultural National market (e-NAM).



1.15.4.5 Other Market Related Strategies

- Mapping the major players in the Chilli value chain who are responsible for moving the product along the value chain;
- Introduction of price stabilization system so the farmers get better price across the season and the fluctuation could be checked;
- Gradually, the project may plan for promoting organic farming and highlighting the organic Chilli in the web portal to attract online buyers. Adoption of organic farming by farmers may take time but the project may keep it as a long term goal to achieve in future.
- Formalization of institutions and completion of all legal aspects.
- Increase in quantity and maintain quality parameter.
- Skill development of members on value addition.
- Exposure to processing units for value addition.
- Market exploring and dealing with traders.
- Finalization of selling modalities including quality, price fixation, transportation, payment and date of lifting.
- Account keeping and maintaining transparency.

1.16 Conclusion

Chilli is a potential product for supporting livelihood of small, marginal and landless farmers in the project intervention area. A Farmers' Producer Company in each project block with linkages with financial institutions, marketing agencies, input suppliers and setting up of Custom Hiring Center with all the necessary pre and post harvesting equipments will ensure that most of functions of value chain are firmly knitted and the benefits are maximised for the primary producers. Investment in terms of primary processing, small storage and collection centre, facilitating establishment of input supply at a time when it is required will certainly bring the more profitability to the farmers and will enhance the benefits of farmers. Foremost, the project from the day of its inception should focus on processing of dried Chilli by setting-up of large processing units; branding and packaging of dried whole Chilli with stem and without stem, crushed dried red Chilli flakes, dried red Chilli powder, Chilli paste, Chilli chutney, Chilli seeds and Chilli oil (oleoresin) are the various processed products,; and both off-line and on-line marketing of these products through opening up of market outlets as well as exclusive web portal managed by the women SHGs, individual entrepreneurs and FPCs, which would help in achieveing sustainability of the intiatives undertaken by the project.

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