

Sweet potato cultivation and ecosystem

Sweet potato (*Ipomoea batatas*) is one of the most important crops in terms of human consumption, particularly in the Sub-Saharan Africa, parts of Asia and Pacific islands with an annual production of 91.82 million tons. It is the sixth most important food crop after rice, wheat, potatoes, maize and cassava. The root of sweet potato is consumed which is rich in carotenoids, potassium and fiber. The roots integrate the qualities of cereals (high starch), fruits (high vitamins, pectin, etc) and vegetables (high vitamins, minerals). The roots are processed into various products like jam, jelly, soft drinks, pickles, sauce, candies, etc. sweet potato is also assumed as a great health food due to various bioactive principles.

In India, sweet potato is mainly grown in North and Eastern parts of the country, mainly in the states of Odisha, Bihar, Chhattisgarh, Jharkhand, West Bengal and Uttar Pradesh which together contributes to 90 per cent of the total production of the crop. (Insert graph: production of world-Asia-India)

Jharkhand has been divided into three agro-climate zones, namely central and northern eastern plateau zone, western plateau and north-eastern plateau zone. Ramgarh lies in the central and north-eastern plateau zone. As per the strategic research extension plan of the district, Ramgarh has been divided into three agro ecological situations (AES) namely i) Upland rainfed forest ii) rainfed-medium land iii) degraded mining situations

Table 1: Agro ecological situations in Ramgarh

AES No.	Name of AES	Name of Block
AES – I	Up land rainfed forest	Mandu
AES – II	Rainfed - medium land	Gola, Dulmi, Chitarpur
AES – III	Degraded Mining situations	Patratu

Agriculture is a predominant economic activity in Ramgarh and employs 75 percentage of the population. The undulating hilly tracts with red laterite soil makes the area fertile and suitable for vegetable cultivation. Agriculture is mainly rainfed, the major crops grown are paddy, wheat, maize and vegetables. The gross irrigated area in Ramgarh district is 11992.5 ha, while the area under partial and totally rainfed agriculture is 49575.1 ha. the blocks with the highest rainfed areas are Mandu, Gola, Patratu and Dulmi Blocks. This indicates the huge dependence of farmers on monsoons. (Source: Department of Agriculture and KVK)

Study purpose

Global Opportunity Youth Network (GOYN) a global multi stakeholder initiative, aims to catalyze youth economic opportunity at scale by strengthening cross-sector, community-based approaches to address youth unemployment. GOYN focuses on “opportunity youth,” (OY) specifically aged 15-29 who are not in education, employment or training or are informally employment, and considers an asset-based framing that recognizes the system, rather than individual nature of challenges that these youth face. Ramgarh district (Jharkhand) has been selected as a prototype rural district due to the presence of a strong multi-stakeholder ecosystem, industry presence, a supportive district administration, close proximity to the state capital, coupled with the fact that the that nearly 70% of the youth in Ramgarh are Opportunity Youth. GOYN takes a place-based approach to youth

opportunity by building local youth-focused collaborative infrastructure. In this context, research was conducted by Accenture development partnerships (ADP) to understand the potential local opportunities available, and to engage the youth in meaningful and lucrative livelihoods options which will improve the local economy of the district. From the research findings, sweet potato emerged as a potential commodity for the opportunity youth of Ramgarh, with favorable agricultural landscape and huge demand for the produce in the markets. Sweet potato is a very prominent crop in the low water retention areas (uplands) of Ramgarh district during the kharif season and the district attracts traders from neighboring states (Bihar, West Bengal and Uttar Pradesh) in the harvesting season which starts in September and lasts till November. As next steps, a working group was formed with subject matter specialists, young farmers, representatives from youth advisory group and local partners to deep dive into the opportunities to engage the opportunity youth.

With very less information available in the public domain on sweet potato cropping pattern, trends in yield, variety cultivated, number of households involved in sweet potato production, etc it was decided to conduct a detailed multi-level field assessment about the crop with farmers at their farm gates, traders and the Government agriculture department

(Insert district map with block & sweet potato areas)

Methodology

An explorative study was conducted in selected patches of Ramgarh. The patches were identified with the use of secondary data collected from Government agriculture department, local farmers and local partner agencies. The purpose of the study is to identify sweet potato patches in the district, explore marketing opportunities for young farmers and value chain opportunities for the commodity. Explorative study mainly includes qualitative research which has greater impact on the results as compared to quantitative data for agriculture related studies. In the study conducted-qualitative research provides us an overall picture of production, area of cultivation, package of practice, market players in the ecosystem and challenges in marketing of sweet potato. A checklist was developed for the semi-structured focus group discussions (FGDs) attached in the annexure. ____ number of FGDs and key informant interview (KIIs) were conducted with farmers, traders and other relevant stakeholders.

- i. Selection of sample and stakeholders for data collection: for the selection of sample areas (Blocks, GPs and villages), a series of discussions and workshops were conducted with the members of the youth advisory group (YAG), officers from the Government agriculture department, representatives from local partners organizations (NGOs) and GOYN team members. the government agriculture department has Krishi mitras (community cadres) at the village level and one Block Technical manager (BTM) for every blocks. the Krishi mitras and BTMs work closely with the farmers and engage with them throughout the year. Thus, they acted as an important source of secondary information for the identifying the sample areas for the study. Similarly, several rounds of interactions were conducted with farmers involved in sweet potato production and with the local traders. On the basis of the secondary information 8 patches were finalized for the study
- Village level traders (VLTs) and Block level traders (BLTs) were identified from the selected clusters for the study as the VLTs and BLTs are sweet potato farmers. The selection of VLT and BLT for KII has been done with purposive selection method.
- Farmers, traders and local CSO representative were involved in the selection of traders for KII
- One FGD and 3-4 KIIs were conducted with farmers for each potential sweet potato patch
- For every FGD, 10-15 farmers involved in sweet potato cultivation were involved. These farmers were from mixed categories i.e., **best, medium and low.**

(Insert: sample size table in form of bar graph)

Table 2: Participants interviewed in sweet potato study

Sl. No	Description	Sample Size
1	FGD with Farmers	8
2	KII with Farmers	30
3	KII with VLT	4
4	KII with BLT	6
5	KII with Government staff	4
6	KII with Agriculture Entrepreneur (AE)	2

- ii. For market study, three types of traders have been identified and categorized into village level traders (VLT), Block level traders (BLT) and outside traders.
- village level traders are the ones who does trading between villages
 - -block level traders are the ones who does trading between blocks
 - -outside traders are the ones who procure the produce from the local areas and market/ sell the produce to other districts/ states
 - KIIs were conducted with the VLTs, BLTs and outside traders to get market related information like- the main market players, volume of sweet potato marketed from the area, peak seasons for sweet potato procurement and marketing, journey of the produce from farms to markets

Data collection

- Primary data was collected through FGDs and KIIs with farmers and trader. Farmers from different categories viz. best, medium and low (best category farmers: medium category farmers: low category farmers:) were selected to get an overview of different segments of farmers. The sample of farmers were selected by the community cadres, youth fellows and partner organizations, under the guidance of an agronomist having experience working on sweet potato in the district
- Secondary data were collected from the representatives of Krishi Vigyan Kendra (KVK), National Bank for agriculture and rural development (NABARD), District agriculture department and desk research from official websites of central tuber crops research institute, Tamil Nadu agricultural University and food and agriculture organization

Study findings

Dulmi and Gola have been identified as highest sweet potato producing Blocks of the district. 8 patches have been identified from these blocks which engages in the commercial production of the crop. Eight focus group discussions were conducted with the three categories of farmers i.e., best, average and struggling/ low at the village level and 30 KIIs were conducted with farmers from 13 villages. So, all total 21 villages i.e., 16% of total village of these two blocks and 127 farmers have been covered for the study

Profile of OY in the sweet potato value chain:

In the study, 127 farmers were involved. A snapshot of age group of farmers is given below

Age group	No of farmers under the age group
20-34 years	24
35-49 years	49
50-64 years	49
65-79 years	5

(The table to be converted into charts/ pie)

Out of the total 127 farmers, 77 percentage of the farmers were in the age group of 35 to 64 years, 4 percent above the age of 65 years and 19 percent below the age of 35 years. The statistics clearly shows, the urgent need of designing intervention of how young farmers can be included in sweet potato value chain.

Education level:

Education level	No of farmers interviewed
Under matriculation	69
Matriculation to higher secondary	46
More than higher secondary	12
Total no of farmers interviewed	127

Out of the 127 farmers, approx. 59 percent have completed matriculation and only 15 percent (approx.) have studied more than matriculation.

Land holding pattern:

The average land holding per farmer from the field assessment patches are 2.47 acres. The average size of low water retention areas with water logging capacity per farmer is 1.4 acres. In the low water retention areas, 50 percent of the farmers are marginal farmers with land holding of less than 2.5 acres and 36 percent farmers are small farmers with land holding of less than 5 acres. Presently, Sweet potato is grown in areas with water retention due to its nature of being a rainfed crop.

Area of farm land owned in acres	No of farmers with landholdings in acres	Average holding of upland area in acres
0.5-2.5	64	0.92
2.5-4.5	46	1.41
4.5-6.5	9	2.05
6.5-8.5	5	4.5
8.5-10.5	3	4.3

Existing production technique

- Farmers start planting the vines during Kharif (June-August) season utilizing the monsoon rains.
- The preferred planting method by the farmers is Ridges and furrow method vs mounds method, which creates drainage problems
- Planting is done by using vine cuttings which are planted in the soil with both ends exposed and middle portion buried in the soil

- Farmers plant the vines 7-10cm deep. A close spacing is practiced in sweet potato cultivation to achieve maximum tuber yield
- The farmers propagate sweet potato by means of vine cuttings. To obtain vine cuttings, a nursery is raised either from stored tubers or from vines of the freshly harvested crop
- Vines obtained from nursery are found to be healthy and vigorous resulting in maximum tuber production. The apical vine cuttings when used as planting material have been reported to secure higher tuber yields in sweet potato
- The cut vines with intact leaves are stored under shade for two days prior to planting in the main fields to promote better root initiation, early establishment of vines and higher tuber yield
- Fertilizers are broadcasted (scattering them all over the soil) by the farmers before making mounds/ridges. The farmers mostly use cow dung, single superphosphate (SSP), urea, etc
- Harvesting is done manually in about 90 to 110 days' time depending upon the variety. The tuber yield ranges from _____ t/ha
- There is no sorting and grading in practice adopted by farmers for selling in the local market.

Sweet potato Cultivation trends:

All total of last three years of data around area of cultivation and production has been taken from 8 patches. The average per farmer per years cultivation area is 0.6 acre and per farmer per year production is 2.12 ton. The average productivity of last three years is 8.46 ton/ha. The highest productivity patches are Bariyatu and Beyang with 11 ton/Ha productivity. The lowest productivity patch is Sirka with 5 ton/ ha

Patch name	Average no of sweet potato farmers in the patch	No of farmers interviewed from the patch	Avg area of sweet potato production in last 3 years in acres	Avg production from last 3 years in tons	Avg productivity from last 3 years n tons/Ha
Bariyatu	Data missing	13	0.96	4.27	10.92
Beyang	200	15	0.51	2.12	10.98
Bongasouri	140	17	0.81	2.13	6.54
Chokad	400	18	0.47	1.82	9.38
Nawadih	700	18	0.39	2.46	8.70
Potamdaga	300	12	0.63	1.81	7.08
Rakuwa	650	20	0.80	2.86	8.74
Sirka	100	14	0.28	0.57	5.12

Patches with highest productivity are Bariyatu and Beyand with yield of 11 tons/Ha and the lowest productivity patch is Sirka with yield of 5tonns/ Ha. The reason behind low productivity is early harvesting practice for getting higher market price- (can insert this is as fact box)

Cost of production and profit (can insert the points below in the form of info-graphs)

Average total cost of production per acre is Rs.15294

Average income per acre is Rs. 38026

Average net profit per acre is Rs.22732

highest cost incurred in the patches are for fertilizers and mound/ ridge making- for fertilizer per acre cost is Rs.5987 & for mound/ridge per acre is Rs.3550

Economics at different stages	Beyang	Bongasouri	Chokad	Koiya	Nawadih	Potamdaga	Rakuwa	Sirka
Average cost for ploughing	3000	4000	2000	4000	3600	2000	3600	3000
Average cost for mounds/ridge	4000	3000	3600	6800	3000	3000	1800	3200
Average cost for fertilizer	9950	9350	3000	10500	4300	2400	3900	4500
Average cost for transplantation	2000	3000	1500	5000	3000	1500	1200	1800
Average cost for weeding	3000	1500	4000	5000	6000	500	2000	2000
Average cost of harvesting	3200	1800	4000	5000	6300	2500	2950	5600
Average of total costs per acre (in INR)	18150	15650	12600	25500	19600	6900	10050	13900
Average production (ton/acre)	4.44	2.64	3.79	4.42	3.52	2.86	3.53	2.07
Average income	44453.44	26477.73	37975.70	44210.52	35222.67	28663.96	35384.61	51821.86
Average profit	26303.44	10827.73	25375.70	18710.52	15622.67	21763.96	25334.61	37921.86

Economics of sweet potato (harvesting stage)

Before the harvesting of sweet potato is done, the rate is finalized between the trader and the farmers. There is little or no scope for the farmers to negotiate the farm rate with the traders and the farmers can access only Gola market for updates on sweet potato rate. The traders decide the local rate taking into considerations the mandis of Gola and out of state mandis, including the procurement costs to be incurred by them. The procurement costs include- cost of bags, transportation costs, commission given to village level traders, agents, labor costs for loading and unloading of produce. The average cost of procurement for sweet potato at the level of block level trader (BLT) is Rs.1188 per ton. The selling price at the farm gate level varies from Rs.7,000/ ton to Rs.31,000/ton. Farmers get a higher price of the early harvests in demand during local festivities like Janmashtami, Ganesh puja and Vishwakarma puja. The price drops once there is surplus supply of sweet potato in the market.

Farmers from Sirka patch, get into early harvesting and are able to grab the local markets with maximum profit. A substantial supply gap of 277 ton (approximately) is often seen during the festivities while the per ton market rate is Rs.13142/ ton.

Type of trader	Average cost of bag per ton	Average cost of transportation per ton	Average cost of labour per ton	Average cost of agent/ VLT per ton	Average of total cost per ton
Block Level Trader	430.30	295.45	184.85	277.27	1197.88
Village Level Trader	381.82	90.91	90.91	0.00	563.64

Margin at different level:

Type of traders	Average minimum margin at VLT level (in ton)	Average maximum margin at VLT level (in ton)	Average minimum margin at BLT level (in ton)	Average maximum margin at BLT level (in ton)
Block level trader (BLT)			583.33	1166.67
Village level trader (VLT)	340.91	856.82		

Age of traders and experience in sweet potato marketing:

The average age of traders involved in sweet potato marketing is 43 years. Out of the --- no of traders interviewed, 40 percent are in the age group of 31 to 40 years and 60 percent are in the age group of 41 to 51 years. The Block level traders (BLTs) have an average experience of around 19 years working in the marketing and trading of the commodity. Similarly, village level traders (VLTs) have an average experience of 12 years working in sweet potato. Some of the VLTs also work as BLTs in Gola and Dulmi blocks.

Education level of traders:

90 percent of the traders are educated, out of them only 30 percent of Block level traders (BLTs) and 20 percent of village level traders (VLTs) have completed matriculation. In case of farmers involved in sweet potato production, around 36 percent of farmers have completed matriculation.

Challenges in sweet potato production:

Production stage

- Unavailability of labor for farm bed preparation
- Higher cost of farm bed preparation
- Dependence on monsoon for irrigation
- Splitting of sweet potato tubers in production stage
- Damage to sweet potato tubers caused by *O.anastomosalis*, which results from the larvae boring into the main stem. This is one of the most destructive pests

Market challenges

- Farmers prefer hybrid variety of sweet potato due to its high yield but be stored for longtime. The traditional varieties give low yield but can be stored for up to 3-6 months.
- Difficult to produce long and thin shape sweet potato, as per the market demand
- Oversize of produce. The preferred produce in big mandis/ markets are sweet potato which are thin and long with an average weight of 150 to 200 grams. As there are no sorting and grading done with late harvesting practices, the size of the produce is affected and in quite unattractive for the big markets. This leads to distress selling of the produce at the local markets with low price
- The Block level traders (BLTs) provide credit support to the farmers in cultivation stage, this creates a sense of compulsion within the farmers to sell their produce to the Block level traders (BLTs).
- Delay in payments is a major problem faced by the farmers. At times, it takes a month for the farmer to get his money from the village level and block level traders. The block level traders are dependent on outside traders for their payments. It takes around 30 days for the Block level traders to get their money from traders of other states. It's a vicious cycle where the payments are dependent on the traders at every stage
- In Ramgarh's sweet potato clusters, the block level traders (BLTs) have no experience in storing the produce. During the field interactions, the BLTs were of the opinion- there is less chances of making profits by selling preserved sweet potato, because it is mainly used for fresh consumption

Sweet potato consumption: existing practice

Presently, sweet potato is being used and marketed for fresh consumption only. Few parts like roots, leaves and vines (part of the plant which climbs by creeps along the ground, or stem) are edible for human consumption. The leaves can be used as leafy vegetable and the roots are mostly boiled or roasted. Sweet potato has the potential to be used as snacks, pickles, desserts and in bakery products. Industrial usage of sweet potato is for production of starch, alcohol and as a flour substitute. The leaves are also used as fodder for livestock feeding because of its high protein content and wholesome nutritional values.

Smart art-sweet potato consumption

Roots can be roasted or boiled for fresh consumption

Sweet potato flour for bakery products i.e., bread, cakes, etc.

Sweet potato jam, ice-cream, kheer and pickles and chips from tubers

Leaves of the plant can be used as leafy vegetables in curries

Starch and alcohol can be extracted from sweet potato for industrial usage

after harvesting, the plant residue can be used for animal feed due to the nutritional content in leaves and vines

Sweet potato value chain:

there are different actors at various levels of sweet potato cultivation. the value chain actors are mapped below:

- fertilizer input service provider
- sweet potato farmer
- agriculture equipment service provider
- Traders (village Block level outside traders)
- retailers
- consumers

Market linkage:

There are three types of market players in sweet potato marketing ecosystem i.e., village level traders, block level traders and outside traders and market systems established in sweet potato production clusters. Market channel have been established for selling fresh sweet potato and Gola is an important center for sweet potato marketing. The Block level traders (BLT) are also involved in supplying of agricultural inputs like pesticide, micronutrient, etc to the sweet potato farmers. From Ramgarh district, sweet potato is mainly marketed to the Northern states of Bihar and Uttar Pradesh and also to West Bengal. Uttar Pradesh has more than 11 mandis, and the big players (traders) from the mandis come to Ramgarh for procuring the fresh sweet potato. A snapshot of which is given below

List of prominent mandis for sweet potato			
Bihar	Uttar Pradesh	West Bengal	Other markets
Chhapra	Gorakhpur	Kolkata	Delhi
Siwan	Akbarpur		Nepal
Patna	Balia		
Gaya	Jounpur		
Jahanabaad	Sultanpur		
	Muradabad		
	Gazipur		
	Salempur		
	Mou		
	Kanpur		
	Varanasi		

Other markets- delhi, Nepal (map as well as table)

SWOT analysis of sweet potato

Strength: • Minimum dependency on external input • Low cost of production • Suitable crop for rain fed conditions • Minimum care is required after plantation • High returns in limited time due to short crop maturity period • High market demand of the produce • Favorable production ecology • Highly nutritious • Large area is under sweet potato production	Weakness: • Unavailability of quality vine cuttings for propagation • Sweet potato plantation activity is labor intensive • Only one variety is available locally for plantation • Low price for late harvest produce • Distress selling at farmer level • No ongoing practice of grading and sorting • Limited knowledge on value addition opportunities
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Opportunity: • There is scope for introducing early harvesting and high producing variety • There is opportunity to introduce farm mechanization in sweet potato cultivation • Knowledge and skill development of value addition of produce • Linkages with new market channel • There is opportunity to set up commercial nurseries for producing quality vine cuttings to be used for sweet potato propagation	Threat: • Short shelf life • Limited knowledge on production techniques i.e., fertilizer application, pest management, pre- and post-harvest management practices • Dependency on rain for irrigation sometimes leads to crop failure • Unavailability of labor
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Economic opportunities for OY in sweet potato cultivation:

Throughout the study, farmers and block level traders shared their requirements for input and output services around sweet potato production and marketing. Farmers mainly require quality planting materials, fertilizers, farm equipment for ploughing, preparing mounds, sprinklers for irrigation, crop management assistance for weeding, etc

Opportunity Youth in Ramgarh will be organized in a producer group to aggregate the produce for a larger quantity and increased bargaining power. 200 OY with average holding of 1.4 acre would contribute a minimum of 500 tonnes of sweet potato. OY will be connected to several new channels of marketing like Direct2Customers portals.

PILOT COMPONENTS:

1. ORGANISING OPPORTUNITY YOUTH INTO PRODUCERS' GROUPS: The bargaining power of small-scale entrepreneurial farmers is typically limited. Their individual output levels are often modest, which limits their capacity to bargain with suppliers. Due to their limited negotiating power, they may be forced to pay more for supplies and equipment. The same may be said about market negotiating power. Small-scale farmers are frequently forced to accept lower prices for their goods due to a lack of bargaining strength. They would have a better chance of determining market prices for their items if they had more negotiating power. Farmers who are just starting out are particularly exposed to economic shocks:

- Unexpectedly poor yields or crop failure
- Price adjustments for inputs and products
- Market relocation
- Interest rate changes
- Service charge increases
- Additional market requirements (e.g., levies, fees, changes in packaging requirements).

Changes like these might be the difference between profit and loss for a farm. Farmers are at a high risk of being unable to recover from such shocks. Strengthening the agricultural business's asset base or reducing its exposure to risk is one way to tackle such problems. Many farmers require support in adapting to economic changes and developing their entrepreneurial skills. There is mounting evidence that belonging to a (youth) producers' group can assist young people in overcoming market access barriers. The proposed pilot program will focus on bringing the OY together in producer groups to prevent such documented vulnerabilities and prevent the market shocks. Formation of producer group will also facilitate large quantities to suffice larger quantities for new D2C market players.

2. ACCESS TO KNOWLEDGE, INFORMATION AND EDUCATION: It is well known that education is essential for rural communities to overcome development problems. Not only is there a clear relationship between food security and rural children's education, but basic numeracy and reading skills have also been demonstrated to assist farmers improve their livelihoods. In poor states like Jharkhand, rural regions generally have less access to information and education than cities, and this disparity is visible as early as primary school. The Internet is becoming an increasingly essential medium for acquiring knowledge and allowing producers to be better linked, especially in the world's poorest regions. Because the next generation of farmers is growing up in an age of smartphones and computers, irrespective of their education status they are more likely to be interested in utilizing the smart phone handy technologies to figure out how to enhance their agricultural operations or call a farm support service. They will most likely be more tech friendly and more willing to explore new technology, as well as having a stronger interest in higher-value items and market connections than earlier generations. Relevant information can be useful in bridging the education gap. It is imperative to use latest information system for establishing the value chain for agricultural commodity. The opportunity youth will be connected with the local available agriculture education institutions for latest information. Extension staff may assist OY in identifying, investigating, and evaluating opportunities.

3. SUPPORT IN IDENTIFICATION OF BASIC INFRASTRUCTURE FOR THE STORAGE OF SWEET POTATO CROP: The next most essential step in the process is to create an inventory of market infrastructure for each market facility that may be included in the Programme.

To obtain profile of each significant markets in the area and around. From these profiles an inventory of market and retail centres can be built up, which can provide the basis for preparing the market development pilot.

Identify responsible agencies responsible for market management

Understand the frequency of operation

Identify the number of villages or areas agreeing to sending produce to the group and total population

Identify the physical facilities available in the area.

The next step will be to identify potential road connections to the markets. Markets should (ideally) have year-round access to the road, although this may not always be practical. The potential markets' accessibility must be specified in terms of how the market's access road (or roads) connect to the rest of the district and regional road network. The best route should be chosen to establish the storage facility.

4. FACILITATING LINKS TO POTENTIAL MARKETS FOR SWEET POTATO CULTIVERS: Millions of smallholders in India confront significant challenges in moving from subsistence to higher-income farming. It is understood that inaccessibility to the potential markets is a major factor. There are numerous other factors that affect the farmers' prospects in value chain and with establishing market linkages. These are location, size of farm and quantity of produce, financial assets and linkage to financial services, ability to manage resources, costs of inputs, transaction costs, volatility of prices, access to and adoption of production technologies, skill trainings, access to roads and transport facilities, availability of farm labour also affects the accessibility to the right market.

The pilot program aims to support OY with smallholding with detailed scenario options for a crop, analysis and potential along with connecting with buyers with reliable market information.

The goal of connecting farmers to markets is to invest in ways that enable specific types of farmers and communities of farmers to access markets that match their capacities, production, investment, and risk profiles, rather than to link the most vulnerable farmers to the highest value or most dynamic markets. The project will also help OY producers to create an understanding about the certifications that retail sector demands for and support in getting those certificates for their farms and produce.

5. ESTABLISHMENT OF INFRASTRUCTRE FOR VALUE ADDED PRODUCTS OF SWEET POTATO: Diversifying agricultural businesses improves revenue streams while also reducing risk. Diversification refers to expanding the number of items produced and marketed. This diversifies revenue sources, reducing the chance of loss. Diversification techniques that work look at underutilized farm resources, unmet demand, and the farmer's expertise and abilities to determine what additional product to grow. Diversification may also happen at the end of the supply chain by adding value and creating "niche" products. Value-adding necessitates a thorough examination of the present product in order to find methods to improve it. Farmers may target different consumers with different goods of varying value to satisfy shifting market demands by adding value.

IMPLEMENTATION TIMELINE:

(Months)

Steps	Major Activities	01	02	03	04	05	06	07	08
Formation and capacity building of youth producer group	Identify the number of villages or areas agreeing to sending produce to the group and total population								
	Mobilization of sweet potato cultivators to form village level associations & motivating/encouraging them to cooperate on input supply, facilitating training & collective marketing								
	Formation of block level associations to federate village associations for collective purchase of inputs, channeling government subsidy schemes and sharing of technical information								
Linkages with technical institutions	Associations encourages and enabled to interact with local technical institutions specialized in agriculture/ horticulture- KVKs, CTCRI, agriculture universities, ATMA and others								
Capacity Building of input supplier	Input suppliers will be encourages & supported in systematically increasing their knowledge of good cultivation practices so that they could advise farmers on the better use of inputs such as seed, fertilizers, bio-pesticides & equipment								

Credit-Linkage with commercial banks & MFIs	Support of sweet potato cultivators in obtaining KCC from banks and group loans from both commercial banks as well as local MFI.								
Identification of Road links	Identify potential road links to the markets ensuring year-round access to the road								
Creating an inventory for each market facility	Profiling of each significant market in the area and around and identifying responsible agencies for market development								
Identification of storage facility	Renovation of existing storage units, linking the OY groups with the facilities								
Co-ordination with diverse market actors	Facilitating connection with sweet potato processing units, health food startups, nearby markets for supply								
D2C startup team linked with sweet potato growers	Sweet potato growers are supported to sell their produce in higher level mandis or directly to startups.								
Retail outlets promoted for marketing sweet potato	Encouraging direct retail of sweet potato by growers in local market places by establishing small shops either individually or in small partnerships.								
Establishment of value addition infrastructure for sweet potato	Identification of location, products to be made, finances, and product market feasibility study								
	Preparation and submission of project proposal for financial support to bank								
	Establishment of local processing centre for sweet potato								

POSSIBLE OY INTERVENTIONS

PRODUCTION:

Soil Testing Labs: Fertilizer consumption in different districts and states in India is extremely uneven, with differences between soils, weather conditions, water availability and crops. The NPK ratio, which is a measure of fertiliser balance, reveals significant interstate variation. Despite an astonishing increase in fertiliser usage during the green revolution, one of the reasons for decreased productivity in recent years has been their careless application. Soil, water, and plant testing are essential tools for research, consulting services, and the formulation of reasonable fertiliser recommendations, as well as the development of appropriate soil management and agronomic techniques.

According to investigations, one cause for the uneven fertiliser use is the lack of adequate soil testing facilities, which obliged farmers to rely on fertiliser merchants for fertiliser recommendations. Soil testing is critical for monitoring various types of land deterioration and deciding on land improvement solutions. Therefore, creating effective and efficient soil, water, plant, and fertiliser analytical services is a vital means of enhancing and maintaining land productivity, as well as crop and food production, a challenge for Indian farmers and scientists. As a result, the Indian government has begun a large effort to promote Soil Health Cards among farmers. In addition, the Government of India has proposed to provide capital subsidy support for the establishment of Soil Testing Labs in rural areas. However, the government soil testing labs in many areas are not functional. There is a soil testing laboratory established by SGS Private Limited in Mandu block of Ramgarh. But many people are not aware about it and even not aware enough to use soil testing as a tool. In Ramgarh, if required, farmers must send their soil samples to soil testing laboratory at Ranchi. The laboratories take a lot of time, sometimes exceeds the season as well. Even after it gets tested, farmers often complain of mixing of samples. Hence, there is a strong need of private owned soil testing laboratory for which GOI provides capital support.

Establishment of soil testing laboratory at village level is one of the much-required enterprise that can help local farmers and generate income. There are 338 villages in Ramgarh district. There is a scope of 338 village level testing labs. Or 6 block level soil testing laboratories can be established, connected by satellite home scale units for sample collections. Another option of mobile soil testing lab can be experimented in the district. Apart from private entrepreneurs/ individuals, PACS, FPOs, farmer clubs or any other entity approved by GoI can establish a soil testing laboratory. There are options for mobile soil testing labs as well.

Estimated Unit Cost of INR 10 lakhs is required for a soil testing unit at village level. For which GoI provides 40% of cost or INR 4lakhs support, whichever is lower. Banks can provide loan to the units with even higher costs.

2. Nursery Establishments for new varieties:

One of the value chain difficulties in India's largely smallholder-based sweet potato production systems is a lack of sufficient planting material at the start of the rainy season. Access to planting material of adapted cultivars is one of the issues that must be addressed in order to achieve widespread acceptance of improved sweet potato cultivars. In Ramgarh, the main stumbling block to reaching maximum sweet potato production potential is a lack of planting material at the start of the planting season. Farmers follow the traditional way of preparing seeds from the locally available tubers and reported shortage of vine, difficulty in conserving and accessing vines as one of the major constraints. Moreover, because sweet potato vines cannot be saved for the following planting season due to the extended dry season, farmers may only plant them once a year during the main rainfall season. This forces farmers to move to traditional practice that results in lesser production.

On an average, 1 acre of nursery production can supply vines for 15 acres. There is a scope of 1 nursery for at-least 2 villages.

3. Composting Units: Sweet Potato is a tuber crop and very well-known root part is consumed. However, the green leaves are also used for few recipes but localised composting pits can be created with the farmers to use the foliage remains of the sweet potato plants. Once the plant is uprooted, the green leaves are either thrown away or mulched in the soil. The green part can be collected and used for composting.

4. Low-Cost Storage Houses at villages: Genotypes, cultural traditions, and the storage environment all play a role in storage. When it comes to storage, there are genotypic variances. The temperature and humidity essential for curing and long-term preservation of sweet potatoes can be maintained in a properly constructed storage facility. But to facilitate the supply chain, local, low cost and common storage structures can be created. OYs can easily engage in construction of traditional low cost, raised structures with humidifiers to retain the moisture but avoids fungal infection. These low-cost structures will help in raising the bargaining powers of the OY farmers. Along with that, this may help in grading and sorting of the crop for the appropriate market requirements. The low-cost structures can be prepared with bamboo or locally available construction wood.

Value added products (post harvesting)

There are several value-added products made of sweet potato in the international markets, but local people are hardly aware of it. In local areas, traditionally people use the raw forms to make vegetables and curry. They don't use the value-added products like flour and chips. However, these days due to health consciousness, urban population is more into value added products. The flour is mainly used by people who are trying gluten free meals for making breads, cookies, pancakes, muffins, crepes, cakes and doughnut. Sweet potato flour is priced at INR 500-600 per kg. The other product is become slowly popular is sweet potato chips. This product is gaining popularity in the health confectionary segment but at a slower pace than other products.

The value-added products like flour and chips need a humongous sum of money for marketing as there is a need to create a new market segment, behaviour among the urban population. Chips and flour production are not feasible in the short term, but it may be feasible in the long run if a lower discount rate prevails. Production of flour is possible with the homegrown varieties as well. However, the research institutes can help in identifying the right varieties for better quality and quantity of flour. Exportable, local marketable, and non-marketable yield components were assessed at harvest, as were the diameter, length, and shape of the roots for export, all with full farmer participation.

Table 3: Summary of possible OY interventions

ENTRY POINTS	STARTUP ACTIVITIES	Estimated No. of OYs engaged
Natural resource management	Upgrade production sites/land preparation support before investing in commercial farming	300
Input Support	Connecting with good quality suppliers, nursery establishments for good quality vines/seeds	150
Infrastructure Support	Identifying cold stores and warehouses, mapping the road network to the potential markets, soil testing laboratories, composting units	150
Unorganized youth farmers with small holding	Form groups and build social capital with savings-led methods before engaging in market linkage	30
More Organized farmers	Focus on strengthening market linkages, storage/warehousing facilities	10
Pilot Testing	work with producers and other chain actors to test innovations before going to commercial scale	10
Processing	Washing & grading facilities, flour making	10

Techniques	unit	
Post-harvest value addition	Go straight to market analysis	05
Existing buyer	Develop business plans and initiate an investment program	10
Support for business development services	Strengthen or develop critical business service	10