

# Tribal Agriculture Discourse

Climate-resilient cropping practices in the tribal hinterland to promote sustainable Agriculture in Jharkhand



JTDS

## The project:

The ***Jharkhand Tribal Empowerment and Livelihoods Project (JTELP)*** supported by IFAD.

The overarching goal of JTELP is to improve the living conditions of tribal people in general and Particularly Vulnerable Tribal Groups (PVTGs) in particular. This is sought to be achieved by organising and enabling the communities to adopt sustainable and productive natural resource management regimes, adopt market-oriented production systems and learn the skills and gain the experience of planning and implementing development plans relevant to their villages.

The project focuses in 14 Tribal Sub-Plan Districts of Jharkhand. The project is focusing in 32 tribal dominated poverty-stricken Blocks in around 1800 villages.

## **Jharkhand Tribal Development Society (JTDS), Ranchi, Jharkhand**

The JTDS, Ranchi has been registered under the Societies Registration Act of 1860, primarily to implement tribal development projects of Government of Jharkhand. The society has a patronage and guidance under the Department of ST, SC, Minority and Backward Class Welfare, Government of Jharkhand. The IFAD funded JTELP in Jharkhand is being implemented by the JTDS, Ranchi. It has one State Project Management Unit (SPMU) and 14 District Project Management Unit (DPMU) in respective project districts.

## **PRADAN Development Services (PDS)**

PRADAN Development Services (PDS) is a public charitable trust initiated in 2009 by development professionals having years of experience in the sector and leading one of the largest voluntary organisations in India namely Professional Assistance for Development Action (PRADAN), New Delhi.

The primary aims and objectives of PDS being -

- Eliminate poverty through capacity building and education fostering community processes.
- Conduct and promote assignments through research and studies on social and economic development including entrepreneurship development, livelihoods improvement and economic development.
- To identify, promote and facilitate development of various livelihoods which are economically, socially and environmentally sustainable.
- To undertake, aid and assist activities for imparting extension of knowledge in the fields of science and technology, socio-economic development as well as human resource development to foster professionalism and enhance capacity of development sector with a view to improve conditions of the poor.

## **Acknowledgment**

Special thanks of gratitude to the entire team of Pradan Development Services (PDS) for their valuable Technical support for compiling "Tribal Agriculture Discourse" for JTDS.

# TABLE OF CONTENT

Sl.	Title	Page
1.	Introduction	1
2.	The context of Jharkhand	2
3.	The climate change effect	7
4.	Why Climate Resilient Agriculture?	8
5.	Principles of Climate Resilient Agriculture (CRA)	9
6.	The learning ground	10
7.	Organic formulations for fertilizer and pesticides	14
8.	Scale and coverage of CRA practices	15
9.	Involvement of Youth in Agriculture	16
10.	Changes experienced after practicing CRA	17
11.	Season wise recommended crop cultivation viz-a-viz land type under CRA	18
12.	The last word	26

## ACRONYMS

ASV	Aboriginal Seed Vendor
CRA	Climate Resilient Agriculture
CRP	Community Resource Person
DAS	Day After Sowing
DSR	Direct Seeded Rice
EFY	Elephant Foot Yam
FPO	Farmers Producer Organisation
Ha	Hectare
HYV	High Yielding Variety
IFAD	International Fund for Agriculture Development
JTDS	Jharkhand Tribal Development Society
JTELP	Jharkhand Tribal Empowerment & Livelihoods Project
KM	Krishak Mitra
MT	Metric Ton
NA	Not Applicable
NTFPs	Non Timber Forest Products
PRADAN	Professional Assistance for Development Action
PSB	Phosphate Soluble Bacteria
SHG	Self Help Group
GSPEC	Gram Sabha Project Execution Committee
TSP	Tribal Sub Plant
UT	Union Territories
YG	Youth Group



# Climate-resilient cropping practices in the tribal hinterland to promote sustainable Agriculture in Jharkhand

*Demonstrated and replicated across 14 Tribal Sub Plan (TSP) districts under IFAD funded JTELP in Jharkhand*

Climate Resilient Agriculture (CRA) can be defined as **'agriculture that reduces poverty and hunger in the face of climate change, improving the resources, it depends on for future generations.'**

*(Christian Aid, Time for Climate Justice 2015).*

Climate resilience is **the ability to anticipate, prepare for, and respond to hazardous events, trends, or disturbances related to climate.**

Resilience, as defined by scientists means **the ability of a system to withstand shock and continue to develop....** In a diverse system, if one part of the system goes down, the other parts can compensate.

## Introduction

Agriculture is the primary source of livelihood for about 58 percent of India's population. Other natural resource-based enterprises are also the foundation for the country's economic growth. Its related sectors, including field crops, horticulture, livestock, fishery, and poultry are strongly associated with each other's to generate livelihood. According to the State of Food Security and Nutrition in the World, 2020 report - nearly 14 percent of the population (189.2 million) is still undernourished in India. The Global Hunger Index 2020 placed India at the 94th position among 107 countries. Achieving 'zero hunger' by 2030 is a humungous challenge, and needs an integrated and multi-dimensional approach for overall sustainable agriculture and food systems in the country.

Jharkhand falls in the Eastern Plateau and Hill Region Zone of the 15 agro-climatic zones in the country. That means it needs special care and thoughtful attention while intervening with Natural Resource for changing human conditions.

The Jharkhand 28th State of India came into existence in the year 2000. So, it is already two decades of generating opportunities and development of various Tribal communities residing in the region. Many a developmental engagement initiative has been since then by Government and other developmental agencies that includes the agriculture sector too. Agriculture practices, crops preferences, cropping timing are diverse in a state like Jharkhand due to its topography, weather, rainfall, tradition, community, culture, and market.

Agriculture in Jharkhand is also not left exceptional in terms of rampant aggravated use of Chemicals, hybrid seed and extraneous crops etc by penetration of markets and illusive promotion of such goods.

All these are directly impacting the agrarian community in rural Jharkhand. The potential of traditionally grown crops is undermined during the last few decades in which families are losing control over seed, traditional knowledge & practices.

The entire agriculture system of Jharkhand is yet not completely derailed. The hope of reviving the pride of these crops is possible. To revive these nutrition rich and wide climate variation tolerant crops in this region having unpredictable rainfall pattern. Efforts made from 2019 to 2021 under IFAD-funded Jharkhand Tribal Empowerment and Livelihoods Project (JTELP) is providing sufficient evidence of reviving it. A combination of modern agriculture science recommendations, round the year localized weather-based cropping practices. It has been possible mainly by creating two sets of critical changes in mindset and practices for doing agriculture round the year. Through this project, farmers were in the journey of experiencing the crop production overlapping two major crop seasons (Kharif and Rabi) and by using residual soil moisture. These in turn has increased cropped area, the cropping intensity,

productivity besides other social advantages. Also, crop cycle overlapping in-between two major cropping seasons to create additional opportunity for increasing cropping intensity with continued engagement in farming. While working with 2 lakhs tribal families of different socio-economic zones of Jharkhand during last six main crop cycles, it has fine-tuned and adjusted the model of Climate Resilient Agri practices too. Promotion of the contextual recommendations is going to create a Jharkhand's farmer-friendly income-generating agriculture practices.

## The context of Jharkhand

Jharkhand is the habitat of 30 notified Scheduled tribes. Santhal (34%), Oraon (19.6%), Munda (14.8%), and Ho (10.5%) are the majority among them<sup>1</sup>. Jharkhand is home of nine primitive tribal groups (PVTGs) too. All of them live with different socio-cultural practices, yet they are identified as scheduled tribes of Jharkhand together.

Tribal community are perceived as aborigine, regressive, unskilled, engaged for bodily work. Womenfolk in these communities play a vital role in the livelihood & sustainability of families. Tribal women work hand in hand at farm fields, collecting forest products and firewood (NTFPs), engages in grazing cattle, bringing things of daily use for the household from the market in addition to routine household chores.

### Classification of rural worker

Particulars	Total Rural Population ('00000)	Percentage of rural population to total population	Total Working Population ('00000)	Percentage of working population to total rural population	Total Marginal worker ('00000)	Percentage of marginal worker to total rural population
India	8337	68.86%	3487	41.83%	1029	12.34%
Jharkhand	251	76.29%	108	43.03%	59	23.51%

(Source : The Census-2011)

From the above-mentioned table, this is clear that around 43% of the total population are from rural and among them 24% are marginal.

### Some other relevant information related to rural household (HH)

Country/State	Estimated no. of Rural HH ('00)	Estimated No. of Agriculture HH ('00)	Percentage of Agriculture HH to total rural HH	Average Monthly income (Rs) per HH	Ranking
India	1561442	902011	57.8	6426	NA
Jharkhand	37516	22336	59.5	4721	26th out of 29 Ranks including UTs
Panjab	27552	14083	51.1	18059	1 <sup>st</sup>

(Source: Situation Assessment Survey of Agricultural Households (Jan-Dec 2013), National Sample Survey Office (NSSO))

<sup>1</sup> The Census of India 2001

## Number and area of operational land holdings by

Category	India			Jharkhand		
	No. of Holding ('000)	Area in ha ('000)	Average size of holding in ha	No. of Holding ('000)	Area in ha ('000)	Average size of holding
<b>Marginal</b> (Less than 1 ha)	99858	37960	0.38	1877	777	0.41
<b>Small</b> (1 to 2 ha)	25777	36435	1.41	427	587	1.38
<b>Semi-Medium</b> (2 to 4 ha)	13776	37168	2.7	281	773	2.75
<b>Medium</b> (4 to 10 ha)	5485	31367	5.72	127	745	5.86
<b>Large</b> (10 ha and more)	831	14212	17.1	20	303	15.32
Total	145727	157142	1.08	2732	3185	1.17

(Source: Department of Agriculture, Cooperation & Farmers Welfare (Agriculture Census 2015-16, Phase-I)) (Provisional)

In the above two tables, it is depicting that around 60% of rural households are directly or indirectly dependent on agriculture whereas the return from agriculture is paltry only Rs4721 per month. At the same time, in Jharkhand, 84% of the rural household are falling under the category of Marginal and Small and they have limited strips of the cultivable piece of land. Almost all the villages in the entire state across Jharkhand are having mostly landscapes with very undulating topography. So, these two figures, it is indicating the present status of return from agriculture. This data is further strengthening the reasons behind the migration scenario of the state.

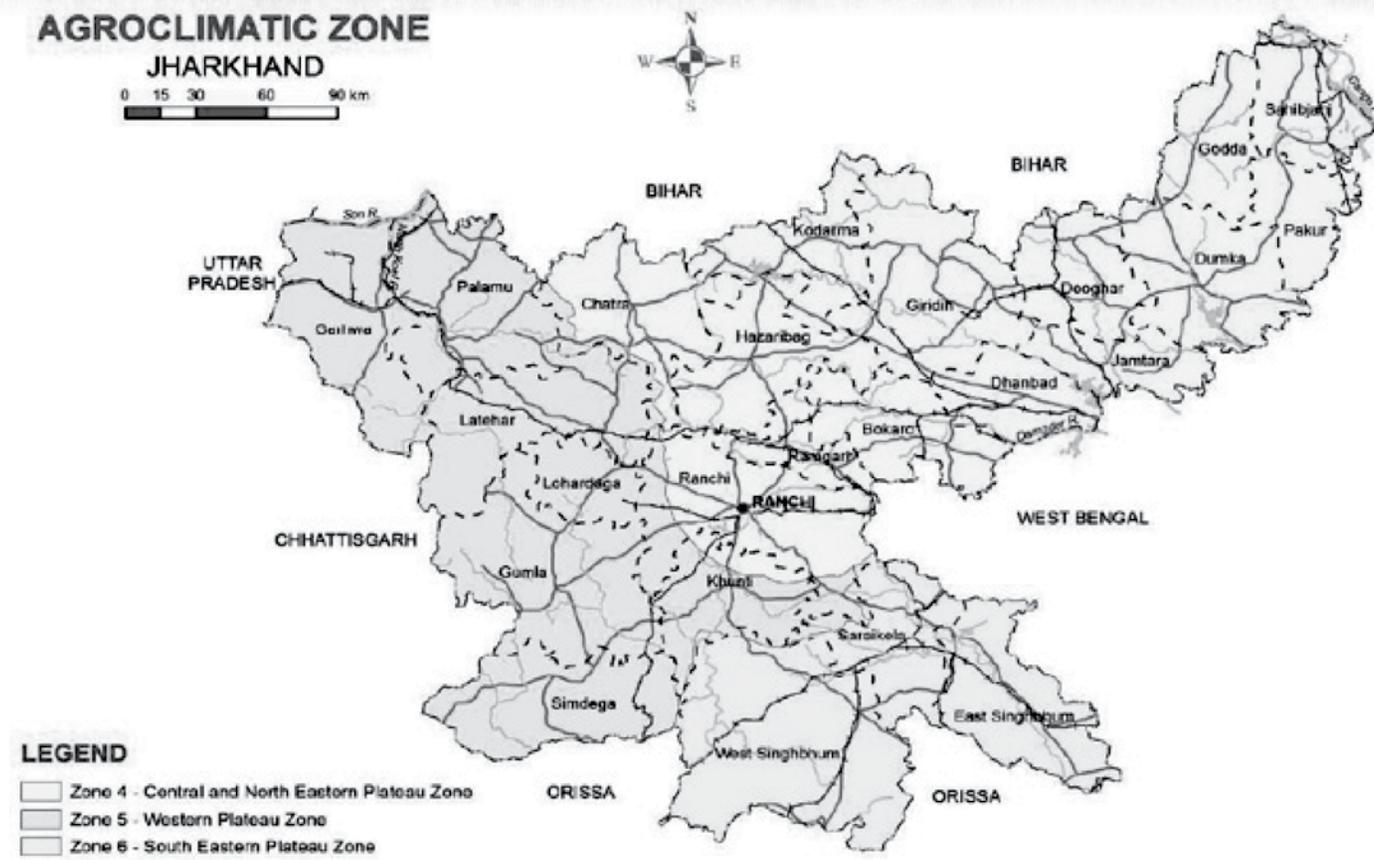
Therefore, it is very difficult to map the primary source of livelihood of the rural poor in Jharkhand. By and large, the livelihood of the forested and forest fringe families is based on rainfed monocropping agriculture, NTFP collection, keeping small ruminants, and working as seasonal migrant laborers across the country for brick kilns and construction works mainly. A horde of young rural folk migrate to the big cities as an unskilled workforce at the factory floor and usually return during the main agriculture season. A study done by JSLPS in the year 2015 found that “only one-fourth of the households in rural Jharkhand have an annual income of above Rs 75000 and more than half of the households have an annual income of less than Rs 50000”.

The soil of Jharkhand has low water retention capacity and is by and large acidic with low fertility. Limited irrigation facilities are another big constraint to bank upon agriculture for round the year livelihood engagement for the families in the villages. The state is having sporadic horticulture plants like Mango, Litchi, Cashew-nuts, and other similar hardy fruits plants.

### Agro-climatic zones

Jharkhand falls in the Eastern Plateau and Hill Region Zone of the 15 agro-climatic zones in the country. The state has 3 sub-zones: North Eastern Central Plateau, Western Plateau, South Eastern Plateau. All the zones are characterized by undulating terrain, erratic rainfall, low water retentive capacity of the soils, low groundwater level, high soil erosion, and lack of soil and water conservation practices. As a result, all the zones have mono-cropping, low agricultural productivity, pockets with chronic drought, high seasonal unemployment in agriculture and acute poverty<sup>2</sup>.

<sup>2</sup> Agricultural Technology Modules for Jharkhand. Bisra Agricultural University. [www.baujharkhand.org](http://www.baujharkhand.org).



The features of these agro-climatic sub-zones are described below

Features	Central and North Eastern Plateau Zone (Zone IV)	Western Plateau Zone (Zone V)	South Eastern Plateau Zone (Zone VI)
Geographical area ('000 ha)	4100	2500	1300
Districts	Dumka, Deogarh, Godda, Sahabganj, Pakur, Jamtara, Giridih, Bokaro, Dhanbad, Koderma, Hazaribagh, Chatra, Ramgarh, part of Ranchi.	Palamau, Garhwa, Lohardaga, Gumla, Latehar, Khunti, Simdega, part of Ranchi.	East Singhbhum, Saraikella, Kharsawa, West Singhbhum.
Forest (%)	13	33	24
Net Area Sown ('000 ha)	618	270	360
Major rivers	Damodar, Ajay, Mayurrakshi.	Koel, Sankh, Auranga, Amanat, Kanahar.	Subernrekha, Baitarni, North Karo, Phulijhar.
Climate	Humid and Sub-humid Tropical Monsoon.	Sub-humid to Sub-tropical.	Humid to Sub-humid tropical.

3 Vision 2030. Birsra Agricultural University. [www.baujharkhand.org](http://www.baujharkhand.org).

4 Viewed at <http://exploreit.icrisat.org/page/jharkhand/968/728> on 21 September 2016.

Features	Central and North Eastern Plateau Zone (Zone IV)	Western Plateau Zone (Zone V)	South Eastern Plateau Zone (Zone VI)
Annual Rainfall <sup>5</sup>	1282.8 mm. Nearly 80% rainfall received between mid-June to first week of October. Highest in Pakur and Ranchi. The districts of Godda, Dhanbad, Giridih, Koderma, Bokaro, Hazaribag, Chatra receive less than 1300 mm rainfall and are prone to prolonged dry spells in July/August even in good rainfall years.	1030.6 mm. 75% rainfall is received from July to September. Latehar, Gumla and Simdega receive fairly good amount of rainfall in normal monsoon years. In aberrant monsoon years this region becomes rain shadow area and dry spells of longer duration (more than 20 days) affect the cropping systems very adversely, particularly in Palamau district.	1199.7 mm. Varies from 1250 to 1500 mm. Nearly 80% of annual rainfall received from last week of June to September.
Break of monsoon	2 <sup>nd</sup> week of June in Normal year.	Monsoon starts from last week of June and continues up to mid of Sept.	Monsoon breaks in the last week of June.
Soil type	Neutral (Rajmahal) to Moderately acidic (Koderma, Hazaribagh, Ranchi). Soil fertility is poor.	Shallow to medium deep, reddish yellow to yellow in colour and moderately acidic to neutral in reaction and poor in fertility.	Red soils are common soils found all over the granite and gneissic plateau of Singbhum. Upland soils are red in colour and acidic in reaction (pH 5-6).
Assured irrigation	9-10% of cultivable area in Rabi. Major area of the Zone is rainfed.	12% of cultivable area in Kharif.	13-14% of cultivable area in Rabi.
Major crops	Rice, Maize with black gram, Arhar, Kulthi, Niger, Til, Mustard, Linseed, Wheat, Moong, Gram, Millets, Vegetables.	Rice, Maize, Gram, Barley, Mustard, Wheat, Arhar, Lentil, Urd.	Paddy, Vegetables, Maize, Linseed, Niger, Wheat, Moong, Gram, Urd, Arhar.
Key challenges to agricultural productivity <sup>6 and 7</sup>	Late arrival and early cessation of monsoon. Erratic and uneven distribution of rainfall. Coarse textured soils. Crust formation on the soil surface. Low water retention capacity of the soils – particularly in uplands. Lack of safe disposal of runoff water during monsoon. Lack of water storage and moisture conservation practices for raising Rabi crops. Drying up of irrigation tanks and wells by February results in limited Rabi crop production. Large number of labours start migrating during Sept to Dec under distress condition results into less focus on intercultural operation in paddy crop causes under production.	Late arrival and early cessation of monsoon. Erratic /uneven distribution of rainfall. Low water retention capacity of soils. Lack of soil and water conservation practices. Large number of labours start migrating during Sept to Dec under distress condition results into less focus on intercultural operation in paddy crop causes under production.	Uneven distribution of rainfall. Low water holding capacity. Eroded soils. Shallow soil depth. Poor soil fertility. Large number of labours start migrating during Sept to Dec under distress condition results into less focus on intercultural operation in paddy crop causes under production.

5 Agricultural Technology Modules for Jharkhand. Bisra Agricultural University. [www.baujharkhand.org](http://www.baujharkhand.org).

6 Agricultural Technology Modules for Jharkhand. Bisra Agricultural University. [www.baujharkhand.org](http://www.baujharkhand.org).

7 Department of Agriculture and Cane Development, Government of Jharkhand. Viewed at <http://agri.jharkhand.gov.in/?ulink=dept/stateprofile.asp> on 22 September 2016.



## Season wise agriculture scenario

### Kharif season

The Kharif season in Jharkhand is the main agriculture season. Most of the arable land usually gets covered with vegetation courtesy of farmers engaged in doing agriculture as well as nature does its work in even for fallow lands. This is the only season when maximum rains for the year are received. The season starts from a pre-monsoon shower in May, creating an indication to prepare for Kharif agriculture. The farmers start to arrange the agriculture equipment and inputs. The collected decomposed manures are taken to the field. The abled-bodied migrated family members start coming back to villages, the hustle and bustle environment gets created.

On other ends, the poorest of poor starts facing scarcity of food grains, cash arrangement for the agricultural need for all families start creating furrows on their foreheads. Families start looking for credit from various sources available at their end.

Kharif agriculture practices start at the onset of the monsoon. Generally, during May, on pre-monsoon showers, farmers start ploughing their fields starting from upland to lowland. On the initiation of the season, farmers target to cultivate crops like pigeon pea, maize, black gram, etc. to cover upland maximum, gradually they move to homestead land to low lands. During the second phase i.e., the first week of June, farmers do put groundnuts, broadcasting of Goraa paddy in upland, maize a sole crop & along with black gram as mix crop. Adequate rain helps farmers to start preparing for transplanted paddy crops including nursery raising and second ploughing of paddy lands. Transplantation starts from the first week of July and continues until the first fortnight of August. In some pockets, finger millets get transplanted in between. The availability of almost all family members is at the field during this intense period, in other words one may say that it is the busiest time for farming families in the entire region. The whole sequence of work depends on the onset of the monsoon and the amount of rain during the period. Accordingly, harvesting of Goraa paddy starts in the month of September followed by the black gram, groundnut, and maize. October onward finger millet gets harvested followed by harvesting of transplanted paddy starts.

### Rabi season

Rabi season usually starts from September, when day length starts dropping thus temperature dipping start gradually. Normally by this time upland crops like maize, black gram, Goraa paddy, etc. get started harvesting. Families receive new grains and start traditional celebrations of the new harvest (nuakhai, nabanna, etc.). Some 10 to 12% of families start planning for Rabi crops, but other start planning for migration to earn remittances. The village has a mix of joy and sorrowful environment for harvesting new crops also pain to see off the able body members of the families for a pretty long period. On other hand, the traditional festive season starts.

Limited water bodies in this undulating topography, a small patch of land gets tilled for rabi cultivation. Traditionally, by this period free grazing starts across villages which directly affects rabi cropping plans. During the rabi season, usually grow potato, mustard, vegetables like chilly, brinjal, cauliflower, radish and wheat, etc. Crops like Niger, horse gram, lentil, linseed, and Lathyrus are cultivated in sporadic patches across the tribal belt of Jharkhand. Depending on monsoon rainfall, all type of crop coverage gets affected, also with delayed sowing of wheat many times result in poor production of wheat due to scarcity of irrigation in a later phase. Across Jharkhand, the potential use of residual soil moisture is ignored. Farmers mainly plan against available irrigation water only. During mid of rabi season, a spell of heavy rain brings a lot of unexpected damages to standing crops particularly vegetables and potatoes. Most of Jharkhand experiences prolonged foggy weather that attracts fungal infestation followed by other pest and insect attacks to add other reasons for poor crop production.

## Zaid Season

Zaid or summer season starts in Feb onwards, to follow the increase in day length as well as an increase in temperature resulting in fast evaporation of moisture from soil and water bodies. The harvest of Rabi crops like mustard, potato, wheat, etc starts During these periods almost all the rivulets start either drying up or only subsurface water flow continues. Green vegetative coverage reduces to the extent that a long stretch of naked and fallow land is visible everywhere. The reduction in soil moisture reduces the microbial activities in arable soil. The stressful time for village women to bring potable water starts sometimes they have to walk 3 to 4 km to bring water for the family. Similarly, cattle and other grazing animals also face scarcity of fodder and water. Women and adolescences girls of tribal families are engaged with the added responsibility to bring head load of fuel woods from long distanced forest places is another drudgery for them.

Under the scarcity of water in general few families do cultivate creeper in their homestead land. Progressive farmers of the area adjacent to Gangetic plain of Santhal Parganas do cultivate green gram in low land during the summer mainly for a pulse for home consumption. The very small patches in selective villages do cultivate summer paddy in lower lands where sufficient water is available due to the presence of active seepage lines.

## Perennial vegetation

The forest coverage of Jharkhand is 29.61% of total state geography. It is a land of tropical dry deciduous forest having Sal trees dominating in numbers. The forest area covers other than sal is tree-like Tamarind, Jackfruit, Mahua, Jamun, Ber, Amla, etc, they are major perennial income-generating trees. Timber species and various shrubs of medicinal importance are abundantly available those are also a source of income for forest dwellers. Other organized horticulture plants like Mango, pear, custard apple, Cashew, etc are grown in the region for economic gains. The ber and arjuna plantations are used as a host plant to rear Lac and Tasar respectively which are mostly forest-based. Few successful attempts have been made to increase the number of these host plants to increase the production of lac and Tasar commercially. The small patch of mulberry, guava, lemon, etc is also available sporadically across the state. Tribal families residing in forest and forest fringe areas have a socio-economical dependency on the forest. During lean agriculture season dependency on forest increases manyfold for the families residing in and around the forest.

## **The climate change effect**

One of the pertinent issues in front of India's food security is *CLIMATE CHANGE AND ITS IMPACT* which is experienced by erratic weather events throughout the cropping seasons. As it is predicted that by 2030, a 1-to-2.5-degree Celsius rise in temperature may happen to affect the entire agriculture production system seriously. Climate change accelerates nutrient mineralization, hampers fertilizer uses efficiency (FUE), and hastens the evapotration in soil. The impact of climate change is directly or indirectly related to crop, water, and soil as it influences the water availability, changes the intensity and frequencies of drought, affects the microbial population, soil organic matter reduction, yield reduction, depletion of soil fertility as driven by soil erosion, etc. High temperatures may reduce crop duration, permit changes in photosynthesis, escalate crop respiration rates, and influence the pest population.

An economic survey in 2017-18 cautioned that "climate change might be reducing annual agriculture income in the range of 15 percent to 18 percent and up to 20 percent to 25 percent for unirrigated areas". This creates food shortages, nutrient deficiencies in humans due to inadequate intake of healthy food makes humans vulnerable to health issues.

Similarly, in the case of Jharkhand, around 80% of the rural population is directly or indirectly dependent on agriculture. The agriculture of the state is mainly dependent on rain and around 90% of the cultivable area is un-irrigated. During the last decade, it has been observed that at the interval of every four-year monsoon fails, at an interval of every three-year monsoon sets delayed, and every alternate year monsoon rains intermittent. In conclusion, it is becoming difficult to predict monsoon by farmers to plan for Kharif crops in general and upland in specific in Jharkhand. In tribal-dominated geography, ranging from 40% to 60% of arable lands are coming under upland categories. So, it



becomes very difficult in the tribal context to utilize upland optimally during Kharif. After Kharif season major chunk of such arable upland remains fallow for the rest of the seasons. On the other hand, for medium and low land, due to erratic rainfall, tribal farmers generally could not get the desired production of crops which is mainly paddy. All these circumstances gradually pushing tribal farmers to believe as if agriculture is not a prominent livelihood option. So, there is an increasing trend of underutilization of arable land as well as human resources in villages. Most of the eligible youth from the rural pockets migrate to other parts of the country in search of their livelihood. Gradually a major part of the state converts from an agriculture-based economy to a remittance-based economy. Rural mass is frustrated to continue with their primary occupation of agriculture and trying to opt secondary and tertiary source of livelihood vocation, which are not their cup of tea always.

## Why Climate Resilient Agriculture?

As climate becoming more and more unpredictable due to indiscriminate handling of climatic factors which are mostly the human tempted factors like the never-ending desire of consumerism, inappropriate mining, use of fossil fuels, etc. Similarly, Agriculture practices became vulnerable due to the rampant use of synthetic fertilizers, chemical pesticides, hybrid seeds, etc. Under such a situation, adopting agricultural practices which are resilient to (suits or adjust to changes in climate) climatic conditions, and suitable for local socio-economic context is the main handle to get the best out of such unpredictable conditions.

Following are some specific reasons for urgently initiating Climate Resilient Agriculture (CRA) in Jharkhand

- The local agriculture-based rural economy is now gradually overruled by the remittance-based economy that means families of rural area are heavily dependent on income from migration.
- Food sufficiency and cash income are not being sufficiently generated in compared to it's potential from the agriculture field due to a lack of knowledge to combat the weather changes with weather-based local area planning.
- Tendency to procure hybrid seeds followed by rampant use of chemical fertilizers, and pesticides push the farmers as well as nature towards a more vulnerable situation.
- Local skills and pieces of knowledge are faded away due to the adoption of hybrid paddy-based Kharif intervention.
- Lack of round the year vegetative cover and exclusion of leguminous crop leads to poor soil health.
- Knowledge of cultivation of crops based on residual moisture has vanished from the major villages of Jharkhand.
- To enhance the cropping intensity of the land, farmers are heavily dependent on high-running cost irrigation infrastructure which also seldomly fail during peak season.
- The practice of crop rotation and mix cropping as per the land category is one of the gaps in agriculture practices.

Discussion with different stakeholders for promoting CRA reveals that there are few requirements at the farmer's end to tie back certain things.

- Knowledge on the local weather-based planning process is lacking or eroded gradually
- Traditional knowledge of preserving quality inputs (seeds, organic manures and pesticides materials, practices, timing of interventions) is fading away at the farmer's level
- The dearth of capabilities to identify and establish the crops to bridge in between two seasons
- Lack of adequate knowledge for preparing and using locally made organic formulations in crop production.
- Wisdom and knowledge of the importance of the cultivation of leguminous crops have vanished
- Social problems like free grazing, lack of solidarity, etc. are also predominant
- Extension services from different stakeholders are seldom to reach the target communities

- Farmers are mostly preferring to go for subsidized agriculture programs more and more resulting in taking them away from traditional crop practices
- Lack of proper water conservation structure as well as irrigation system in entire farming geography.
- A robust local weather forecasting system is not in place.

## **Principles of Climate Resilient Agriculture (CRA)**

Climate resilience is based on a fundamental concept of climate risk management. In this context, resilience refers to the ability of an agricultural system to anticipate and prepare for, as well as to adapt to, absorb and recover from the ill-impacts of changes in climate and extreme weather. Resilience can be enhanced by implementing short and long-term climate mitigation and adaptation strategies, as well as ensuring transparent and inclusive participation of multiple actors and stakeholders in decision-making and management processes.

The CRA approach seeks to reduce trade-offs and promote synergies to make crop and livestock systems, forestry, and fisheries, and aquaculture more productive and more sustainable.

The three pillars of CRA are

- i. Sustainably increasing agricultural productivity and incomes through increasing crop coverage round the year, cultivation of leguminous crops, utilizing the soil moisture, etc.
- ii. Enhancing the resilience of livelihoods and ecosystems
- iii. Reducing and/or removing greenhouse gas emissions, where ever possible.

## **Potential aspects to be looked upon to attempt Climate Resilient Agriculture**

### **o Create resilient foundations with inclusive development**

Rural poverty is grossly dependent on access to basic services including knowledge & information, finance, social care/security schemes, infrastructure, health care, etc. These are a strong predictor of affecting the rural community in the scenario of climate change. So, to create a successful strategy to address the climatic adversaries, it becomes inevitable to consider the inclusion of vulnerable communities those always have the limitations in accessing different resources.

### **o Support community for strengthening their participation**

A deprived rural community is going to be most affected by the increasing climatic unpredictability and adversities created. So, it is required to get direct support in addressing basic challenges of lack of proper information, fund flow, social biases, improper market access, inventions with the best technological support, and handholding for adoptive better agriculture practices, which are the biggest obstacle in general for them to have combat against the climatic adversities.

### **o Programmes and procedures to create infrastructural support, proper utilization by under-privileged**

Most of the infrastructural resources, their accessibility is suitably designed for a privileged section of society. Even after having favourable processes and guidelines privileged sections took the most benefits due to reckless execution. To ensure the contribution and reduce the vulnerability of the disadvantaged in combating climate adversaries, it is required to develop programs and processes by adopting pro-poor policies by the Government and other philanthropists.



### o **Putting the robust focus on primary occupations of rural community**

In the last two years, pandemic situation due to Covid has affected Livelihoods of poor families most directly or indirectly and many of them have lost all the options too. On the other hand, rural mass dependent on agriculture as a primary source of livelihood remained relatively less affected. Also, the stressed workforce in other occupations looked for the opportunity of survival again in the primary sector - the agriculture. It gives enough evidence that under any short of devastating condition which is expected due to climatic changes, it is required to give more attentions to strengthen primary sector of our country.

### o **Popularizing and allocating adequate support for increasing production of pulses, oilseeds, vegetables, and fruits**

The country is sufficiently producing food grains but the requirement of pulses and oilseed is being fulfilled by importing, which has a direct impact on the economy of the country, which has indirect impacts on the disadvantaged community. Due to climatic changes and less focus on the crops like pulses, oilseeds, etc are going down in crop coverage as well as production. Whereas these crops including vegetables and horticulture are immensely capable in contributing the economy, improving the health of the rural mass, protecting fertility deterioration and enhancing soil health in long run.

### o **Community based institution as support condition**

Any calamity cannot be addressed without the direct contribution of the affected or about to be affected community. In the scenario of climatic changes, the community especially the rural mass needs to be engaged directly as they are obvious to be affected. Partnering with the rural community as a decision-maker would be helpful to create a favorable condition to work upon CRA. It is difficult to work with each household individually, for the community-based institution like SHG and its tires, FPO, farmers club, producer cooperatives, etc would be preferable options to engaged for handling the situation.

## **The learning ground**

The ***Jharkhand Tribal Empowerment and Livelihoods Project (JTELP)*** is supported by IFAD. Besides strengthening community-based institutions and improving natural resource management, the project emphasizes productivity enhancement and up-scaling of proven, market-oriented production activities to reduce poverty. The project focuses on 14 Tribal Sub-Plan Districts of 32 tribal-dominated poverty-stricken Blocks in around 1800 villages of Jharkhand. JTELP thus has given priority to focus on local weather-based round-the-year agriculture practices during its implementation. Under this project, different stakeholders including farmers were trained, made convinced and equipped to adopt, to continue practices/ technologies to get the best amongst all possible vagaries of weather to attain food securities along with cash income to ensure livelihoods of targeted families.

### **Adopted CRA practices**

The process started with a series of consultative meetings with various stakeholders like the project management team, NGOs, farmers, Agriculture experts, social leaders, and community cadres to understand the effect of climatic vagaries on the agriculture production system. Also, a series of discussion happened for alternate suitable ways to get rid of the situation. Gradually, the meetings followed by concept sharing, perspective building, village level planning, season-specific set of crops identification, possibilities of cropping in between two major seasons, organic formulations, etc around CRA suitable in local context done.

Capacity-building activities organized for specific technical training, use of tools, plant protection measures, required intercultural practices for the different crops suitable for different land types according to cropping seasons. Focus is kept managing soil health, microbial activities, soil moisture, optimal use of resources available at the village.

Therefore, traditional crops like different millets, sesame, short-duration upland paddy, lentil, linseed, Lathyrus, horse gram, Niger, groundnut, mustard, etc. brought into the core of agriculture practices to maximize the benefits of it to address the climatic change.

Apart from this, the focus was also brought to establish the use of high yielding crop varieties wherever possible instead of Hybrid varieties which leads to lower use of fertilizers & pesticides and thus reduce the input cost. Similarly, equal focus is given to have a mix of cereals, pulses, oilseeds across all land types viz-a-viz cropping seasons for most of the families.

Another, strategy of reducing the climatic risk is to adopt the crop mix particularly for upland in Kharif, and optimal use of residual soil moisture from the rest type of land during Rabi & Zaid. Emphasis was also made to ensure summer ploughing at the onset of pre-monsoon shower to reduce the pathogen load in soil.

The additional area of engagement under CRA practices included the measures like the use of bird preachers, pheromone traps, etc to reduce the need of use of chemical pesticides. The farmers are motivated to preserve the seeds of high-yield varieties in a recommended manner at their end for next season for all possible crops.

To have the seeds at farmers end provides a favourable condition for a critical component of CRA, as farmers can sow the crop as per local weather situation to tackle the year-wise change in climatic conditions and could catch the season.

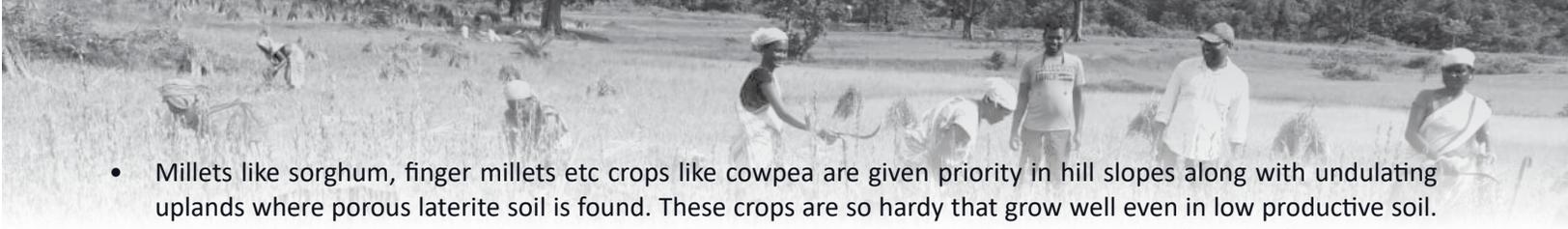
The community with initial reservations started engaging with assured handholding support to get confidence. By the fifth cropping cycle, most of the villages started adopting the practices on a large scale. They experienced the change in soil texture specifically where multiple cycles of pulses were done, developed confidence in reducing the use of synthetic fertilizers and pesticides to get expected yield from various crops. To further support the cash income different creepers, vegetables, and suitable fruit plants are introduced in different suitable seasons. The most vulnerable also see opportunities with crops like Elephant Foot Yam, drumstick, etc. The daily need for household nutrition through safe fresh vegetables through Nutri-garden get introduced and adopted in masses.

## **Adoption of different improved agriculture practices in all cropping seasons towards CRA**

### **During Kharif**

The intervention starts with ensuring summer ploughing of maximum cropping fields at the onset of the pre-monsoon shower, to control weeds, destroy eggs, larva & pupa of insects, and hyphae, spores, etc of fungus, bacteria, etc. to minimize the disease occurrences during Kharif.

- Planning starts at the village during May, according to available human and draft power to cover the maximum land with suitable crops. As water flows from upland to low land and chances of not getting favourable soil moisture is more in upland, thus the focus starts from upland to low land for crop coverage to optimize the soil moisture utility. The water holding capacity of soil is also proportionately dependent on the availability of organic matter in the soil. So, it is facilitated and recommended crops as per the water holding or retention capacity of different land types viz-a-viz duration of crops. In the case of upland where, water availability is for relatively less period, crops varieties of 80 to 90 days duration are recommended to adopt, similarly in case of midland and homestead land, where crop varieties are recommended for the period of 100 to 110 days followed by low land varieties of more than 120 days. In addition to this crop, the selection is also facilitated based on the root depth of different crops. To improve the soil health of uplands and to uptake nutrients from different layers of soil depth, it is recommended to adopt leguminous crops like pigeon pea, black gram in upland, as it remains water-stressed during remaining seasons so difficult to add organic matters otherwise.



- Millets like sorghum, finger millets etc crops like cowpea are given priority in hill slopes along with undulating uplands where porous laterite soil is found. These crops are so hardy that grow well even in low productive soil. There is a limited option with low input cost of crops to grow in these low productive land types, else it remains fallow throughout the year to degrade and erode land leading to the non-arable condition.
- Towards the settling monsoon period, there is another opportunity to cover remaining fallow uplands under crop production like sweet potato. This crop does not require any irrigation support rather it grow under available soil moisture. So, this crop has a great potential to increase production area as a cash crop for farmers of Jharkhand.
- The intercultural operations in tribal-dominated geography are limited to maize only in few pockets. The reason behind such operational practices is the pattern of sowing, limited window of sowing crops, scarcity of human resources, etc. in the state. On the other hand, as per improved agriculture practices, interculture operation is one of the important factors to ensure the increase in production of any crop. To overcome such issues, project has demonstrated the line sowing method in all the crops with recommended spacing. In addition to its different small handy farm, tools have been inducted to ease the interculture operations. This also reduces the drudgery of women working in farm fields. At the same time, the availability of human resources including, skill, current engagement practices in agriculture have to be considered during the crop planning process. To handle the small window of crop sowing which is very much a hindrance for CRA, there is a recommendation of adoption of Direct Seeded Rice (DSR), which is one of the suitable answers to create additional sowing windows for the crops in midland.
- The shortcoming of skills, line sowing, preparing suitable nurseries, using tools, timely interculture operations, etc. on a large scale at the village level is facilitated through a series of training, demonstration, and handholding support provided by trained cadres.
- In the last decade, high penetration of Hybrid seed varieties has been experienced in the hinterland of Jharkhand resulting in increased dependency on market, which is another hindrance in practicing CRA. So, under this project, the use of High Yielding Variety (HYV) of different crops wherever possible over Hybrid varieties is on focus to reduce the dependency on market for seeds in villages. At the same time use of HYV at the village level helps to retain soil health as it requires less use of fertilizers. By using HYV with few technical interventions, farmers are getting the opportunity to preserve the seeds for the next season, gradually being able to create a seed sovereign village.
- The use of Hybrid seeds also attracts more no. of diseases and pests to use a specific chemical to control them be the solution otherwise huge losses have been reported. Lack of knowledge and increasing input costs become difficult for small and marginal tribal farmers. In all these situations the use of synthetic chemicals (fertilizer & pesticides) is getting increased which is hazardous for the beneficial microbes of soil to compromise with soil health. On the other hand, reinforcement of HYV uses helps reduce the pest and disease attack, thus resulting in less application of synthetic chemicals. At the same time introduction of organic formulations for fertilizer and pesticides along with the use of bird preachers, pheromone trap, etc. strengthen the farmer's position viz-a-viz input cost in agriculture. It also indirectly helps in the restoration of soil health and favourable ecosystem (abode of beneficial insects, predators, snails and slugs, frogs, fishes) in long run.
- Varieties selection of crops not only based on land type but also to ensure higher production of crops cultivated. One of the critical factors to get optimal production is the timely sowing of any crop followed by interculture operations. So, under CRA practice the timely sowing of crops is emphasized through informing and demonstrating the benefits of timely sowing of the crops in comparison to the delayed sowing of the same crops.
- Staggering the nursery to get the right aged seedlings to transplant in adverse weather situations (delayed monsoons, more than 15 days dry spells after onset of monsoon, etc.) is another appropriate intervention that farmer have adopted in scale.

## During pre-Rabi

- Due to erratic climatic conditions, many a time it becomes very difficult to execute the agriculture plans for Kharif season, among all land types the uplands get most affected and hence ignored. To address such conditions a contingency plan is always required to have to cover uplands which are not been under cropping during the Kharif season. Under such a contingency plan in case of Jharkhand conditions, farmers are encouraged to go for crops like Niger, horse gram sowing. Over the last three cropping seasons the practicing farmers are now confident of growing such crops which are mainly part of their contingency plan. The best part of these Pre-Rabi season crops is that they are grown in residual soil moisture, require minimal attention, are less prone to diseases and pests, and short duration crops grown as non-perishable cash crops.
- In homestead lands and also in midlands the early mustard and early potato are the combinations of crops that create a win-win opportunity for farmers to get a quick return by optimally utilizing the resources. This set of crops are managed with lesser no. of irrigations as well as less pest attach to get a relatively good price for early harvest.

## During Rabi

- Rabi season in Jharkhand usually starts in October. By this time the low lands and medium low lands have standing paddy crops and few patches of upland with pigeon pea. Rest of the lands start getting vacated as the harvesting starts.
- Farmers generally target the land which has irrigation facilities during Rabi season with a mindset that no crop is possible without irrigation in this season. In Jharkhand, irrigated land is limited to 0.16 million ha which is just 9.3% of the total cultivated area of the state. Under this limited irrigation support, only a few farmers can grow Rabi crops. On the other hand, as per the principle of CRA, there is enough opportunity for the farmers in Jharkhand to grow crops during Rabi season starting from homestead land to low land. The only critical factor is to the sowing of the crop inappropriate time to utilize the opportunity of residual moisture, else the moisture reduces very fast to utilize it for crop production. By recommending crops for medium land like Bengal gram, sesame, etc., for low land options are Lathyrus, lentil, etc creates enough scope to increase crop coverage during Rabi season in unirrigated land. All these crops are low in investment even some of them do not require ploughing the entire field to utilize the soil moisture. Most of these crops are less susceptible to pests and can be harvested within 80 to 85 days after sowing. Out of these options, the farmer can grow at least one leguminous crop in each type of land that enhances the soil health which is very much required in the current context of degrading soil quality for crop production.
- Under irrigated conditions, the farmer grows potatoes, mustard, wheat, peas, vegetables, etc. Hence, the Rabi season witnesses two sets of crops one dependent on assured irrigation, the second set of crops that mainly grow using residual moisture and intermittent rains during the winter season. Even crops like Lathyrus, lentil, chickpea is recommended to grow in low land of paddy field as paira- cropping which requires to sow seeds 15 to 20 days before the harvesting of paddy.
- The crops which require assured irrigation are grown in & around the area where irrigation infrastructures are available, which is anyway minuscule in comparison to any village's total arable land. These areas are mainly around dug wells, ponds, low land wells, earthen dams, and narrow strips on the bank of rivulets. Even in these small areas with irrigation support, the management of water for irrigation is another critical intervention to optimize the use of available water. So, under the irrigated condition the focus is to train the farmers to adopt the techniques that facilitate the principle of "more crop per drop of water". In these two ways, villagers can cover maximum land for cropping during Rabi season following the principle of CRA.
- The technical interventions for irrigated crops are like preparing crops fields by dividing them into smaller manageable plots to avoid flood irrigation, use of rain pipe, sprinkler, etc are to maximize the use of water for irrigation.



- The rainfed mono-cropping agriculture practices across Jharkhand, All the arable lands are kept fallow for more or less six to nine months. During this period of keeping land fallow, there is hardly any vegetative coverage to drastically reduces the microbial activities which is much required for sustaining soil health, this also exposes the topsoil to get eroded further reducing the fertility status of the soil. In many villages, it is evident from the status that uplands are becoming barren.

### **During early summer**

By December, there is an opportunity for farmers of Jharkhand to go for the early cultivation of creepers and melons at low lands with irrigation facilities. Both these crops are sown in early summer, usually, fetch a premium market price for the produce. The critical intervention of these crops during this season is to grow seedlings in the nursery. Creepers include all types of gourds, and cucumbers suitable for the state. To cultivate these crops, farmers need not plow the entire field rather pit based cropping practices are promoted to check the evaporation of soil moisture. Adoption of pit method of cropping helps to check the irrigated water to evaporate fast, as gradually temperature starts increasing. By this time water also become the most scares item in villages. The crops sown during these periods keep bringing cash to farming households and farmers remain engaged with the crops till April.

### **During Summer**

The same crops sown during the early summer continue to sow during the summer season also on the availability of irrigation facility. The technique of sowing changes from nursery preparation to direct seeding in pits. In addition to these, vegetables like okra, chili are another suitable crop for the summer season in Jharkhand. Seeing the water scarcity, mostly farmers have options to grow vegetables in small patches of their homestead lands. As the temperature rises more than 20C the crops like ginger, turmeric is suitable to sow in the state like Jharkhand. Farmers are advised to grow these crops in homestead lands where soil moisture remains relatively higher than other fields. The critical step to growing these crops requires mulching and raised seedbed, which reduces the evaporation loss of soil moisture as well as in case of heavy downpour in pre-monsoon shower.

There is another crop suitable to sow during the summer period is Elephant Foot Yam in the homestead lands. The hardy characteristic of the crop barely requires any intervention after sowing in homestead, thus a significant number of poor tribal families are adopting the cultivation of EFY.

In the case of a homestead, other than seasonal crops, there are options to grow plants that are perennial for fruiting like drumstick, apple ber, lemon, etc recommended. All these crops require low maintenance and can withstand water stress. Where are other perennial crops like Papaya, mango, lichi, etc are also suitable for the state but it requires intense management support to produce expected fruits. The canopy of these fruit plants also helps to reduce the evaporation of soil moisture from the homestead.

The crop of green gram is recommended to cultivate in the low lands with silt soil. This crop grows even under moisture available in soil but to get a good production one to two irrigation support is required. Being a leguminous crop, it helps to rejuvenate the soil. It is also recommended to grow as a green manuring crop in subsequent paddy crop.

## **Organic formulations for fertilizers and pesticides**

Agriculture practices based on synthetic fertilizer and pesticides are penetrating very fast in rural Jharkhand. Even farmers in far-flung areas of the Santhal Parganas and Kolhan region are increasingly dependent on chemical-based fertilizer and pesticides for agriculture production. Due to the lack of information and influence of the market, they are bound to develop a dependency on inorganic ways of agriculture. As a result, farmers are repeatedly sharing the adverse impact of it on soil health as well as on the production of crops. To protect as well as improve soil health,

alternate organic options of fertilizer and pesticides are introduced, which reduces the cost of cultivation. These formulations are prepared based on locally available materials. Few of such formulations are readily used by farmers like Neemastra, Agneyastra, Brahmastra, Beejamrit, Jeebamrit, etc.

### Organic inputs in agriculture production a new hope

***“Manna Oraon has a new attraction in the local market. He has started selling his vegetables in the Bhandra market in Lohardaga as “जैविकि उपज” which is attracting buyers, even at competitive rates”.***

The JTELP introduced the practice of organic formulation in villages. Biofertilizers and biopesticides were introduced, which are made from locally available materials. The idea was introduced through a series of training and demonstrations events. The events were coupled with video sessions and village events which caught the eagerness of villagers towards a new practice. There were few farmers only who took the idea forward and inspired others to set an example for the village.

Manna Oraon is one of the farmers, who has successfully learned the principles of organic practices and adapted them in cultivation. He shares that usually; he sells his chemical-free produce at comparatively better rates in the market. He sells his Agri-produce in Bhandra, Chatti, and Bero markets of Lohardaga and Ranchi district. He has learned about the preparation of organic formulations of fertilizer and pesticides and their use under the JTELP training program provided by PRADAN.

Last year (2020), Manna Oraon has used waste decomposer, Jeevamrit, and Neemastra in his crops including paddy, vegetables, etc. The quality of production was at par with others, though he invested less for inputs. It became an attraction for other farmers to inquire about the formulations of organic and their uses.

The intervention is now attracting the tribal farmers gradually, replacing high-cost pesticides with locally made formulations. In addition to it, other interventions are contributing too like yellow sticky traps, bird perches, pheromone traps, etc. to reduce the use of chemical pesticides. This is the beginning of the era for small & marginal tribal farmers to do agriculture by reducing dependency on market for input, especially for costly synthetic fertilizer and pesticides.

## Scale and coverage of CRA practices

### Year and season wise status of agriculture coverage under JTELP

Year	Season	No. of farmers	Area in Acre
2019-2020	Kharif	47321	61428
	Rabi	92241	108000
	Summer	66323	35584
2020-2021	Kharif	119835	132552
	Rabi	133023	107336
	Summer	85381	5941
2021-2022	Kharif	189740	NA

(Sources – JTDS report)

The above illustration of the no. of tribal farmers under JTELP in three different cropping seasons articulate that the participation of farmers has been increased from forty thousand farmers at the beginning to almost two lacs farmers in a span of two and half years in continuity.



## Involvement of Youth in Agriculture

The simpler science of CRA has added advantage as the critical technical knowledge can easily be transferred to farmers with the help of trained community cadres. So, strategically, to rollout such a project to benefit millions of households, a cascading model of transferring knowledge and handholding support developed a large pool of trained community cadres. They all showed their excitement in addressing the technical issues of agriculture in larger geography with millions of tribal families. Two community-level cadres viz. Community Resource Person (CRP) and Krishak Mitra (KM) are engaged. They are trained to serve farmers at the field level to execute the agriculture activity. Every village has one to three community cadres based on the size of the village and additionally 3 Krishi Mitras per panchayat are trained to exclusively support the agriculture extension work.

These cadres are performing following tasks under agriculture activity

- ✓ Conducting concept seeding meeting, planning meeting with SHG/GSPEC members around improved agriculture practices
- ✓ Providing handholding support to SHG/GSPEC members for land measurement/Seed treatment/nursery raising/transplanting etc. to adopt improved practices
- ✓ Providing help to procure and distribution of inputs
- ✓ Fill up the format depicting the information of crop growth
- ✓ Conducting exposure visit of SHG/GSPEC members
- ✓ Attending fortnightly/monthly review meetings

To do such tasks at the village level, all these cadres get training from PRADAN professionals as well as from trained FNGO agriculturist staff in every season. These are the lists of the trainings for them.

- a. Orientation on JTDS program and their role clarity on agriculture promotion
- b. Soft skill to facilitate the villagers
- c. Agriculture planning at village level
- d. Package of Practices (PoP) of different crops (Kharif, Rabi, Summer)
- e. Disease and Pest management of different crops
- f. Yield assessment of standing crops
- g. Post-harvest handling (grading, sorting, storage, seed preservation etc.) of cereals, pulses, oilseeds and vegetables
- h. Marketing of agriculture produce
- i. Training of organic formulation and use as fertilizer and pesticides
- j. Training on record keeping of agriculture engagements

So, from the above-mentioned training list it is clear that they are not only being trained around the technical issues of agriculture interventions but also be trained around soft skill development

In the present situation, Community cadres are involved with the community in two ways, one is knowledge dissemination and handholding. In gradual process they may get involved in the following activities for making their services more relevant and remunerative

- Nursery growing for vegetables and fruit plants as nurse grower
- Produce and sale the organic based fertilizer and pesticides to the farmers
- Potential to play a role in propagating & promoting indigenous and local crop varieties for the farmers as Aboriginal Seed Vendor (ASV).

## A hope as one of the vocations among many for youth in villages

Due to the uncertainty of agricultural return from their own land, families, in general, faces a great challenge to survive on the agricultural outcome. Youths are specifically getting affected and losing interest in an agriculture-based engagement at villages, as a result, they look for alternate vocations by migrating to distant places. So optimal use of village resources including human is going down and the remittance-based economy gradually gets strengthened in rural Jharkhand. The trained cadres in project villages are showing their excitement & interest as they could experience change possible in the scenario by adopting CRA. They are flag bearers of the CRA in their respective geography and are benefiting millions of fellow tribal households. The simpler science of CRA has added advantage as the critical technical knowledge can easily be transferred to farmers with the help of trained community cadres.

## Changes experienced after practicing CRA

A systematic engagement process has been followed to cover maximum land throughout the year in the project area following the principles of rainfed agriculture. Based on the field experiences, the processes got intensified gradually during the last two and half years with progressive changes happened with the tribal community. In the entire project area, various remarkable changes have been observed at a different level. Following are some areas where changes have been experienced

**Agriculture production:** Under climate-resilient agriculture, the main target was to enhance the cropping intensity, cropped area, crop diversity, and equal focus on cereals, pulses, oilseeds, and vegetable cultivation throughout the year. **Targeting upland during Kharif was the game-changer.** Stabilization of paddy production through DSR enhances the yield at the tune of 3-3.5ton/ha. Similarly, upland has been covered through Pigeon pea, Finger Millet, Maize, Jowar, Black Gram, and Groundnut as per the choice of the farmers to increase the food security for extra 3-4 months and also generated significant cash income. Cultivation of leguminous crops like Pigeon pea and Black gram helps to restore soil health as well as increase the biomass production in the soil.

Similarly, in the case of medium and lowland (where paddy is only predominant) in the tribal-dominated area, **suitable HYV of paddy was the game changer** to increase the productivity as well as to release the field for the next probable crops during early-Rabi and Rabi season. The crops for such lands which can be grown under residual moisture condition or require partially irrigation support where then selected. The production of paddy in medium land was around 4.5-5MT/ha whereas for low land it was around 6-6.5MT/ha. In some cases, the production of lowland touched up to 7.5MT/ha (with Cono-weeder use twice for inter-culture operation).

Due to erratic rainfall, in many places' uplands were kept fallow during the Kharif season. So, the first target is to utilize these uplands with appropriate climate resilient crops and varieties. The possibility initiates during the early Rabi season. These crops mainly grow under residual moisture of soil and intermittent rains. Crops like Sesame, Niger, Horse gram, etc. are suitable for such upland conditions. These crops are part of tribal traditional crop baskets which get harvested within 80 to 85 DAS. Among these crops horse gram being a legume crop also helps to enhance soil health. The crop cutting data for sesame reveals its productivity of 0.5 MT/ha which is at par with the country average productivity of 0.45 MT/ha. Whereas the average productivity of horse gram and Niger is reported 0.66 MT/ha and 0.98 MT/ha respectively are also at par the national avg. productivity. During the last couple of years, it is evident from the field that almost 35% to 50% of uplands across villages brought under such category of uplands where each Kharif season remains fallow for some or other reasons.

## Adopting a new cropping pattern helps to gain new energy and more return

PRADAN engages in JTELP as Agriculture Technical Support Agency since 2019. PRADAN supports the farmers of the JTDS area by different means of agriculture training and handholding to adopt improved agriculture practices based on the principles of rainfed agriculture.

During the agriculture training at the Khunti district, there was a reluctance of farmers to adopt the recommendations. Few of the cadres took the challenge to demonstrate mixed cropping practices to experience their relevance in their context. After, the first year of successful demonstration a greater number of tribal farmers adopted the practice. Now, in Erki & Karra block of Khunti district has large patches of such mixed crop and intercrop practiced by hundreds of farmers like Maize with Cowpea, Maize with Pigeon pea, Pigeon pea with Groundnut, upland Paddy with Pigeon pea, Mustard with Potato, Mustard with Gram, Mustard with Wheat, etc.

Fekal Mahto is one of the farmers of Chainpur village in Erki block, having two and a half acres of land in which one acre is upland, where he is doing mixed crop for the last three years. In his first year of intercrop benefit testing, he only tried in 20 decimals of land with maize and pigeon pea. He sowed two lines of maize and one line of pigeon pea. To his surprise, he harvested more than one quintal of maize grains along with 40kg of pigeon pea. As per Fekal Mahto, *"itna upaj toh hum nahi soche the"* (I have never imagined such production). Afterward, he is practicing intercropping in all possible lands and become one of the practitioner spokespersons for intercropping methodology in the region.



Technically maize is a shallow-rooted crop and pigeon pea is a deep-rooted crop that takes nutrients from different soil zone from the same land, there is no competition for growth. Pigeon pea is a leguminous crop, fixes nitrogen in the soil which will be available for other crops in the next season, thus improves the soil health.

After harvesting crops of Kharif season from the homestead and midlands are prepared for Rabi crops like Potato, Mustard, Vegetables, Wheat, Green peas, etc. based on the availability of irrigation facilities. From November onwards the paddy gets harvested from medium to low land. These lands usually kept fallow after paddy harvest. But in the project villages, with the available soil moisture farmers are following the practices of paira-cropping as well as a sole crop of Chickpea, Lathyrus, Lentil, Linseed in these lands to tap the opportunity. The farmers practicing this cropping process ensure the sowing of the crop within a week time after paddy harvest to optimally utilize the soil moisture otherwise soil moisture reduces drastically and becomes short for any crop production. All these crops are of short duration and can withstand water stress. As the produce of these crops are non-perishable farmers can store those at their level. Being, Leguminous crops these also improve the soil health of the land.

By this time (February), homestead and irrigation facility become vacant once harvest of existing crops (early Rabi crops and late Kharif crops) is over. The preparation for growing creepers like Sponge gourd, Bitter gourd, Ridge gourd, Bottle gourd, Cucumber, and Melons in such homestead and irrigation supported lands starts. It offers advantageous situation to get crop harvest during the early season of summer for premium price realization. The seedlings are prepared pro-tray or in well maintained nursery by using germinated seeds and later transplanted in the main field in

the pit method to optimize the use of water for irrigation. Crops like Ladies' fingers, Chili, Brinjal, etc. are also done in the plots where irrigation is possible during the summer season. As during summer, these crops are not very much susceptible to diseases and pests and hence production is assured. All these crops help the tribal farmers of the project to generate cash income during the lean period. In low lands where subsurface flow remains on even during March and April, green gram is sown.

### *Utilizing land optimally under mixed cropping*

In Jharkhand, poor land fertility, cropping intensity, and productivity always remain a challenge. So, in this condition mixed-cropping is evolving as a good livelihood opportunity for the farmer of this area.

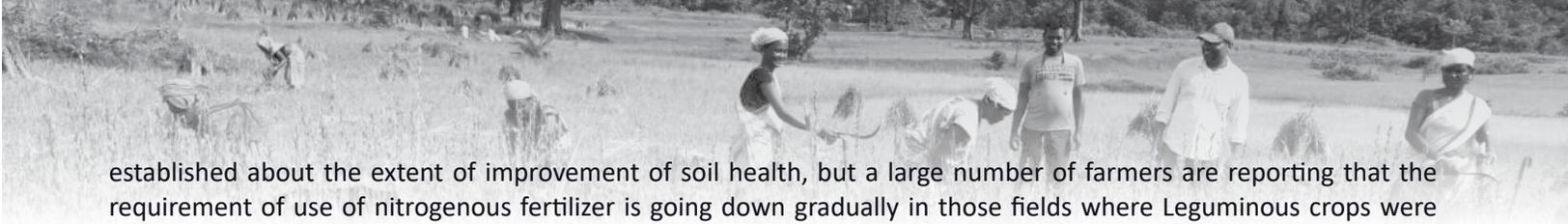
*Nirso Hembrum* is a marginalized farmer from one of the tribal villages Mirgi of *Saraikela* block delimited with hills and forest.



*Nirso* has less than one acre of land for cultivation. He used to cultivate pigeon pea in the traditional method in his upland during the Kharif season. In a training session about mixed cropping practices, where *Nirso* and farmers from his village get information about the practices & importance with the benefit of mixed cropping. He followed all the critical steps shared during the training session like seed treatment with Rhizobium and PSB, seed sowing in an alternate row of maize and pigeon pea. He ensured inter-culture and nipping timely as recommended for the crop. He got bumper production of maize at the end of the third month of sowing. By selling the maize from the field he earned about rupees ten thousand from his half an acre of land. This income helped him a lot in the purchase of Kharif crop input and household expenses. After harvesting maize, his field was filled with pigeon pea. He also harvested about one quintal of pigeon pea from the same piece of land. He has been doing cultivation for so many years but never gets such production from his upland.

*Nirso* and farmers from his village experienced the importance of mixed-cropping. During the 2021 Kharif season, most of the farmers from the village adopted mixed crops in their fields, particularly in uplands. They cultivated maize with cowpea or pigeon pea.

Throughout the project villages, it has been a practice to grow at least one leguminous crop in each land type once in every year to rejuvenate the soil health. Farmers have adopted harvesting method of cutting the stems of Leguminous crops (than uprooting entire plants) to keep the nodules along with root parts within the soil. It is still to be scientifically



established about the extent of improvement of soil health, but a large number of farmers are reporting that the requirement of use of nitrogenous fertilizer is going down gradually in those fields where Leguminous crops were grown in previous season.

### *Jamgami a village on the path of greenery round the year*

Jamgami is one of the tribal villages of Ranchi district, which shows a path of progress to all the tribal villages of Jharkhand in round the year agriculture practices under CRA. This village is 8 Km far from the Bundu block of Ranchi District. This village has a total of 185 tribal households. Almost most all the families of the village are primarily dependent on agriculture as their primary source of livelihood. The village is surrounded by hills and mountains, and the land is very undulating. Monocropping and free grazing are the major constrains of this village along with the poor agriculture extension services.

Earlier, at least one member of each family in this village had to migrate to a distant place like Odisha, Maharastra, Tamilnadu in search of alternate livelihoods. Other use to work in local areas as a laborer to mitigate their daily needs.

In 2018 JTDS initiated agriculture promotion under the JTELP project in this village and initiated community mobilization through different types of technical training and capacity building. Villagers were mobilized for vision-building exercises for preparing an agriculture plan based on the local weather-based crop planning for around the year agriculture practices.

In the village level meeting, all the farmers got convinced around the principles of rainfed agriculture and prepared a plan about the potential use of residual moisture for crops in the Rabi season. Together, they took the challenge to cover a large patch of land under Rabi agriculture by utilizing the residual soil moisture.

The plan included a mix of crops including pulses and oilseeds with cereals & vegetables. Later for the Zaid season cultivation of creepers and watermelons included. The farmers were initially supported by JTDS under the project with input arrangement. The technical training and hand holdings were done by PRADAN professionals in association with other stakeholders.

During 2019, most of the farmers with input and technical support cultivated paddy and legume crops in Kharif, wheat and mustard in rabi and creeper and green gram patch in summer, which became a point of attraction for all the nearby villages. From next year onwards the farmers of this village continued the practice of round the year cultivation and included more crops of legume and oilseeds like Lathyrus, lentil, chickpea, linseed, various gourds, and watermelons. The model has excited nearby villagers and they have adopted the cropping practices as recommended and suggested by trained cadres under the project. The result of round the year agriculture has helped to reduce the distress migration from the village. As they have started cash income from these crops too, the crop coverage has increased to 80% of their land by the third year.

In addition to the above crops and practices, the cultivation of Elephant Foot Yam (EFY) is another winning crop for tribal families across the project area. Resource-poor families are also widely getting benefit by growing EFY. Though, it is a long duration crop, yet, it's other qualities like low in maintenance, able to resist water stress, and can be grown in and around the household even under sheds make it a suitable crop for all. EFY has been grown for household consumption as well as a crop that can be encashed whenever a family requires it as it can be stored at the household level for a pretty long period.

## Seed preservation of HYV- a pathbreaking process for tribal farmers

The quality of seeds is one of the primary reasons to get a better crop yield. Now a days, farmers are becoming more and more market dependent for their need of seeds for almost all the crops. The penetration of hybrid seeds in far flung areas is growing due to farmer's aspiration for getting higher yields in most cultivated field crops like Paddy, Maize, Wheat etc. The hybrid seeds are voracious in nature and needs more amount of fertilizer and other plant protection chemicals for good yields. This trend has started to increase the input cost of growing field crops year after year.

In case of tribal areas of Jharkhand, trend of purchasing hybrid paddy varieties is increasing many folds in last few years. On an average the input cost of hybrid varieties increases 1.5 to 2 times in comparison to the input cost of High Yielding Varieties (HYV) of Paddy.

Suleman Hembrom from Saribinda village of Borio Block in Sahbganj cultivated MTU-7029 a HYV in the year 2019 and with the technical help from PRADAN professional, he preserved the seeds for the next year. In 2020, the crop yield was as equal as the previous year and he realized the technical issues behind the seed preservation. As per him "Even sometimes after spending money we didn't get such good result and now I think in this way farmers can solve their problem as well as can save a significant amount from input cost". Now in the last year onwards almost all the farmers of his village and nearby villages are started to preserve their paddy seeds from HYV.

The crop produced from High yielding Varieties can be utilized as Seeds by adopting certain standard practices of seed preservation started from selection of field for seed production, Plant Protection, care during threshing, drying and storing.

## The small tools a helping hand

Agricultural activity is the primary source of livelihood for rural people. The rural women are involved directly with all sorts of agricultural activities except ploughing due to some taboo. All the crops require at least one interculture operation to get an optimum yield. In the rural scenario, due to various reasons, the adoption of interculture operation in all the crops is minimal or absent. As a result, the food security and surplus cash income are getting affected seriously. Drudgery involved in interculture operations, especially for women involves physical and mental strain, agony, monotony, and hardship experienced by them. On the other hand, under improved agriculture practices, a handful number of small tools based on various situations and land types are available to ease the interculture operation at the field to ensure a good yield of the crops.

The small tools like Cono-weeder, dryland-weeder, marker, paddy thresher, maize sheller, spade, sprayer, low hp water pump, etc. are quite helpful for the small and marginal farmers for easy use and maintenance. Drudgery reduction, time & cost saving are some of the benefits of the use of small tools which have been introduced at the village level under JTELP.

One of the project villages called Tilga is situated at the bank of Sankh river in Garja Gram Panchayat of Sadar block in Simdega district of Jharkhand. The total household of the village is 112 numbers, majority of them are tribal. The primary source of livelihood of this village is agriculture. All the farmers of the villages are marginal category, having an average landholding of 1.5 acres. Under this project to enhance the food security and cash income, the main focus is to cultivate different crops as per the suitability viz a viz land types. During the Kharif season, farmers grew Pigeon pea, Finger millet, groundnut, maize, and paddy. During 2019, in the Kharif season, after getting the demonstration of the utility of small tools, the farmers of the village started using the tools like dryland weeder, Cono-weeder, sprayer, etc. It helped them to improve their cultivation practices with drudgery reduction.

During the current 2021, Kharif season, almost all the farmers used these small tools in their field. Few more additional tools get used in the village like the use of line-markers for maize sowing, paddy thresher for threshing, etc. It was fun for the women to use these tools at the field level. Agriculture cadre Sibanush Baghwar shares "***Mahilaon ka kaam asan hogaya hai aur small tool ko chalne main unko maza bhi aata hai***" (small tools are reducing women drudgery and they enjoy too while using it). Seeing the experience and continued use of various tools making convenient in agriculture operations in Tilga village, nearby villages also demanded such tools and are exploring in the market to use in their agriculture fields.

## Agriculture production data

### Average Production (MT/Ha) Kharif 2019-20

District	Maize	Black gram	Ground-nut	Sesame	Paddy			Pigeon Pea
					Don-1	Don-2	Don-3	
Dumka	2.95	-	-	-	4.72	4.87	2.55	1.02
E. Singhbhum	3.00	0.78	-	-	5.35	4.83	-	1.12
Godda	0.60	-	-	-	3.02	3.04	2.93	
Gumla	2.22	0.43	1.00	-	4.89	3.87	2.63	1.20
Jamtara	2.50	-	-	-	5.74	3.52	-	-
Khunti	2.96	0.63	2.22	-	3.64		-	-
Latehar	5.80	-	-	-	3.50	3.35	-	-
Lohardaga	2.00	0.58	-	-	4.01	3.33	-	-
Pakur	2.91	-	-	-	5.70	5.22	2.64	-
Ranchi	1.20	0.52	-	-	5.13	6.38	3.58	-
Sahibganj	2.30	-	-	-	5.35	4.02	-	-
Saraikela-Kharswan	1.50	0.91	-	-	5.57	5.18	2.35	1.02
Simdega	1.90	0.98	1.17	-	5.57	3.90	3.40	
W. Singhbhum	1.85	0.89		-	3.47		2.22	0.98
Average productivity in project	2.41	0.72	1.46	-	4.69	4.29	2.79	1.07
Average productivity of Jharkhand	2.03	0.94	1.05	0.48	2.24			1.04
Average productivity of India	4.43	0.56	1.32	0.45	2.41			0.81

### Average Production (MT/Ha) Kharif 2020-21

District	Maize	Black gram	Ground-nut	Sesame	Paddy			Pigeon Pea
					Don-1	Don-2	Don-3	
Dumka	2.52	-	-	0.39	5.69	4.26	3.42	-
E. Singhbhum	2.00	0.94	-	0.77	4.43	4.27	4.27	-
Godda	2.04	-	1.39	-	3.53	2.79	2.16	0.65
Gumla	1.97	0.87	1.12	-	2.68	2.46	2.41	-
Jamtara	2.07	-	-	-	4.63	3.48	2.66	2.43
Khunti	2.70	0.75	1.16	-	4.33	4.33	3.22	-
Latehar	3.25	0.83	1.35	0.41	5.56	4.56	3.04	-
Lohardaga	1.80	0.89	1	-	3.25	3.02	2.93	0.94
Pakur	2.17	-	-	0.42	5.46	4.75	-	-
Ranchi	2.63	0.77	0.98	-	5.79	4.75	3.96	1.21

District	Maize	Black gram	Ground-nut	Sesame	Paddy			Pigeon Pea
					Don-1	Don-2	Don-3	
Sahibganj	2.14	0.46	-	-	6.44	6	3.48	-
Saraikela-Kharswan	2.52	0.66	0.95	-	4.09	3.37	2.63	-
Simdega	0.00	0.83	1.31	-	3.98	3.76	3.61	-
W. Singhbhum	2.63	0.7	-	-	3.76	3.49	3.55	-
Avg. productivity in project	2.34	0.77	1.15	0.5	4.55	3.99	3.18	1.3
Avg. productivity of Jharkhand	2.03	0.94	1.05	0.48	2.24			1.04
Avg. productivity of India	4.43	0.56	1.32	0.45	2.41			0.81

### Average Production (MT/Ha) Rabi 2019-20

District	Wheat	Lathyrus	Linseed	Mustard	Gram	Niger	Lentil	Horse Gram	Potato
Dumka		0.84		0.77	1.15	-	1.18	-	-
E.Singhbhum	2.21	1.36	0.63	0.87	1.19	-	1.07	-	-
Godda	-	-	-	1.9	-	-	-	-	12.86
Gumla	2.4	1.2		1	-	-	-	-	14.15
Jamtara	-	-	-	-	-	-	-	-	-
Khunti	2.71	-	0.51	2.7	0.92	-	0.72	-	-
Latehar	-	-	-	-	1.16		1.05	-	-
Lohardaga	-	-	-	-	-	-	-	-	-
Pakur	-	-	-	-	-	-	-	-	-
Ranchi	-	-	-	-	-	-	-	-	-
Sahibganj	-	-	-	-	-	-	-	-	-
Saraikela kharsawan	2.01	0.92	0.51	0.68	1.19		1.06		
Simdega	-	-	-	-	-	-	-	-	-
W.Singhbhum	-	0.77	0.62	0.84	1.23		0.99	-	-
Avg. productivity in project	2.33	1.02	0.57	1.25	1.14		1.01		13.50
Avg. productivity of Jharkhand	2.01	1.20	0.61	0.73	1.17	0.40	1.12	0.60	13.95
Avg. productivity of India	3.20	1.50	0.57	1.30	0.96	0.33	0.80	0.46	21.51

### Average Production (MT/Ha) Rabi 2020-21

District	Wheat	Lathyrus	Linseed	Mustard	Gram	Niger	Lentil	Horse Gram	Potato
Dumka	2.14	1.45	0.61	0.81	0.9	-	0.96	-	12.07
E.Singhbhum	2.11	1	0.66	0.71	1.12	-	0.79	-	10.56
Godda	2.15	1.22	1.05	1.2	0.86	-	1.44	0.73	22
Gumla	2.05	0.8	0.79	0.81	-	-	0.85	-	3.93
Jamtara	2.01	-	-	1.4	-	-	-	-	14.23
Khunti	1.75	0.77	0.51	0.78	0.92	-	-	-	8.72
Latehar		0.42		0.77	1.21	-	1.05	-	6.98
Lohardaga	2.33	0.74	0.74	1.12	1.11	-	0.89	-	10.86
Pakur	-	-	-	1.2	-	-	-	-	-
Ranchi	2.29	0.95	0.85	0.56	1.06	0.34	1.04	0.52	8.92
Sahibganj	2.08	1.43	0.53	0.96	0.68	-	0.84	-	13.53
Saraikela kharsawan	1.64	1.19	0.48	0.95	1.09	-	0.89	-	13.17
Simdega	-	0.84	0.52	0.5	0.8		0.5		16.42
W.Singhbhum	-	1.1	0.49	1.25	1.09	0.63	1.23	0.77	15.8
Avg. productivity in project	2.05	0.99	0.66	0.93	0.98	0.48	0.95	0.67	12.09
Avg. productivity of Jharkhand	2.01	1.2	0.61	0.73	1.17	0.4	1.12	0.6	13.95
Avg. productivity of India	3.2	1.5	0.57	1.3	0.96	0.33	0.8	0.46	21.51

In the project villages last two and half years, by adopting the principles of CRA farmers are articulating the ill effect of imbalance use of synthetic fertilizer and pesticides as soils are getting harder to plough, soil moisture reduces very fast. In comparison to earlier soil conditions, the population of earthworms is less, whereas in uplands it is near to vanished. As the yield potential of the traditional varieties of crops is relatively lower than hybrid seeds, thus the push of market forces engulfed the seed preservation practices. As a result, to maintain the yield potential of these hybrid varieties, the use of a significant quantity of supplementary synthetic fertilizers and pesticides became inevitable for the farmers. All these circumstances increased the dependency for inputs on market. Under CRA practices, the farmers are using HYV and traditional varieties, which require relatively lesser use of supplementary NPK and pesticides with almost stable productivity. To reduce the dependency for inputs on market, it is also re-establishing the traditional seed preservation practices supported with scientific methods and also the adoption of preparing and using organic formulations made from locally available natural materials. Due to the adoption of seed preservation of HYV on large scale in different villages by farmers, they could catch the proper sowing season throughout the year which is a big scenario change in the agriculture practices in the project villages.

## Season wise recommended crop cultivation viz-a-viz land type under CRA

Cropping season	Types of crops	Crop selection on the basis of land type in Jharkhand				
		Upland (Tand)	Homestead (Baari)	Don- III	Don- II	Don-I
Kharif	Fruit plant	Mango, Lemon, Papaya, Guava, Moringa etc.		-	-	-
	Cereals	Millets, Maize etc.	Maize	Millets and Direct Seeded Rice (DSR) (80 to 90 days varieties)	Transplanted paddy (100 to 110 days varieties)	Transplanted paddy (more than 110 days varieties)
	Pulses	Black gram, Pigeon pea	Black gram, Cowpea	-	-	-
	Oilseeds	Groundnut, Sesame (Til)	Groundnut	-	-	-
	Other vegetables	Sweet potato, FYM, Ginger, Turmeric, & Tomato, Brinjal, Chilli, etc.		-	-	-
Early-Rabi	Cereals	-	-	-	-	-
	Pulses	Horse gram	-	-	-	-
	Oilseeds	Niger	-	-	-	-
	Other vegetables	Green pea	Potato, Green pea	Mustard	-	-
Rabi	Cereals	-	Wheat	Wheat	-	-
	Pulses	-	Green pea	Green pea, Lentil, Bengal gram	Bengal gram, Lathyrus, Lentil	Lathyrus, Green gram
	Oilseeds	Mustard	Mustard	Mustard, Linseed	Linseed	-
	Other vegetables	Green pea, Cauliflower, Cabbage, Tomato, Onion, Beans, Chilli, Carrot, Brinjal etc.	Potato, Green pea, Cabbage, Tomato, Onion, Beans, Chilli, Carrot, Brinjal etc.		-	-



Cropping season	Types of crops	Crop selection on the basis of land type in Jharkhand				
		Upland (Tand)	Homestead (Baari)	Don- III	Don- II	Don-I
Summer or Zaid	Cereals	-	-	-	-	-
	Pulses	-	-	-	Green gram	Green gram
	Oilseeds	-	-	-	-	-
	Other vegetables	-	Creepers (Bottle gourd, Sponge gourd, Bitter gourd, Cucumber etc.)	Watermelon & Muskmelon	Creepers (Bottle gourd, Sponge gourd, Bitter gourd, Cucumber etc.)	

## The last word

Jharkhand is a state where almost 84% of holdings are small and marginal, though the primary livelihood option for all these households is agriculture, it is becoming inadequately compensable to generate food sufficiency along with the cash needs of families. Whereas the natural resources available at villages have the potential to generate around the year engagement in respective villages with sufficient surpluses to make the village liveable. Some of the culprits are the whimsical nature of the climate, limited irrigation & allied, which pushes Jharkhand on 27th rank with barely Rs 4721 per month income generation from agriculture out of the list of 29 states including UTs in India. Vagary of climate is one of the most contributing factors behind the sorry state.

Based on the principles of rainfed agriculture, the practices of CRA create an opportunity to cover all the land types of Jharkhand throughout the year to grow different crops with existing infrastructure. Most of these crops are indigenously grown and have a close association with rich tribal culture. Due to various unavoidable circumstances, slowly these crops and practices of growing them disappeared or were about to become extinct.

Under the climatic vagaries, this is one of the suitable options for the state machinery to enhance the rural economy of Jharkhand to save the life of the community.

The discourse of such initiative has a great potential to cover the entire Jharkhand to generate sufficient food crops and surplus cash income for the families of Jharkhand in general and tribals in particular.





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