Policy paper No. PP-02/KR/E-2016

Shifting Cultivation in Odisha State

Issues and Challenges

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Dr P.K. Mishra, Director

FOREWORD

Shifting cultivation is the most primitive among all types of agriculture. It's being followed by many tribes inhabiting in the tropical and subtropical regions all over the world. According to recent estimates, India's 0.59% of the total geographical area is under shifting cultivation. Odisha is one of the major states of India, where shifting cultivation is widely practiced among the scheduled tribes. It's popular among tribal communities due to lack of some alternative employment opportunities.

Shifting cultivation is practiced in some form or other in almost all the tribal areas of Orissa. Crops grown under shifting cultivation are usually for home consumption with primary emphasis is given on cultivation of food crops. Sometimes they grow cash crops like oilseeds, pulses, ginger, turmeric and vegetables but they constitute a very small amount of the total product.

Studies observed two opposite views on shifting cultivation on the one hand this system of farming has been accused of being ecologically destructive and is blamed for removing the tropical forest. On the other, this practice has been acclaimed as a highly suitable and viable form of agriculture in the tropics where soils are poor. Further, total replacement of the system is neither feasible nor desirable as its mixed problem connected not only with availability of plain land or alternative means of livelihood but also connected with the customs, traditions and beliefs of the tribal's.

I hope that this document on **"Shifting Cultivation in Odisha State: - Issues and Challenges"** comprising of present status of shifting cultivated land, crop productivity, technology gap, social and economic impacts, control and rationalization of practices will be helpful for policy makers to take policy decision on shifting cultivation.

Dated the
Dehradun

(P.K. Mishra)

PREFACE

Odisha is one among the biggest State in the Eastern State covering 15.57 Million ha and supporting 41.9 million populations. Tribal population accounts for about 23% of the total population of the State. Agriculture is the main economic activity where 67% of the total population is depending on farming. Total rainfed area to total cropped area is 69% indicating high rain dependant farming with climatic variability's. Agriculture development is much lower than its potential and provides limited opportunity for employment generation. The State is deficit in production of pulses and oil seeds. But surplus in overall food grain production.

Land degradation constitutes one of the greatest threats for food and environmental security. A total of 37.3 lakh ha land area is degraded which accounts for 24% of the total geographical area of the state. The severity of land degradation is highest in the district of Koraput, Rayagada, Phulbani, Kalahandi and Gajapati. Shifting cultivation is also called *podu chaso* in odiya and being practiced by more than 20 tribes in the State. A total of 16 districts in the State shifting cultivation is being practiced out of which the predominant districts are Gajapati, Ganjam, Kalahandi, Khandamal, Koraput, Malkangiri and Rayagada. This report presents the scenario of shifting cultivation in the state, status of ownership, process and practice followed in the shifting cultivation, types of crops grown, production potentials, erosion problems, soil conservation measures practiced, impact on biodiversity, economics of shifting cultivation etc. Based on the available data, information and also feedback from Officers and communities a Road map for Research and Development actions are identified and proposed.

We acknowledge the support and guidance of Dr P.K. Mishra, Director, ICAR-IISWC, Dehradun. Our special thanks to scientific, technical and administrative staff of the Research Centre.

This publication will be useful for research, administration and policy makers in understanding the process and practice in shifting cultivation and to address the issues through livelihood-cum-natural resource conservation programs and schemes.

Authors

1.0 Background on Shifting Cultivation

Shifting cultivation (SC) is a life supporting agriculture production system, considered to be the most ancient practice of tribal agriculture dating back to the lower Neolithic period. This practice is started before the settled agriculture hence, its origin has been reported as old between 13000 and 30000 BC (Goswami *et al.,* 2009). This practice generally known as "Field Forest Rotation" or “slash and burn agriculture” highly practiced in the tropical countries in Asia and Africa. In India, it's practiced in Eastern and North-Eastern regions.

A Shifting cultivated site in the Eastern Ghats part of Odisha

About 5.0 M tribal families in India are practicing this system of agriculture on 4.37 M ha of land covering 11 states (Sahu *et al.,* 2005). About 85% of the total cultivation in North-East India is shifting cultivation (Singh and Singh, 1992). Due to increased use of land for cultivation, the cycle of cultivation followed by leaving land fallow has been reduced drastically in recent years. Earlier, fallow cycle was of 20-30 years duration, thereby permitting the land to return to near natural condition (Patro and Panda, 1994). Due to reduction of cycle, the land is put under high risk of degradation. In spite of all these evil effects, the tribal community in Eastern Ghats region of Odisha are still practicing shifting cultivation on steep hill slopes and locally called as *podu cultivation* (*Podu chasi*). In the present policy paper, efforts have been made to assess dimensions of shifting cultivation practices by tribal's in Odisha. This congregated information can be much more helpful for the policy makers, planners, researchers, scientists and line department officials for easy reference and to tackle with the shifting cultivation practice and land degradation problems in the region.


30 years old secondary forest cleared for cultivation


Forest cleared and brunt for cultivation

2.0 Community Practicing Shifting Cultivation in Odisha

A number of tribal communities inhabiting different areas of the districts in Odisha state are practicing shifting cultivation. About more than twenty types of tribal communities in Odisha are practicing *viz., Bondo, Didayi, Koya, Gadaba, Paroja, Soura, Kutia Kondha, Dongaria Kondha, Kandha, Parenga, Jatapur, Juang, Paudi Bhuyan, Erenga Kolha* etc (Dash, 2006). Majority of these communities have been identified as a Primitive Tribal Groups (PTGs). Many festivals and other such rituals revolve around the *Podu* fields, because the tribal view *Podu* cultivation not only as a means of their livelihood, but also as a way of life.

A *Paroja* tribal farmer in a forest cleared site with tree stumps

3.0 Area under Shifting Cultivation and Dependent Population

In Odisha, shifting cultivation is being practiced by the tribal's particularly in the Eastern Ghats region (Patro and Panda, 1994). Odisha state accounts 36.6% (1.6 M ha) of the total area under shifting cultivation in the country and it's a subsistence farming for more than 2.0 lakh tribal households in the state. Area under shifting cultivation was reported by various agency/organisation since 1951 is presented in Table 2 (Dash, 2006).

A *Kondh* tribal women doing weeding operation

A *Gadaba* tribal man doing cleaning & burning operation

A *Koya* tribal women doing cleaning & burning operation

Table - 1 : Tribes practicing shifting cultivation in different areas of Odisha

Tribe	District (undivided)	Area
Bonda	Koraput	Khairput area of Malkangiri sub-division
Didayi		Kudumulgumma area of Malkangiri sub-division
Koya		Malkangiri sub-division
Gadaba		Semiliguda & Pottangi area of Koraput sub-division
Paroja		Dasamantapur area of Koraput sub-division
Lanjia Soura		Puttasingi area of Gunupur sub-division
	Ganjam	Parlakhemundi sub-division
Kondh	Koraput	Koraput s and Rayagada sub-division
	Phulbani	Kandhamal sub-division
	Kalahandi	Th. Rampur and Lanjigarh of Kalahandi Sub-division
	Sambalpur	Bamara area of Deogarh sub-division, Rairakhol sub-division
Kutia Kondh	Koraput	Gudari, Ramanguda Muniguda, Chandrapur areas of Gunupur sub-division.
	Phulbani	Balliguda sub-division
Dongria Kondh	Koraput	Bisam cuttack area of Gunupur sub-division.
Juang	Keonjhar	Telkoi, Harichandrapur area of Keonjhar sub-division
Paudi Bhuiyan	Keonjhar	Telkoi, Banspal area of Keonjhar sub-division
	Sundargarh	Bonai sub-division
	Dhenkanal	Pallahara sub-division
	Sambalpur	Bamara area of Deogarh sub-division
Erenga Kolha	Sundargarh	Bonai sub-division
Parenga	Koraput	Pottangi area of Koraput sub-division

Table - 2 : Estimated area and dependent population under shifting cultivation by various sources in Odisha

S. No.	Source	Year	Dependant Population (Lakh)	Area Affected	
				Area (Lakh ha)	% to TGA
1	H.F. Mooney	1951	9.36	32.7	21.0
2	Forest enquiry committee report	1959	9.28	33.1	21.2
3	ICAR	1958	10.00	8.6	5.5
4	French Inst. Pondicherry & ICAR	1967	7.06	30.2	19.4
5	FAO/UNFPA	1980	7.06	26.5	17.0
6	Task Force	1983	-	26.5	17.0
7	FRTS-Imaginary	1984	-	9.2	5.9
8	Wasteland Atlas of India (NRSA)	2003	-	1.18	0.76
9	Wasteland Atlas of India (NRSA)	2006	-	1.45	0.93
10	Wasteland Atlas of India (NRSA)	2009		1.44	0.92

3.1 Change in area between 2009 and 2006 assessment : The shifting cultivated data for the year 2009 revealed that, this traditional practice is exist in only 12 districts out of total 30 districts in the Odisha (Table 3 and Map-1). The area under shifting cultivation is more than 1000 ha in 9 districts and in remaining three districts namely Boudh, Cuttack and Sundargarh very negligible area is under shifting cultivation. Change in area between 2009 and 2006 revealed that, 15% of current *jhum* is decreased, and about 34% area increased under abandoned *jhum* but total area was decreased by 1% only. Current *jhum* has been decreased (4 to 100%) in all the 12 districts and abandoned *jhum* (6 to 397%) has been increased drastically in all the districts except Boudh district during 2009 (Map-2). A total area of 727 ha was declined during the period between 2006 and 2009 indicating that practice of shifting cultivation is decreasing at slower phase due to various reasons including developmental programmes/schemes, availability of food grains through public distribution systems etc.

Vegetation recovery in the abandoned *Jhum* site in the Kotgarh elephant reserve, Kandhamal Odisha

Current *Jhum* in the Koraput district, Odisha

4.0 Land Ownership

The type of ownership for shifting cultivated field varies among the tribes from individual ownership to communal ownership which is governed by tribal customary rules. Among the *Juang* and *Paudi Bhuiyan* of Keonjhar district, the land under shifting cultivation is the communal property owned by all the villagers in common. Every year in the month of *Magha* (January-February) the village headman and the priest select the land for cultivation. Generally the patch which has completed its rotation cycle and is sufficiently covered with trees and bushes is considered suitable to be cleared for shifting cultivation. After the patch is selected, the headman demarcates the boundary lines by putting mark on trees by axe and the land is sub-divided into several plots which are allotted to the households (Mohapatra and Devi, 1973). The ownership of land after allotment is transferred to the head of the household for a period of 2 to 3 years till he cultivates it actively. But as soon as it is left to rest/fallow it become the property of the community (Patnaik, 1977).

Table - 3 : Shifting cultivated area and change between 2006 and 2009 in districts of Odisha state

S.No.	District	2006				2009				Change (2009-2006)						
		Area (ha)				Area (ha)				Area (ha)				percent		
		CJ	AJ	Total	PTT	CJ	AJ	Total	PTT	CJ	AJ	Total	PTT	CJ	AJ	Total
1	Boudh	131	160	291	0.2	42	28	70	0.0	-89	-132	-221	30.4	-68	-83	-76
2	Cuttack	5	0	5	0.0	0	0	0	0.0	-5	0	-5	0.7	-100	*	-100
3	Gajpati	31877	13007	44884	31.1	30517	15656	46173	32.1	-1360	2649	1289	-177.3	-4	20	3
4	Ganjam	8805	3377	12182	8.4	1927	9020	10947	7.6	-6878	5643	-1235	169.9	-78	167	-10
5	Kalahandi	9270	5563	14833	10.3	8778	6246	15024	10.4	-492	683	191	-26.3	-5	12	1
6	Keonjhar	643	375	1018	0.7	126	904	1030	0.7	-517	529	12	-1.7	-80	141	1
7	Khandamal / Phulbani	16709	4878	21587	14.9	13849	7016	20865	14.5	-2860	2138	-722	99.3	-17	44	-3
8	Koraput	11797	3088	14885	10.3	11260	3279	14539	10.1	-537	191	-346	47.6	-5	6	-2
9	Malkangiri	17903	10779	28682	19.8	16496	12871	29367	20.4	-1407	2092	685	-94.2	-8	19	2
10	Nawrangpur	1290	36	1326	0.9	1186	179	1365	0.9	-104	143	39	-5.4	-8	397	3
11	Rayagada	3942	898	4840	3.3	3283	1140	4423	3.1	-659	242	-417	57.4	-17	27	-9
12	Sundargarh	0	0	0	0.0	0	3	3	0.0	0	3	3	-0.4	*	*	*
	Total	**102372**	**42161**	**144533**	**100.0**	**87464**	**56342**	**143806**	**100.0**	**-14908**	**14181**	**-727**	**100.0**	**-15**	**34**	**-1**

*** Area increased over base year is zero**

(AJ: Abandoned *Jhum*; CJ: Current *Jhum*; PTT: Percent to State Total) (Source: NRSA, Wasteland Atlas of India, 2011)

Particularly in Southern Odisha namely Koraput and Ganjam areas the communal ownership of the village over *Podu* land is completely absent. Each household owns a number of sites on hill slopes and uses these in rotation. In course of time, *Podu* land has become private property which can be owned and inherited by customary right. There is no legal sanction behind it. *Bonda* tribes even sells his plots under shifting cultivation to another and mortgages it whenever required (Mohapatra and Devi, 1973). Among the *Koya*, the unreserved forest land is treated as private property and is also inherited by the legal heirs. However, there is no legal rights/title to tribals on these lands in any part of the Odisha state. As right of ownership on land only by public opinion and there is no individual record of right. However, Forest Right Act (FRA)-2006 has been introduced and details are given below.

Practice of *Jhum* cultivation in the community forest by the tribals at Lilliguma, Rayagada dist.

4.1 Forest right act-2006 : The Ministry of Tribal Affairs is the nodal agency for implementing the provisions of the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006. The Act seeks to recognize and vest the forest rights and occupation in forest land in forest dwelling Scheduled Tribes and other traditional forest dwellers who have been residing in such forests for generations but whose rights could not be recorded. The Act was notified for operation with effect from December 31,2007. The Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Rules, 2008 for implementing the provisions of the Act were notified on January 1,2008. As per the provisions of the Act and the Rules framed there under, the onus of implementation of the Act lies at the level of the State/UT Governments. The Act seeks to recognize and vest certain forest rights in the forest dwelling Scheduled Tribes and other traditional forest dwellers. The Ministry, to ensure that the intended benefits of this welfare legislation flow to the eligible forest dwellers for which comprehensive guidelines have been issued to the State/UT Governments on July 12,2012 for better implementation of the Act. Further, to strengthen the Forest Right Rules, 2008, the Ministry has also notified the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Amendment Rules, 2012 on September 9,2012.
(http://tribal.nic.in/Content/ForestRightActOtherLinks.aspx;http://www.forestrightsact.com)

5.0 Site Selection and Shifting Cycle

Podu cultivation is generally practiced on the hill slopes and the general characteristic is presented in Box 1 and dynamic process involved in SC is presented in flow chart 2. In the first year of *Podu* cultivation, tribals' sow *Kandul* (*Cajanus cajan* : variety of pigeon pea) by broadcasting the seeds in the field during onset of monsoon The tribal's ensure adequate protection of their shifting cultivated field. After harvest, the land is left fallow. During the next monsoon, *Suan* (*Panicum miliare*: little millet), *Kangu* (*Setaria iitalica*- Foxtail millet) and ginger (*Zingiber officinale)* are sown. Generally, *Haldi* (*Curcuma longa*)is sown with *Kangu* and *Suan*. Where *Haldi* forms the underground crop having economic value, *Kangu* and *suan* form the overland crops for consumption. At many places ginger is raised as the pure crop. At maturity, harvesting of overland crops is followed by harvesting of underground crop. Generally, after the third year, the tribal's abandon and shift to new cleared land. On the abandoned sites, natural regeneration starts from the available root stocks and seed bank from nearby forest. Bamboo (*Bambusoideae)* comes up naturally; and Kendu (*Diospyros melanoxylon*), Mahua (*Madhuca longifolia*), Terminalia (*Terminalia spp.)* along with certain other climbers also regenerate. Generally, this land is not cultivated for the next 20-30 years and this period is called *Podu* cycle. During this period, tribal's use this land to collect edible root suckers which are used as eatables. *Mahua* and *Eleocarpus* (*Salpa*) trees are used for the preparation of alcoholic drinks for own consumption. Due to demographic pressure, this *podu* cycle has now drastically reduced to 2-3 years in Odisha.

Practice of 20 years shifting cultivation cycle in Lilliguma, Rayagada dist., Odisha

Burning of felled trees in Lilliguma, Rayagada dist., Odisha

Mixed crop cultivation in the forest cleared site in Lilliguma, Rayagada dist., Odisha

Podu cultivation is an agricultural system which is characterised by rotation of field rather than crops, by short period of cropping alternating with long fallows periods (short to long periods) and clearing by means of slash-and-burn. The *podu* cycle followed by different tribes is selected blocks of Odisha districts are presented in Table 4 (Rath, 2015). Study conducted by Srivastava (1996-97) reported that out of the 157 shifting cultivation sites, 35% of the sites (55 plots) had cultivation phase of 5-6 years followed by 25% (40 plots) with 3-8 years, 18% (28 plots) with 3-6 years, 14% (22 plots) with 5-10 years and 8% (12 plots) with 1-8 years of cultivation phase. Increasing weed infestation with the progress of cultivation phase was the major factor for crop productivity in shifting cultivated areas where weeds compete with crops for nutrients and other resource. Weed biomass increased from 92 kg ha^{-1} in first year of cultivation phase to 851 kg ha^{-1} in 5th year of cultivation phase in finger millet (*Eleusine coracana)*.

Box -1: Characteristics of Shifting Cultivation

- **Slashing and burning of vegetation for cropping.**
- **Growing mixed crops cereals, pulses, oilseeds, vegetables, spices, root crop etc.**
- **No or minimal use of external inputs like inorganic fertilizer, pesticides and herbicides.**
- **Harvesting of crops at different times/dates.**
- **Mainly family labour is used.**
- **Low crop yield, to meet family needs.**
- **No marketable surplus.**
- **Field fallowing for restoring soil fertility.**
- **Temporary/Short crop growing cycle.**
- **Rotation/shifting of cultivated field/plots.**
- **Use of simple hand tools and implements for land clearing and crops cultivation.**

Table - 4 : Podu cycle in selected blocks of Odisha districts

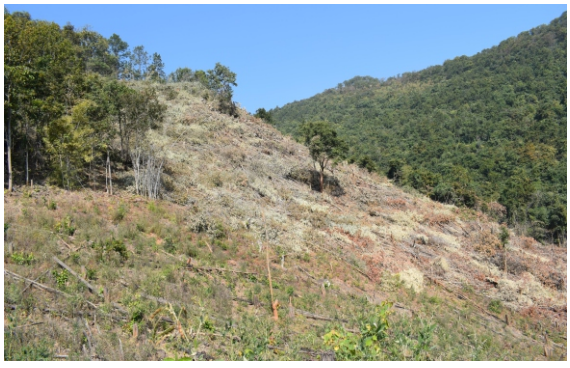
Tribe & Region	Cultivation / Fallow rotation (Year)									
	1	2	3	4	5	6	7	8	9	10
Kandha(Kalyansingpur Block)										
Kutia Kondha (Chandrapur Block)										
Kondha (Bissam Cuttack Block)										
Bonda poroja (Bonda Hills, Khairaput Block)										
Kondha (Narayana Patna Block)										
Koya (Podia Block)										
Gonda (Raigarh Block)										

(Yellow colour indicates cultivation: green colour indicates fallow period)

5 year shifting cycle at Jeypore Ghat Koraput dist., Odisha

12 year shifting cycle at Bonda hills, Malkangiri dist., Odisha

16-20 year shifting cycle at Lilliguma, Rayagada dist., Odisha



20-25 year shifting cycle at Kotagarh, Kandhamal dist., Odisha

6.0 Size of Land Holding

The average land holding in the region has decreased from 1.25 ha in 2000-01 to 1.02 ha in 2011-12 (http://agcensus.dacnet.nic.in/stateholdingsizeclass.aspx and http://inputsurvey.dacnet.nic.in/RSL/StateTable1.aspx). The per household average area of shifting cultivated land in Koraput region is 0.95 ha is much less as compared to the situation in the past (Rath,2015). According to survey more than 40% of the households having less than one ha land (shifting cultivation) as compared to 20% in case of settled cultivators (Rath,2015).

Per household average available land holding was more in case of cultivators who following both settled + shifting (1.76 ha) cultivator which was followed by only settled cultivator (1.43 ha) and was only 1.07 ha for only shifting cultivators (Rath,2015). Limited settled lands i.e., wet lands, terraces and medium lands compel the cultivator to depend upon shifting cultivation to supplement the income (Figure 1).

1. Secondary forest

2. Cutting, clearing and burning

3. Crop cultivation

4. Natural regeneration during fallow

Flow chart 1 : Dynamic processes in shifting cultivation cycle

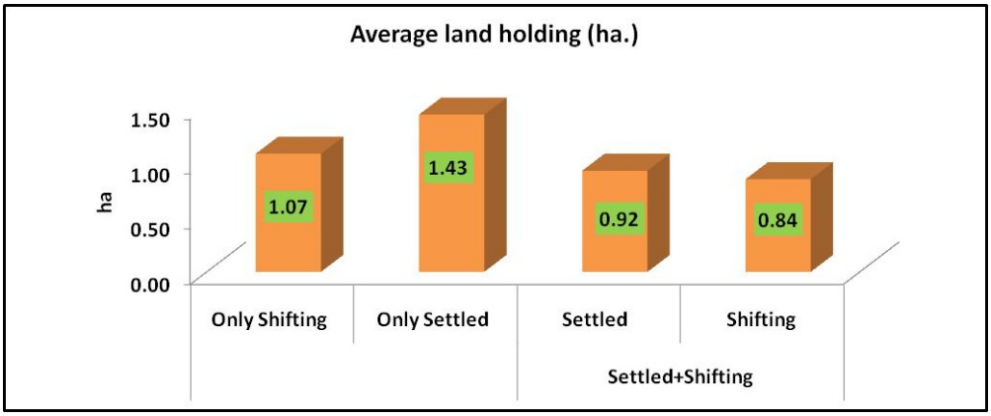


Figure 1: Average land holding per house hold under different type of cultivators (Modified from Rath, 2015)

7.0 Productivity of Crops

Crops grown under shifting cultivation are usually for home consumption with primary emphasis on cultivation of food crops. Sometimes crops like oilseeds, pulses, ginger, turmeric and vegetables are also grown but they constitute a very small amount of the total produce. Mixed cropping minimise the risk of complete crop failure due to vagaries of monsoon, insect and pest attacks, which are common in a primitive environment. The age old practice utilises the soil moisture in different layers of the soil profile in divergent root system of different crops and help recouping soil fertility by plantation of leguminous crops. A variety of crops grown by the cultivators who are following settled, shifting and both (shifting+ settled) the cultivation practice is presented in Table 5. The common, english and scientific name of crops grown in shifting cultivated sites is presented in annexure 1.

Agriculture crops cultivated at different shifting cultivated sites in Odisha

Table - 5 : Crops grown in shifting and settled cultivation in Koraput

Cultivation		Crops
Only shifting		Paddy, Ragi, Kangu, Maize, Khedjana, Jana, Ganthia, Jhudunga, Horse gram, Green gram, Red gram, Black gram, Vegetables and oil seeds.
Only settled		Paddy, Ragi, Suan, Pulses (Red gram), Niger oil seed, Maize, Vegetables
Both (Shifting+ Settled)	Shifting	Paddy, Ragi, Suan, Pulses (Red gram), Niger oil seed, Dangarrani, Horse gram, Green gram, Red gram, Black gram, Pumpkin, Banana, Turmeric, Khedjana, Jana, Ganthia, Jhudunga, Sesamum
	Settled	Paddy, Ragi, Suan, Pulses (Red gram), Oilseeds, Vegetables, Bajra

A comparative analysis between different cultivators revealed that paddy and ragi yield was higher in case of farmers following shifting cultivation as compared to other cultivators, but yield of maize and red gram was less. It reveal that the output per ha was more under settled cultivation in respect of farmers following both settled and shifting cultivation for crops like paddy, ragi, red-gram (Figure 2a).

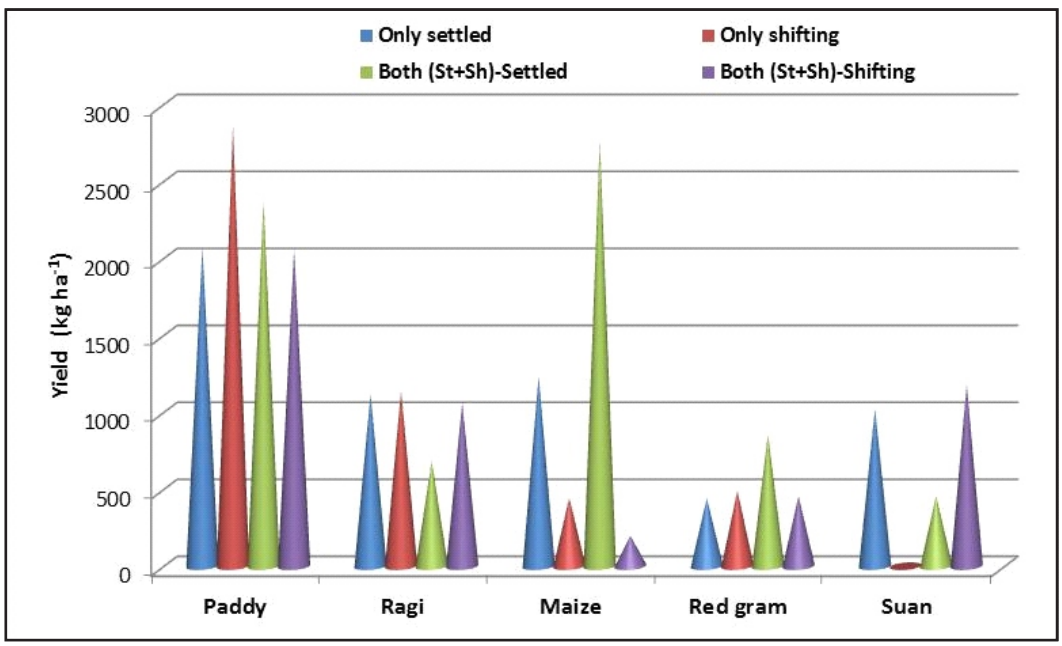


Figure 2a: Average crop yields under settled, shifting and both the production shifting (Modified from Rath,2015)

Whereas the output per ha was less in maize and oil seeds under shifting cultivation. Similarly, the crop wise productivity of different crops in these two types of cultivation revealed that the average productivity of *ragi* and *suan* were higher under shifting cultivation in respect of farmers following both shifting and settled cultivation but the productivity was less in case of paddy, maize and red-gram. On the whole it reveals that, paddy equivalent yield was higher in case of settled cultivation (1825 kg ha^{-1}) where tribal practicing both settled and shifting cultivation followed by only shifting cultivation (1558 kg ha^{-1}) and only settled cultivation (1438 kg ha^{-1}).

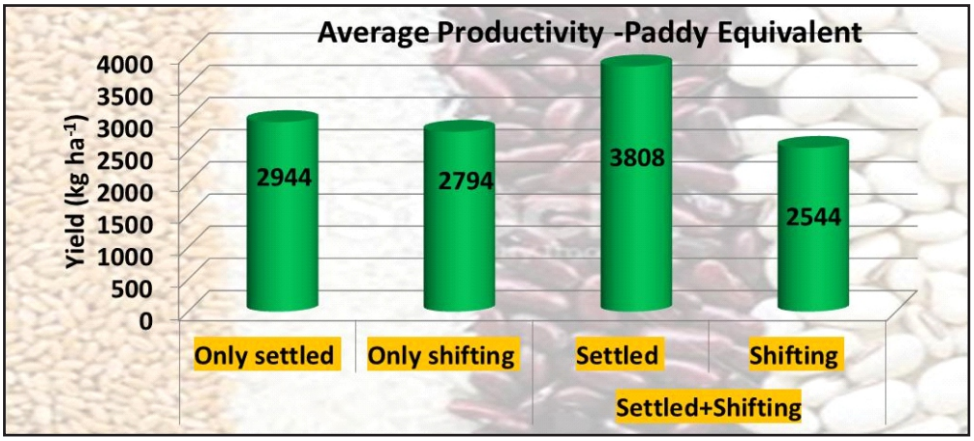


Figure 2b : Average yield of crops (Paddy Equivalent) under settled, shifting and both the cultivation practices (Modified from Rath,2015)

8.0 Labour and Energy Inputs

Shifting cultivation provides work to all members of a tribal family. Women take active part in cleaning *Podu* land, breaking clod of earth, hoeing, dibbling of seeds, weeding and reaping. The children right from a tender age help their parents on all these activities. Maximum only family labours are being used for all the operations and some time they do it on mutual sharing basis among the tribal community. Component wise labour inputs revealed that, maximum labour is required for weeding (30.3%) followed by harvesting (23.8%), land preparation (18.0%), processing (10.9%), sowing (9.5%) and site clearing (6.1%). The energy input pattern also followed the similar trend that of labour inputs (Figure 3). Maximum labour input is required in the first year due to clearing of site and burning (37.07%) and the remaining year of cultivation relatively less labour are required (Figure 4). Total energy input for the three years cultivation period was 11845 MJ ha^{-1}, out of which first year input energy share was 35.22% compared to second (32.16%) and third year (32.62%). Total energy output for three years cultivation cycle is 104845 MJ ha^{-1} out of which first year energy output was relatively higher (36.36%) due to better soil fertility status compared to second year (34.55%) and third year (29.09%). Net energy benefit also followed the similar trend that of total energy output.

The average energy ratio or energy use efficiency (EUE) of the three years cultivation is about 9.0 whereas energy productivity is 0.35 kg MJ^{-1} of energy and the specific energy is 2.86 MJ kg^{-1} of grain (Paddy Equivalent Yield). In shifting cultivation to produce one kg of grain (Paddy) it required 0.18 man-day labours or in other words about 5.5 kg of grain (Paddy) is obtained from one man-day labour input. Considering the MSP of paddy (2016-17), it workout to Rs. 80.60/- per man-day which is very lower than the minimum wage. This shows substance level of farming in the absence of other alternatives to maintain family.

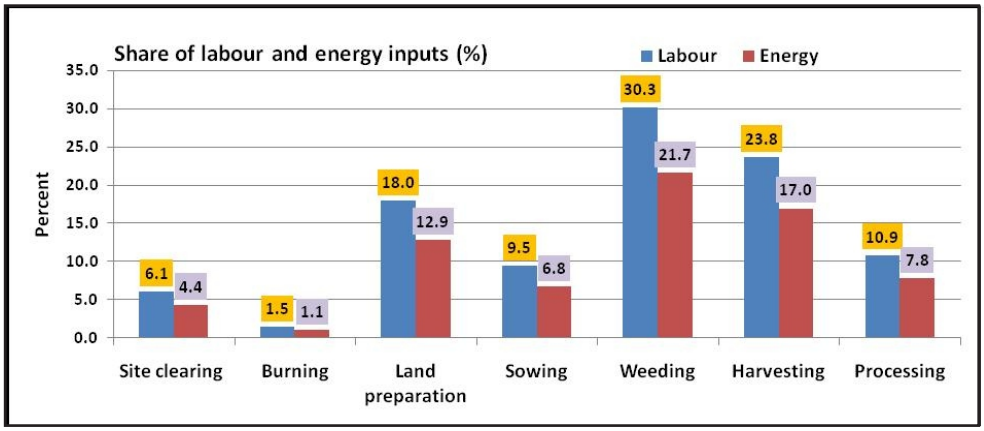
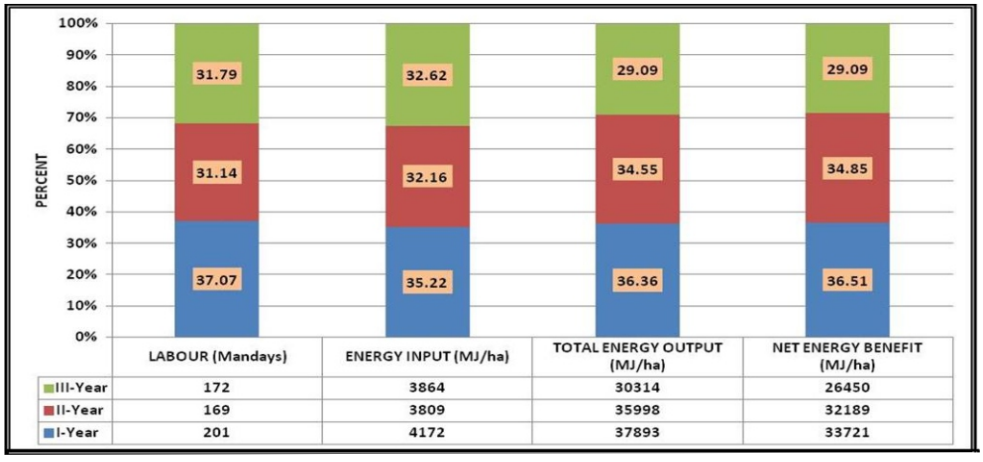


Figure 3 : Component wise share of labour and energy input in shifting cultivation cycle of three years



	LABOUR (Mandays)	ENERGY INPUT (MJ/ha)	TOTAL ENERGY OUTPUT (MJ/ha)	NET ENERGY BENEFIT (MJ/ha)
III-Year	172	3864	30314	26450
II-Year	169	3809	35998	32189
I-Year	201	4172	37893	33721

Figure 4 : Labour, energy input, total energy output and net energy benefit under shifting cultivation cycle

9.0 Effects of Shifting Cultivation

Main ill effects of shifting cultivation are discussed under the following headings.

9.1 Soil erosion: The problem of soil erosion due to shifting cultivation is very serious in Odisha and severity of erosion problem has increased due to reduction in fallow period from 20-30 years to 2-3 years. The vegetation stubbles and stones provide little protection against water erosion. Soil erosion is very high particularly on steep slopes and some time entire top soil is washed out of the field making soil unfertile which leads to poor crop yield. The soil loss varies from 84 to 170 t $ha^{-1}yr^{-1}$.

Srivastava (1996-97) reported that bush fallow fields produced lower runoff and soil loss compared to cultivated fallow and crop cultivation. Increase in land slope from 9% to 37%, increased the runoff from 12.8% to 33.2% and soil loss from 10.1 to 34.8 t $ha^{-1}yr^{-1}$ (Figure 5).

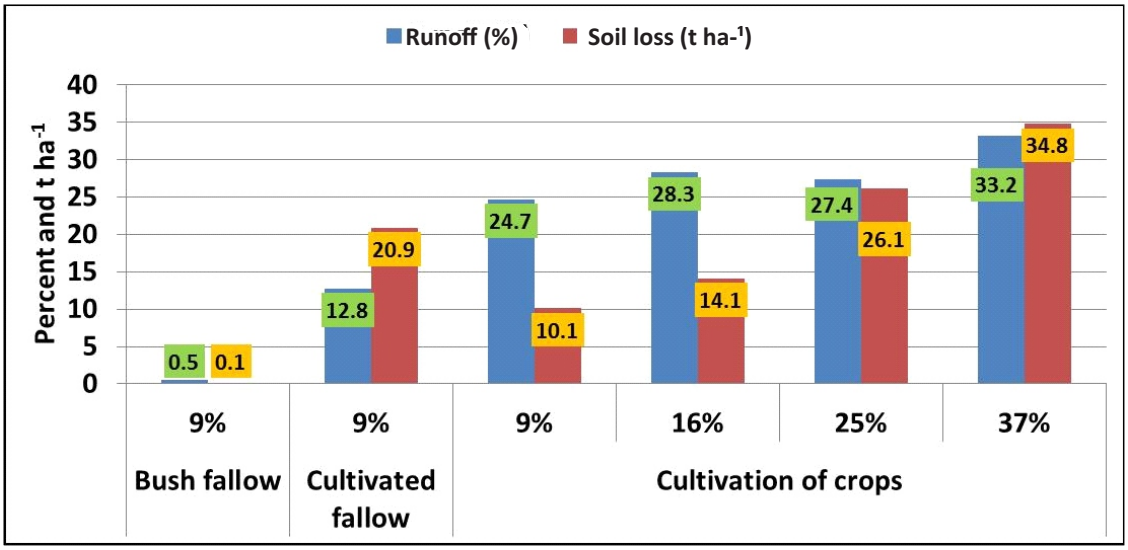


Figure 5: Runoff and soil loss under different slopes with fallow and cultivation of crops in shifting cultivated sites

Various kinds of land degradation problems due to the practice of shifting cultivation

9.1.1 Soil and water conservation measures: In general, no soil and water conservation measures are followed in the shifting cultivated sites by the tribal community due to additional man-days and cost involved. At places where stone are available were picked up from the field in the process of site clearing and placed in the form of bunds. Earthen bunds or stone stoned bunds can be seen in some fields. At few sites, lack of legal rights on the land may be the reason for not following any conservation measures of their own or by the any developmental agencies. During the cropping season, mixed crops take care of soil and rainwater conservation in the cultivated sites. Absence of conservation measures causing severe soil erosion which decreases the recovery potential/rate of soil either in current or during fallow periods.

Soil and water conservation practices at shifting cultivated sites

High density cover raised in Jhum sites

9.2 Soil properties: It's estimated that on an average 7-10 t $ha^{-1}yr^{-1}$ of soil lost from shifting cultivated land along with the valuable nutrients (Figure 6). There is drastic change and decreased in soil properties in the shifting cultivated site at the end of the cycle compared to before and after clearing and burning the site. Increased in soil organic carbon, pH, available P and K, and exchangeable Ca after clearing and burning of vegetation compared to end of the crop cycle. This increased soil nutrients support growing of crops during the initial years and drastic decrease in soil fertility status at the end of the cycle (Table 6). In general, no external inputs is being used or added to the shifting cultivated fields during the cropping season and crops depends on only nutrients available in the field. Many studies have reported restoration of soil fertility during the long fallow period. The soil organic carbon recovery however, is influenced by the basal area and the species diversity of the land use (Hombegowda *et al*., 2016).

Table - 6: Soil properties in shifting cultivation

Soil properties	Before burning	After burning	End of cycle
pH	5.1	5.5	4.2
OC (%)	0.13	0.25	0.05
Available P (kg ha^{-1})	3.3	5.5	1.2
Available K (kg ha^{-1})	210	570	40
Exch. Ca (meq/100g)	7.15	9.46	2.82

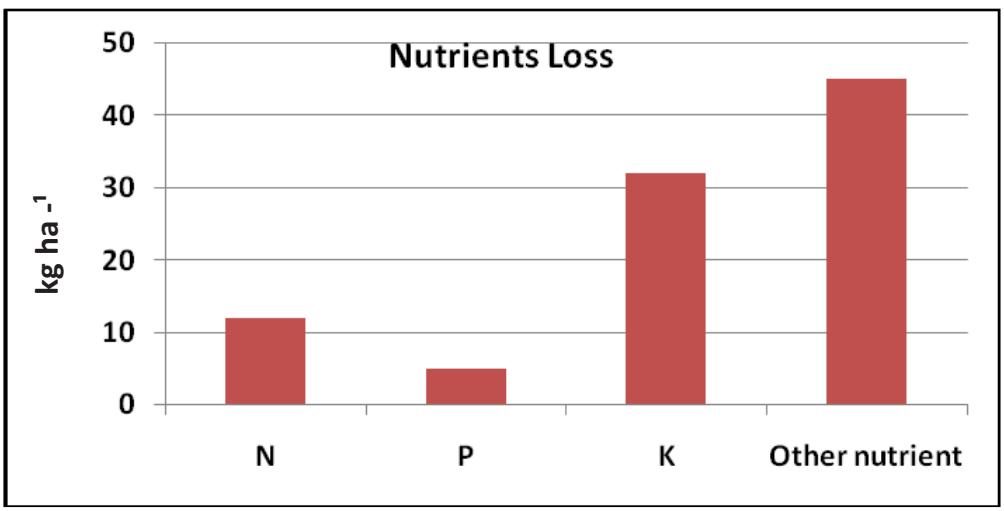


Figure 6: Nutrients loss due to soil erosion from shifting cultivated site

9.3 Biomass turnover during fallow-cultivation phase : The tribal farmers who practice shifting cultivation prefer natural vegetation over planted vegetation due to high biomass production without much labour inputs and management. Higher biomass production also provides more nutrients upon burning. This may be reason that shifting cultivated plots in general with stubbles and stumps of vegetation provides the vegetation cover at short period. More time lag in the planted vegetation for its establishment result in poor or low biomass production. Biomass production of both natural and planted vegetation was studied over a period of 3 years (Table 7). Natural vegetation produced greater biomass (30.2 to 358.7 t ha^{-1}) over planted vegetation (4.9 to 20.3 t ha^{-1}) for a period of 3 years. Bush fallow system produced the maximum biomass of 358.7 t ha^{-1} among the natural vegetation and whereas *Gliricidia* on field boundary produced maximum of 20.3 t ha^{-1} biomass under planted vegetation (Srivastva,1996-97).

Table - 7: Fresh biomass production under natural and planted vegetation in shifting cultivated area

Treatment	1st year	2nd year	3rd year	Total
Natural vegetative hedge (t ha^{-1})				
At 5 m interval	1.7	10.8	17.6	30.2
At 10 m interval	0.9	5.4	32.1	38.4
Bush fallow	85.0	135.0	138.7	358.7
Planted vegetation at 5 m interval (t ha^{-1})				
Sambuta	0.0	2.1	2.9	4.9
Gliricidia	0.2	4.6	8.2	12.9
Sambuta	0.0	2.1	2.9	4.9
Pigeon pea	0.0	6.1	1.3	7.4
Gliricidia on field boundary	0.0	5.6	14.7	20.3

9.4 Global warming: During the first year of cultivation, the secondary forest or bush vegetation is cleared and burnt which leads to release of CO_2 to the atmosphere. Whatever CO_2 fixed during fallow period through regenerating vegetation will be released back during the first year of cultivation. Based on the Table 8, during the three year fallow period an amount of 76.4 t ha^{-1} of dry biomass is generated, while 34.4 t ha^{-1} of CO_2 is released to atmosphere due to burning of vegetation and in addition to this soil organic carbon is also released during the cultivation. It's reported that nearly 1 t ha^{-1} of soil organic carbon is released back to atmosphere from the top 20 cm soil depth during the 3 year of cultivation. Thus shifting cultivation is acting as a source of global warming with a global warming potential of about 35.4 t ha^{-1} in a shifting cycle of three year fallow and three year cultivation phase.

9.5 Yield of crops: The Impact of biomass recycling on yield of finger millet is revealed that (Table 8), greater crop yield with recycling of biomass from natural vegetation hedge at 10 m interval (730 kg ha^{-1}) followed by planted vegetation biomass recycling of Gliricidia (*Gliricidia sepium*)+ Sambuta (*Saccharum spp.*) (655 kg ha^{-1}) and nutrients recycling @7.5 t ha^{-1} of biomass (630 kg ha^{-1}). In general, there was gradual decrease in yield of crops due to depletion of soil fertility status.

Table - 8: Influence of biomass recycling on yield of finger millet

Treatment	Grain yield (kg ha^{-1})				
	1994	1995	1996	Mean	Increase over control (%)
Natural Vegetative Hedge					
At 5m interval	586	183	347	372	2
At 10 m interval	875	561	755	730	101
Planted Vegetation at 5 m interval					
Gliricidia + *Sambuta*	540	561	865	655	80
Sambuta + Red gram	391	590	283	421	16
Nutrient cycling@ 7.5 t ha^{-1}		624	636	630	74
Untreated control	483	313	293	363	

9.6 Biodiversity: Clearing and burning of primary or secondary forest for the practice of shifting cultivation was considered as the principle driver for the deforestation. This practice was responsible for the loss of tropical forest area by 61% until 1991(Myers 1991). Deforestation of primary forest causes decrease in forest cover, increase in obnoxious exotic weeds and unwanted plants, and disappearance of valuable endemic flora and fauna which ultimately results in land degradation. Saldarriage *et al* (1988) reported that due to the disturbance of the ecosystem, sensitive endemic plant species have not fully recovered after the long fallow period and face threat of extinction. Whereas the generalized forest species was reported to be recovered after the 50 years of fallow in Bolivia (Kennard, 2002).

Even though shifting cultivation leads to loss of biodiversity, the fallow period offers the opportunity for the recovery of the lost species. But once the land is fallowed, obnoxious weeds predominates the fallowed area and influence the recovery of native plant population, which adversely affect the diversity of the secondary forest. Vegetation parameters such as species richness, canopy cover, percentage of tree species in regeneration, and tree biomass were considerably higher in plots cultivated for three years in comparison with sites cultivated continuously for more than six years (Uhl, 1987). Shorter fallow cycles such as 4–5 years in North-East India resulted in arrested succession, since pioneer species were dominated by the weedy species, and over time the soil seed bank was replaced with seeds of weedy shrubs (Saxena and Ramakrishnan, 1984).

Study from the North-East India reported that species feeding on young leaves and seeds (e.g., Phayre's leaf monkey, *Trachypithecus phayrei*) persisted in 10-year and older secondary sites to some extent (Guptha and Kumar 1994). Even though shifting cultivation has many benefits for the ethnic population for the livelihood point of view, but in long run it destroys the ecosystem balance and native endemic flora and fauna.

9.7 Economics of shifting cultivation: The total cost (TC) of cultivation following only shifting cultivation calculated at Rs. 5409 ha^{-1} against gross return (GC) of Rs. 4080 ha^{-1} negative net returns(NR) of Rs.1329 ha^{-1}. But in case of farmers following both the types of cultivation (Settled+Shifting), it was found that per ha net return is greater from settled cultivated field than that of shifting cultivation which is negative. In case of cultivators following only shifting cultivation, the net return per ha for all crops was positive (Rs. 335 in case of red gram to Rs. 1666 in case of maize) except paddy which was negative (Figure 7).

If tribal community use their own family labour than the average net return was around Rs. 1560 ha^{-1} under only shifting cultivation. Net return per ha (Rs. 3714) was more under settled cultivation in respect of farmers following both settled and shifting cultivation. Whereas the net return per hectare was less under shifting cultivation. The economics of only settled and only shifting cultivation was similar in trend but tribes who have both settled and shifting cultivation get profit from settled cultivation. This strongly supports the fact that substance level of farming to get family requirements and family employment opportunities.

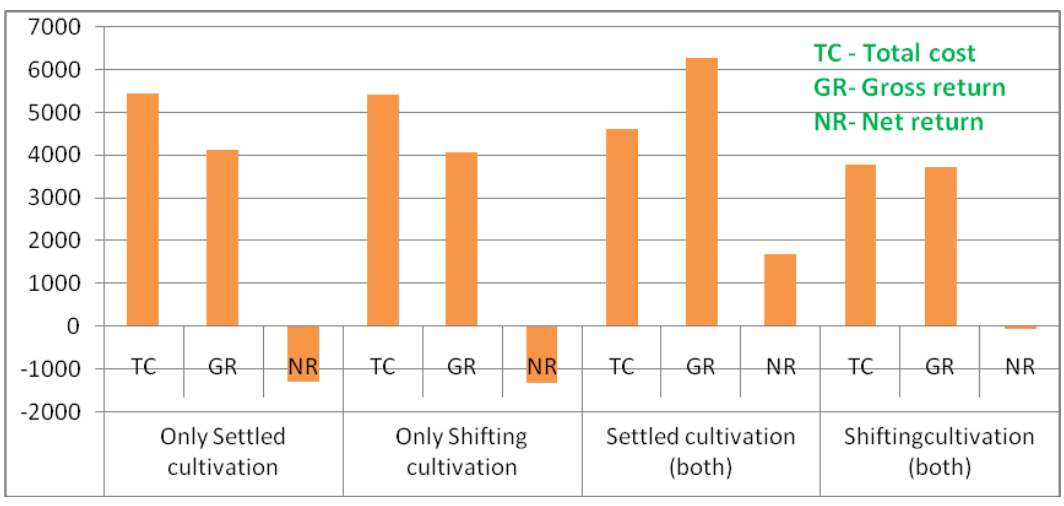


Figure 7: Economics of only settled, only shifting and both (Settled+Shifting) cultivation in Koraput District (Modified Rath, 2015)

10.0 Merits and Demerits of Shifting Cultivation

Merits and demerits of shifting cultivation are presented in Box-2.

Box-2: Merits and demerits of shifting cultivation

Merits

- Only source of land for landless tribal'
- Provide employment to all the family members
- Mixed cropping provides less risk of crop failure
- Provides balanced diet to the family
- Maintaining cultural heritage and unity among the people/community

Demerits

On-site	Off-site
• Deforestation	• Silting of water bodies
• Loss of biodiversity- flora and fauna	• Ecosystem degradation
• Soil erosion and land degradation	• Imbalance in eco-system services
• Loss of soil organic carbon	• Seasonal migration
• Loss of soil fauna and microbes	• Reduction in hydro-power generation and water availability
• Decreased soil depths	• Increased human-wild animal conflicts
• Increased soil stoniness	• Global warming and climate change
• Decreased productivity	
• Vulnerability to climatic variability	

11.0 Existing Measures Adapted to Control and Rationalize Shifting Cultivation

A number of schemes and programmes sponsored by the central and the state governments have been adopted and a few of them are under implementation. Measures have also been taken to rationalize it in a scientific way so as to do away with its evil effects (Box-3).

Box - 3

- **Resettlement of tribal people in colonies**
- **Rational land use on watershed basis:** Providing land to the tribal who is willing to give up cultivation on steep slopes, plantation of economic species useful for tribal communities on steep slopes, introduction of conservation farming to obtain higher production from crop land and utilization of steep slopes for production of timber.
- **Soil and water conservation:** Land development measures like vegetative bunding, stone bunding, land levelling /terracing and development of drainage system, water harvesting structures
- **Alternative measures like** Agri-silviculture,*Taungia* system, Half plot method, introduction of cash and horticulture crops, and afforestation programme
- **Other economic activities** under different sectors like Coffee plantation,Cotton cultivation, Medicinal and herbal plantation, Vanilla cultivation, Small scale industries, Cottage industries and handicrafts, Animal husbandry and Fishery.
- **Poverty alleviation programmes supported by state and central government.**

12.0 Road Map for R&D Activities on Shifting Cultivated Area in Odisha

Road map for R&D activities for shifting cultivation in the State is presented figure 8.

Parameters	land		Soils			Vegetation		Socio-Economic	
	Current	Fallow	Fertility	Productivity	Restoration rate	Dynamics	Diversity	Households	Economics
Assessment									
Dependant population									
Soil erosion									
SMC measures impacts									
Crops & cropping systems									
Above & below ground biomass production									
Carbon sequestration rate									
Soil dynamics									
Species richness & diversity									
Vegetation/soil recovery rate									
Devp.models in the State									
Devp. models in other parts of the country									
Impact of tribal development programmes									

Available		Not applicable		To be Developed	
Not		Strongly Needs		Available in other part of the country	

Figure 8: Road map for R&D activities for shifting cultivated areas in Odisha state

13.0 Policy Options

An analysis of measures indicates that any single or group of measures undertaken by the Government only tend to scratch the surface of the tribal problems. The basic prerequisite is to change the objective situation of the tribal economy by ensuring their access to better land in the plains, input services, skill and organisation which are designed to control them. For the restoration of the shifting cultivated affected ecosystem and to improve the socio-economic conditions of tribal families the following policy options have been proposed.

13.1 Employment opportunities: Due to remoteness of tribal hamlets, no or very limited scope for employment opportunities. During lean season migrating to nearby town/cities within and outside the state to get some employment is common feature. Providing better employment opportunities and income generation activity can change the dependency of the landless people on shifting cultivation along with their socio-economic level improvement. Establishment of rural and forest based industry will improve the employment opportunity, basic infrastructure, market and overall economy of the region. Financial incentives should be provided for the cooperative efforts at village levels for carrying out forest-based activities, i.e. basket making, rope making, cane furniture processing of minor forest produce, honey collection, etc., and good market network facility should be created.

13.2 Imparting education to tribal children and youths: Massive mass awareness programme for educating tribal men, women and children about the menace of shifting cultivation on ecosystem should be done with the involvement of villagers. The services of various Non-Governmental Organizations and voluntary agencies, besides the regular Government machinery, are required for undertaking such work on sustainable basis. Present skill development initiative of the government is a greater opportunity to the youths particularly from land less tribal community so that dependence on shifting cultivation is slowly decreases.

13.3 Reach to unreached: Many of the tribal villages are in remote locality where there is lack of basic infrastructural facilities like drinking water, housing, schools, road and transportation, communication, primary health centres, electricity, etc. Many developmental programmes/schemes are unable to reach to the community level and continue to leave under the situation of unreached. These need to be addressed through suitable developmental initiatives with socio-political willpower to reach the unreached. The data on area under SC indicates there is declaimed in trend of current SC area and increased area under abandoned SC area. This is attributed to many reasons and including developmental initiatives.

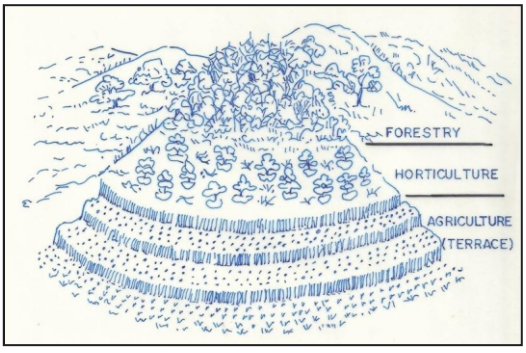
13.4 Ecosystem restoration and fallow management: Overall ecosystem restoration can be achieved through increasing the permanent vegetation cover which intern improves the surface and ground water resources, conserves soils, provides fuel wood and small timber and improves overall microclimate of the region apart from biodiversity conservation (Photo 8). Complete protection of the SC affected land from the biotic pressure along with the adoption of site specific soil and water conservation measures enhances the natural regeneration and recovery from degradation. Soil and water conservation measures greatly help in restoration of soil fertility status. For fast recovery of lands, massive afforestation programme consisting of native tree species should be encouraged with the people participation (Joint forest management). Village committees shall be formed and encouraged for the protection and development of the SC affected lands with appropriate mechanisms. Necessary policy interventions are to be addressed through national forest policies.

Vegetation recovery at different shifting cultivated abandoned periods

13.5 Low external inputs with best management practices: Low external input based farming practices may be encouraged. Conservation-cum-production practices such as land development, development of irrigation, rising of orchards and horticulture plantations, rising of plantation crops, forest plantation, pasture development, animal husbandry, and development of Pisiculture and soil conservation measures should be encouraged. Settled agriculture with scientific practice will improve the food production, provides employment opportunity and improves the nutritional condition of the people. In general, education, employment and settled agriculture will reduce the area under shifting cultivation. Replacing traditional crops and crop varieties is a debatable issue. Improved and high yielding crops varieties need high external inputs and increases cost of cultivation which is not desirable practice particularly for the tribal community. Slowly disappearing of these traditional crops varieties is the major concern both from the point view of biodiversity and productivity. Crop varieties developed through selection breeding process from the traditional crops types appears to be rational from the point view of tribal community.

13.6 Soil conservation measures: Soil erosion is the most critical and severe particularly current SC due to exposed soil without any vegetation cover. On-site retaining the soil through soil and water conservation measures improvises soil fertility and this helps to increase productivity of soil. Due to land legal rights an issue, either individual or any programme/schemes unable to take-up suitable conservation measures but it's a must to get both onsite and offsite benefits. The programme of soil conservation was introduced in the State in 1953. The key features of the programme are; Provision of land to the people who are willing to give up cultivation in the steep slopes; plantation of economic species useful to the tribal communities on steep slopes; introduction of conservation farming to obtain higher production on crop lands and utilisation of steep slopes, unfit for crop production or fruit farming for timber production. Land development measures including plantation crops like cashew, coffee, etc., were taken up and land development and terracing were done. But due to lack of follow-up mechanism outcome result is not satisfactory.

Terracing of mild sloppy Jhum sites



Stratified hill model for different alternative land-use to shifting cultivation.

13.7 Integrated and co-ordination approach for implementation : A number of Departments such as agriculture, horticulture, forest, rural engineering organisation, health, education and industries are responsible for implementing different programmes connected with the control and rationalisation of shifting cultivation. In the newly created administrative set up the ITDA authorities are responsible with the task of integrating the activities of different departments. However, the ITDP confronts various difficulties in bringing about co-ordination in implementing the programmes. The greatest limitation of this new set up is the lack of regional framework with an adequate administration framework for implementing the programmes. The creation of an autonomous body containing in it the personnel drawn from different development departments can serve as a better alternative to the existing pattern (Mohapatro,P.C, workshop feedback).

14.0 Recommendations and Action Points

14.1 The discussion during the one day workshop-cum-brainstorming session culminated into the following recommendations

- Data base on shifting cultivation with dependant population needs to be updated periodically.
- Soil erosion rate on different slopes with varied fallow cycle to be assessed along with impact of soil and water conservation measures.
- Detailed studies on soil carbon dynamics, GWP, carbon sequestration rate/potentials and soil recovery rate of shifting cultivated sites are needed.
- Soil erosion rates are too high to be addressed through appropriate land use with soil and water conservation measures are highly essential.
- Biodiversity aspects of shifting cultivation need adequate attention.
- Ongoing developmental/livelihood security programmes are to be evaluated for their impacts and to upscale the successful models or programmes.
- Market linkage is a vital factor for successful of any rural enterprises like agriculture, forest, small scale cottage industries, etc.
- Reached to the unreached through improving infrastructural facilities *viz*. roads, health, education, and communication.

14.2 Action points and implementation

Based on the workshop-cum-brainstorming discussions, module for implementation of the proposed policy options in the Odisha state is presented below;

(i) Efforts of the government are to enhance the living standard of tribal community through various developmental schemes and programmes. These programmes should reach to the remote localities to benefiting to the community (Action: State govt. and developmental departments).

(ii) Data base on shifting cultivated area, socio-economic status, soil carbon dynamics, bi0diversity, soil/vegetation recovery rate etc are to be assessed and studied (Action: Research organizations).

(iii) A strategic afforestation programme for restoration of abandoned/fallow shifting cultivated sites may enhance ecological values. (Action: Forest Department, OFDC etc.).

(iv) Diversified land based and income generating activities with strong technical and marketing linkages to increase employment opportunity. (Action: State governments with developmental department like ITDC).

(v) Skill developmental programme of state and central government based on community needs and potentials. (State Government, Line Departments, NGOs etc.).

(vi) Strengthening communication and infrastructural facilities particularly remote areas, community capacity building and awareness generation.(Action: State Government, Line Departments).

(vii) Enforcement of Forest Right Act and resolving land ownership rights (Action: State Government, Forest and Revenue Department).

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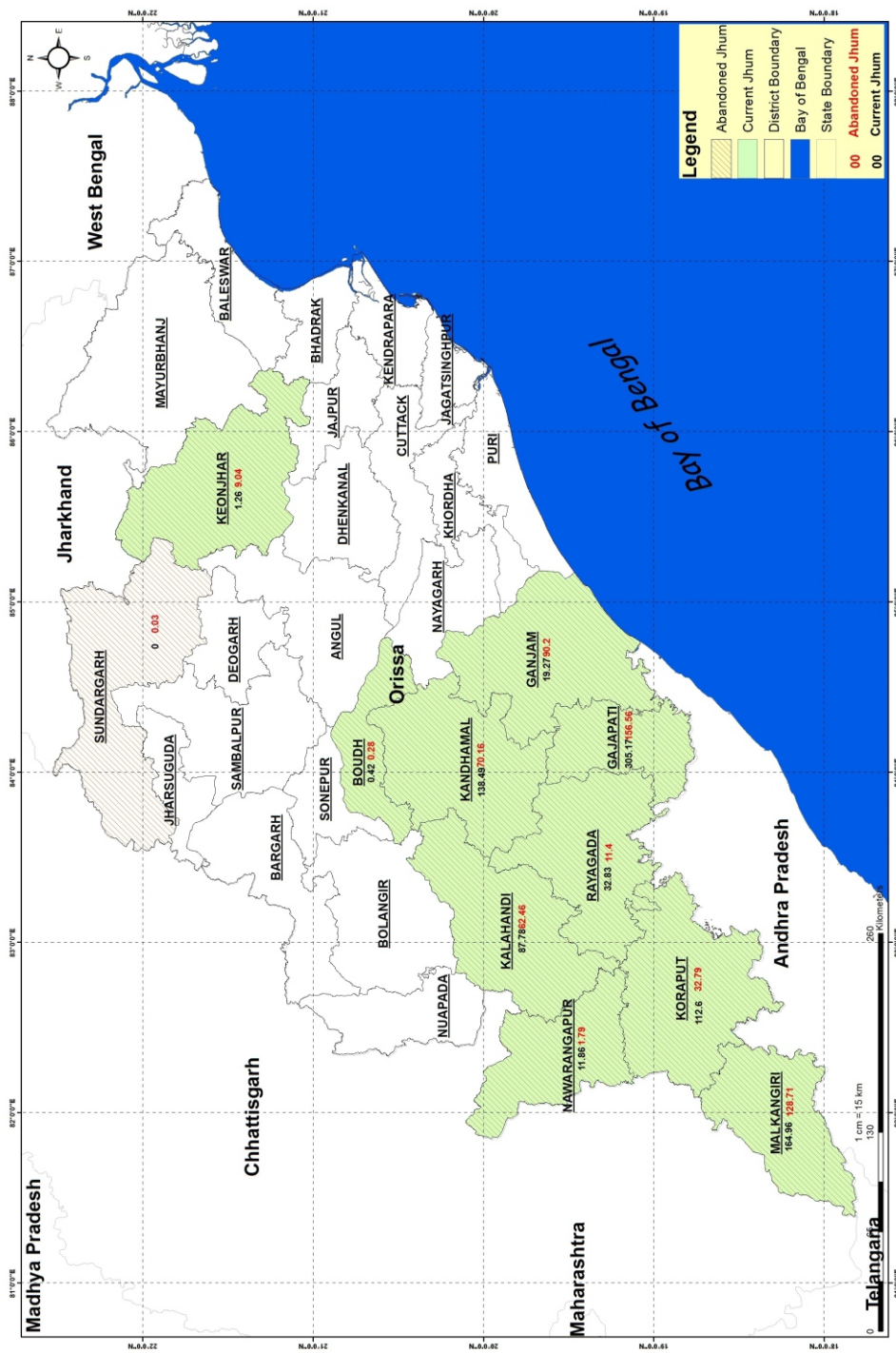
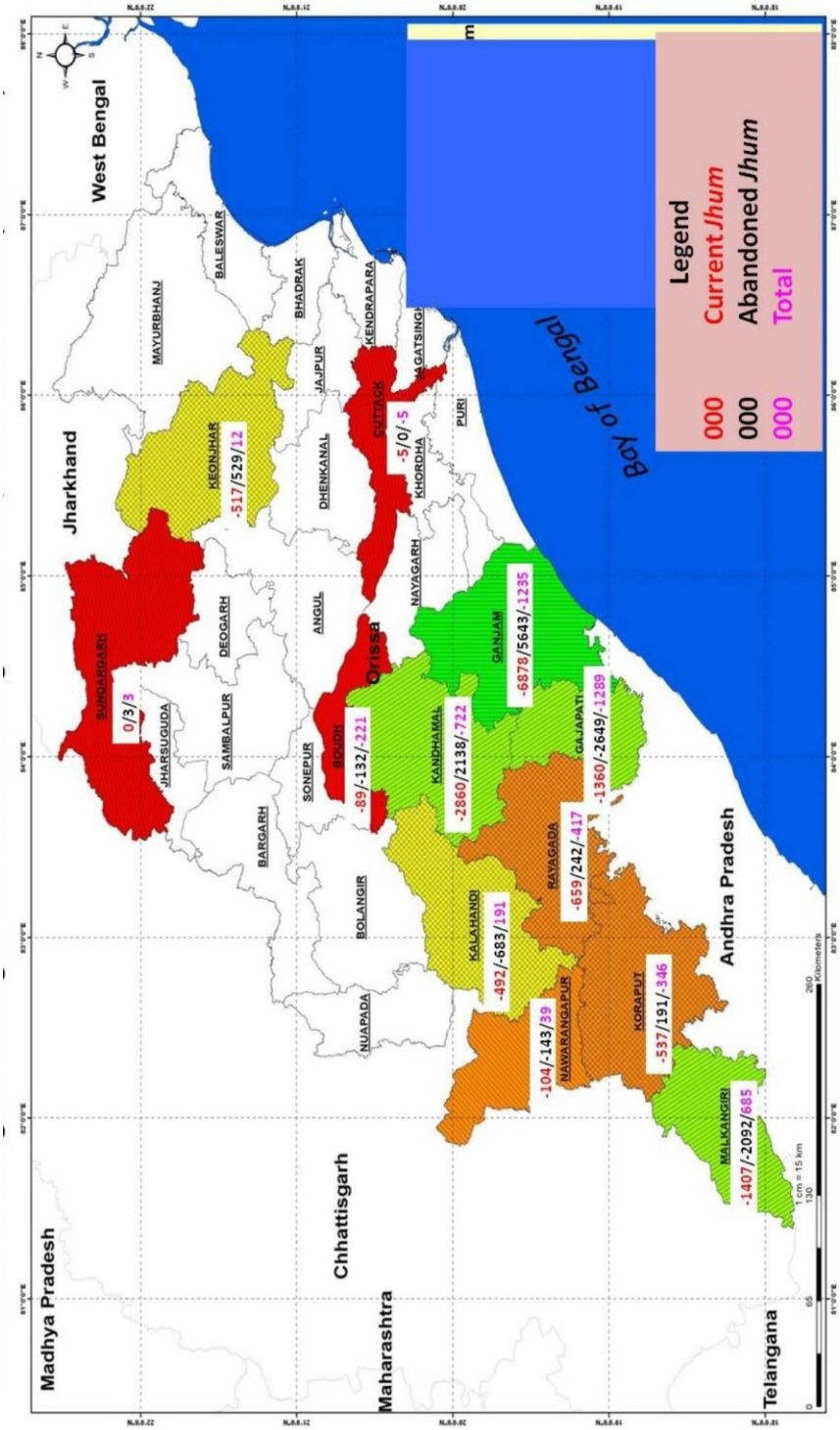


Map 1: Shifting cultivated area during 2009 in districts of Odisha state (Area in ha)



Map 2: Change in shifting cultivated area between 2006 and 2009 in districts of Odisha state (Area in ha)

Annexure 1: Common, English and Scientific name of crops grown in shifting cultivated sites

S No	Common/Local Name in Odiya	English Name	Scientific Name
1	*Dhano*	Paddy/ Rice	*Oryza sativa*
2	*Mandia*	Ragi	*Eleusine coracana*
3	*Kangu*	Fox tail millet	*Setaria italica*
4	*Moka*	Maize	*Zea mays*
5	*Khedjana*	Sorghum	*Sorghum vulgare*
6	*Ganthia*	Pearl millet	*Pennisetum glaucum*
7	*Jhudongo/ Bodoi*	Cow Pea	*Vigna sinensis*
8	*Kolotho*	Horse gram	*Dolichos biflora*
9	*Mugo*	Green Gram	*Vigna radiata*
10	*Kandul*	Red Gram	*Cajanus cajan*
11	*Biri*	Black gram	*Phaseolus mungo*
12	*Suan*	Little millet	*Panicum miliaceum*
13	*Alsi*	Niger	*Guizotia abyssinica*
14	*Donger rani*	Rice Bean	*Vigna umbellata*
15	*Kumbda*	Pumpkin /Winter Squah	*Cucurbita pepo*
16	*Kodli*	Banana	*Musa paradisiaca*
17	*Haldi*	Turmeric	*Curcuma longa*
18	*Til*	Sesamum	*Sesamum indicum*
19	*Bajra*	Bajra	*Pennisetum glaucum*

Annexure 2: List of participates in workshop on status of shifting cultivation in Odisha

1. Dr Malaya Kumar Misra, Prof. Department of Botany, Berhampur University.
2. Dr P. C. Mahapatro,Director, COATS, Koraput.
3. Dr Narendra Kumar Rath,NGO Consultant, Sunupur.
4. Dr Sahant Kumar Palita,Dean, School of Biodiversity and Conservation of Natural Resources, Central University, Koraput.
5. Dr S. K. Palita, HOD, Biodiversity Division, Central University of Odisha.
6. Dr M.Madhu,Head, ICAR- IISWC, RC- Koraput, Odisha.
7. Dr Debarata Panda,Asst. Professor, Central University of Orissa, Koraput.
8. Dr Kartik Charan Lenka,Scientist, M .S. Swaminathan Research Foundation, Jeypore, Koraput.
9. Shri Satyaranjan Mohanty,Project Manager, I.T.D.A, Koraput.
10. Shri Prabhakar adhikari,Secretary, PRAGATI NGO, Koraput.
11. Shri Rajesh Kumar Sahoo,Dy. Manager, Avatha Agritech. Ltd.
12. Shri Mantureej Sahoo,Extension Officer, Avatha Agritech. Ltd.
13. Shri Savihani Chity,PRADHAN, Semiliguda, Koraput, Odisha.
14. Shri Samir Kumar Jena,Forester, Malkangiri Forest Division, Odisha.
15. Dr Basudev Sahoo,Lecturer, Sunabeda Womens College, Koraput, Odisha.
16. Shri Manoj Kumar Meena,Niger Breeder, AICRP on Niger, Semiliguda, Odisha
17. Shri Laletedu Nayak,Jr. Scientist (Agronomy),RRTTS, Semiliguda, Odisha.
18. Shri G. Venkata Reddy,Soil Chemist, Semiliguda, Koraput, Odisha.
19. Shri Semenchal Mishra,Forester, Semiliguda, Koraput, Odisha.
20. Shri Ananda Kirsani,Forester, Mathili, Malkangiri, Odisha.
21. Dr HombeGowda,Scientist, ICAR-IISWC,RC, Sunabeda, Koraput, Odisha.
22. Dr P.P. Adhikary, Scientist, ICAR-IISWC,RC, Sunabeda, Koraput, Odisha.
23. Dr Praveen Jakhar, Scientist, ICAR-IISWC,RC, Sunabeda, Koraput, Odisha.
24. Dr Karma Beer, Scientist, ICAR-IISWC,RC, Sunabeda, Koraput, Odisha.
25. Shri Mukesh Ku Meena, Scientist, ICAR-IISWC,RC, Sunabeda, Koraput, Odisha.
26. Shri G.W. Barla, Technical Officer, ICAR-IISWC,RC, Sunabeda, Koraput, Odisha.
27. Shri G.B.Naik,Technical Officer, ICAR-IISWC,RC, Sunabeda, Koraput, Odisha.
28. Mr. Lingraj, Scientist, Plant Science.
29. Mr. Govind Bal, Ph.D. Scholar, Dept. of Biodiversity Central University, Koraput, Odisha.
30. Miss. Bandana Pradhan, Ph.D. Scholar, Dept. of Biodiversity, Central University, Koraput.
31. Miss. Swetashree Purohit, Ph.D. Scholar, Dept. of Biodiversity, Central University, Koraput, Odisha.

32. Miss. Jijnasa barik,Research scholar DBCNR,CUO, Koraput, Odisha.
33. Mr. Sidharth Sekhar Bisoi,Research Scholar, Regional Institute Of Education(NCERT), Bhubneshwar.
34. Miss. Supriya surachita,M.Phil,Research Scholar, DBCNR, CUO, Odisha.
35. Shri Surendra Nath Rath,Semiliguda, Koraput, Odisha.
36. Mr. Anil Latif,M.Phil Research Scholar, CUO, Koraput, Odisha.
37. Miss. Poly Tikadar,Research Scholar,CUO, Koraput, Odisha.
38. Shri Joyti Prakash Rath, DHAN, NGO, Koraput, Odisha.
39. Shri Danu Muduli,Farmer, Village Patraput, Koraput, Odisha.
40. Shri Kusa Jaypuriya, Farmers, Village –Kuturput, Koraput, Odisha.
41. Shri Santosh Krisani,Farmer, Village Chalanput, Koraput, Odisha.
42. Shri Dambru Guntha,Farmer Patraput, Koraput, Odisha.
43. Shri Karna Nayak,Farmer, Village –Kuturput, Koraput, Odisha.
44. Shri Kamlu Guntha,Farmer, Village Patraput, Koraput, Odisha.
45. Shri Udhava Nayak,Farmer, Village –Kuturput, Koraput, Odisha.
46. Shri Dhanapati Supia,Challanput, Koraput, Odisha.
47. Shri Gopi Jaypuriya, Farmer, Village –Kuturput, Koraput, Odisha.
48. Shri Bhagaban Khora,V.D, Koraput, Odisha.
49. Shri Dhana Guntha,Farmer, Village Chalanput, Koraput, Odisha.
50. Shri Dhana Murja,Farmer, Village Chalanput, Koraput, Odisha.
51. Shri Mukunda Supia,Farmer, Village Challanput, Koraput, Odisha.
52. Shri Suku Guntha,Farmer, Village –Kuturput, Koraput, Odisha.
53. Shri Arjun Gamanga,Farmer, Village –Kuturput, Koraput, Odisha.
54. Shri Ghenu Gamanga,Farmer, Village –Kuturput, Koraput, Odisha.
55. Shri Rabi Samanga,Farmer, Village –Kuturput, Koraput, Odisha.
56. Shri Adu Gamanga,Farmer, Village –Kuturput, Koraput, Odisha.
57. Shri Jaganath Gamanga,Farmer, Village –Kuturput, Koraput, Odisha.
58. Shri Samara Murja,Farmer, Challanput, Koraput, Odisha.

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