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**ORIGINAL ARTICLE**

**Contribution of Non-Timber Forest Products to livelihood economy and impact of Climate variability:- A Case Study from the Palamau Tiger Reserve, areas Jharkhand, India**

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**ABSTRACT**

*The forests of Palamau Tiger Reserve (PTR) areas support rich diversity of timber as well as non-timber yielding species. The non-timber forest products (NTFPs) possess imperative part of the traditional life style in Jharkhand and utilization of these products has been contributing much to the local livelihood. The present study reflects the contribution of NTFPs to livelihood economy of the people living in PTR and Betla National Park (BNP) areas in Jharkhand, India. In this area 97 species of trees, 46 herbs and shrubs, 21 climbers and 17 species of grasses are present. The economically important NTFP belonging to 32 families have recorded which were variable in number and composition in the plant community with the alternation of seasons. The most dominant plant species has been found dry deciduous sal (*Shorea robusta*), which was almost used as varied species due to versatile importance. Tribal peoples living inside the PTR has mainly incomes from Mahua flower, Lac, Tendu leaves, Gam etc. NTFPs such as fuel wood, house building materials, wild edible vegetables and medicinal plants are mostly collected from natural habit. The total contribution of NTFPs to annual household income was maximum (23% of the total income) in the villages of Barwadih circle, in Garu circle (21% of the total income), Mahuadnar circle and Manika circle (19% and 18% of the total income respectively). Addition to it we have also studied the climate change and its impact on agriculture, availability, quality and quantity of forest product.*

**Keywords:** NTFPs, livelihood, economy, impact, climatic change.

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**INTRODUCTION**

The state of Jharkhand lies in the eastern part of India spreading over an area of 7.97 million hectares, with a population of over 2, 69, 09, 428. Out of this total population, 28% belong to the scheduled tribes (around 31 different tribes) and 12% are from scheduled caste communities. A vast majority of these people live in or near forests, eking out a living based on NTFP s and subsistence agriculture. Forests provide significant social and economic benefits at all levels, especially in developing countries. Economics of people living in forest finger have traditionally been dominated by subsistence agriculture. Jharkhand literally means 'forest region' where forests play a central role in the economic, cultural and socio-political systems and the entire lives and livelihoods of a majority of the people revolve around forests and forestry. Non-timber forest products (NTFPs) play an important role in supporting rural livelihoods and food security in Jharkhand. The NTFPs have variable abundance according to season and the collection of these NTFPs record variations with the seasonal occupation of the local people. However, non-timber forest products (NTFPs) play vital role among the tribal people and provide a source of income and subsistence living [1-2]. NTFPs like fuel-wood, medicinal plants, wild edible vegetables, house building materials etc. are integral part of day-to-day livelihood activities especially for tribal people [3]. Since the early 1990s the role of NTFPs for sustainable forest use and poverty alleviation has received increased attention [1]. The socio-economic importance and the value of NTFPs in the economics of

tropical countries are now well recognized [4-5]. In almost all tropical countries, the collection of NTFPs is a major economic activity [6-9] and about 500 million people living in or near forests being depended upon them for meeting their livelihood needs [10]. The Scheduled tribe communities in India constitute 8.6% of the country's total population (Census of India, 2011), and widely distributed in Central and North East Region of India. In Central India where Panchayat Extension to Scheduled Areas Act (PESA), 1996, implies, have majority of ST population resides and predominantly distributed in the hilly and forest region. Their close association with nature especially forest for their livelihood, traditional agricultural practices, their socio-cultural systems, norms and institutions are well known. The groups own marginal lands where they practice agriculture during monsoon period already facing challenges due to climate variability. These communities are largely dependent on Minor Forest Products (MFPs) for subsistence and cash income. These items include food items (nuts, wild fruits, honey etc.), medicinal plants, building material (bamboo, canes), fuel, fodder and other consumption items. Besides, some produce like tendu leaf, bamboo, Mahua, tamarind, chironji etc. are important commercial items. The term Non-Timber Forest Produce (NTFPs) are also known as Minor Forest Products (MFPs) or Non-Wood Forest Products (NWFP) and has been defined differently. The definition and classification of MFPs has great significance. The present investigation are emphasizing the study tries to explore the livelihood contribution of Non-Timber Forest Products (NTFPs) to the tribal's. The specific of this work to understand the socio-economic conditions of rural households, estimate the contribution of NTFPs to rural household income & employment and also to study the economics of NTFPs collection. The main objective of this research paper is to report and identified the Non-Timber Forest Products and rural livelihood contributions of NTFPs to the income of tribal peoples leaving inside the PTR in Latehar district of Jharkhand state. We have also reported seasonality of collection of important NTFPs, climate change and its impact on agriculture, availability, quality and quantity of forest product.

## MATERIAL AND METHODS

**Study Area:** PTR and BNP situated between latitude 23°25' N to 23°55' N and longitude 83°50' to 84°36' E, was notified in 1973 as one of India's first nine tiger reserves established under Project Tiger. It is located in the western part of the Chhotanagpur Plateau and spans an area of 1129.93 square km comprising the Palamau Wildlife Sanctuary and Betla National Park is spread over Latehar, Palamau and Garhwa District in Jharkhand. It is also part of the Central India Landscape and extends into the Sanjay-Dubri Tiger reserve and Achanakmar-Kanha tiger landscape through the Jashpur and Mahan forest of Chhattisgarh. The vegetation types mainly categorized as dry moist forest, dry Sal forest, moist Sal forest, high level plateau Sal forest bamboo and moist forest. BNP is also becoming home to many unwanted non native plants. The area experiences both tropical and sub-tropical conditions and is well known for excessive rainfall (250-400 cm per annum) and varying temperature ranging with relation to changing altitude, i.e. from 4°C to 45°C. The temperature usually falls below freezing point during winter; the relative humidity remains high and varies from 47% to 93%.

**Methods of the Study:** For the present study four blocks namely Barwadih, Garu, Mahuadanr and Manika of Latehar district were selected based on their proximity gradient from the forest. A sample of 50 respondents was randomly selected from site. A structured interview schedule has administered on the respondents. The study is based on empirical field work using both quantitative and qualitative data, both from primary and secondary sources. Fuel wood consumption has been estimated separately in two different season's viz. winter (October to March) and summer (April to September). The analysis of the study has carried out of livelihood substance of tribal communities and livelihood in participation of NTFPs in economic activities. The study is based on personal interviews of the selected respondents through interview schedule, personal observations and participatory rural appraisal tools i.e. semi-structure interview and focus group discussion carried out in the sample villages using multi-stage random sampling technique

### **Data collection:**

Primary and secondary data has been collected for the study. Primary data has mainly collected through interviews and Focus Group Discussion (FDG), with the households dependent on forest produce and grass root level NGOs working on tribal issue. Information on livelihood practices, agriculture, NTFP availability, distribution, seasonal patterns, contribution of Minor Forest Products (MFPs) in household income, marketing mechanism, challenges in NTFP collection and marketing etc. were collected using standardized questionnaires. Concentrated efforts were made during FGD to record perceptions of tribal's on climate change and its impact on agriculture, availability, quality and quantity of forest produce. The term climate change was broken into rain, temperature, extreme events, intense storms and related events like frequency of drought, floods and landslides etc. The participants were asked to recall

memories of past 10-15 years to describe these events and felt impact on natural and human resources. Secondary data has been collected from relevant sources such as research papers, books, journal, libraries, Annual reports at the district, online documents, Published work, Government sources like the Ministry of Forest and Environment. Information on marketing mechanism of NTFPs policies, available evidence on impact of climate change, rules and regulations and policy framework relevant to NTFPs collected and subsequently linked with the finding of primary data.

## RESULT AND DISCUSSIONS

### Household and Market Survey

For this study extensive field surveys were made during the year *i.e.* from December 2015- January 2016. In PTR region all four blocks of the Latehar district and six villages from each circle were selected for the study. Detailed household surveys using a semi-structured questionnaire emphasizing on the used pattern of NTFPs were done. Ten percent households in each selected villages were sampled randomly. Information on NTFPs plant species and their utilization pattern were collected through personal interview with the village headman and other villagers of different age group and sex. The information gathered has again cross-checked with the other villagers of same tribal. Official information has collected from the forest department head quarter Medininagar. It is observed that maximum population leaving in Barwadiah and minimum in Garu and maximum literacy in Mahuadanr and minimum in Manika block (Shown in table 1). The population is dominated by scheduled tribal's of Oraon, Cheros, Munda, Birjia, Korwa, Kherwar, Asur, Birhor etc. The monetary value has calculated by multiplying the quantity consumed with the average market price of that particular product prevailing at nearest local market. Market surveys were conducted by periodic visit to the local markets in all selected sites and found that in each block head quarter weekly market is conducted for examples in Barwadiah at Sunday, in Garu Friday, in Mahuadanr two days in week on Monday and Thursday and in Manika on Saturday.

**Table 1:-** Total Numbers of persons in that household in Palamu Tiger Reserve areas of Latehar District in Jharkhand.

Particulars	Blocks			
	Barwadiah	Garu	Mahuadanr	Manika
<b>Total Population</b>	78,037	35,447	66,159	64,633
<b>Male</b>	40,398	13,012	33,695	32,806
<b>Female</b>	37,639	12,495	32,464	31,827
<b>Literacy</b>	40.93 %	36.52%	57.30%	33.45%
<b>SC</b>	19,892	1,475	2,394	20,199
<b>ST</b>	50,832	24,199	29,198	43,534
<b>Others</b>	7,313	9,773	34,567	900
<b>Literate(15-35 Year)</b>	13,871	5,335	7,922	15,698
<b>Livestock</b>	43,489	3,559	18,654	34,976
<b>Non Workers</b>	61,459	16,565	36,610	51,126

### Dependency of Livelihood on NTFPs

The minor forest produce provides employment to the families round the year. Currently, uncertainly in weather parameters resulting into loss of agricultural productivity (shown in table 4) hence to compensate the loss rate of livelihood from crop production, extraction of NTFPs increases by the families. NTFPs have been considered as Common Property Resources (CPR) and available in forest areas. The commonly found NTFPs in the study area are - tendu leaves, sal seeds, sal leaves, mahua flower and seeds, amla, harra, gum, lac, tamarind, mahulam leaves, etc. Besides these, several important medicinal plants are also found in the forests. A few such products such as mahua, tamarind and kusum tree are also found in the individual land which is harvested by the family owning the land. During the season of collection, the tribal's including male, female and children collect the produce from the forest. The collection and quantity depend on the availability of NTFPs. A majority of species is available during the month of April to July. For collection of NTFPs, villagers including tribal women and children go deep inside the forests and cover long distances ranging from 3-10 km inside the PTR. The tribal women give more time for collection and processing of produce (drying and storage of tendu, Siali, Sal leaves and seeds). The commodities are used for self-consumption and sale depends on quantity. The average income and unpaid employment generated through NTFPs based self-employment for the surveyed population in the area varies from Rs. 2812-6600 household/ annum, this play an important role in the livelihood support. This contributes 35% in Barwadiah, 30-35 % in Garu, 40% in Mahuadanr and 40-50%

in Manika block of annual income of surveyed families. A few insights on major NTFPs collected from the study villages are :

- Mahua—the tree grows in forest and agricultural field area. Per family have average two to three trees. One tree yields about 5 kg of dry flowers per day in session which is sold @ 32Rs/ kg. Oil is extracted from Mahua fruit (local name doori) used for self-consumption and for selling as well as edible.
- Tendu leaves are collected by most families; each family collects average 200 bundles in a season. One bundle comprises 100 leaves sell @ Rs. 80/- to 100/- for 100 bundles.
- Tendu fruit is collected and sold. Each family collect average 03 basket (dalia) and one dalia contains 20-30 kg/- Rs.22/-kg .
- Sal fruit-families collect average 4-6 dalia and sale @ Rs 25/Kg . The oil extracted from sal seed is utilized for cooking, lighting and massage purposes and the residue oilseed cake is utilized as cattle feed.
- Amla- 25 to 30 kg average per family collection and sale @ Rs.30-40/kg. Also used for self consumption– make pickle, use on hair.
- Kachnar and chirul flower, bhelwa fruit and genthi are important vegetables for the local population for self-consumption and also sold by quantifying them in handful (Kheja) basis in local haats.
- Kusum and karanja seed is collected for self-consumption for extracting oil consumed in cooking, lighting or lubrication and the residue oilseed cake is vended as cattle feed. The oil has medicinal /therapeutic use and sale in market for Rs. 40/-kg.
- Bel, Ber, Jungli aam (wild mango), Jamun fruits and Mushroom (phutko) are eaten for supplementing nutrition and health. These fruits are also sale in local market (Jamun - sale in dona – leaf cups- /Rs. 10, Jungliaam (wild mango) –Rs.6/ Kg, Ber - Rs. 40/kg, Mushroom (phutko)-Rs. 80-100/ kg)
- Bamboo shoots (dry@Rs 80-100/-kg and raw (karil) @Rs. 150-/kg sale in the local market. On an average one family sale average 20 kg/- of bamboo shoots. The bamboos are priced for its multifarious uses like, young culms (Karla) for pickle, culms for brooms, baskets, fans, sieves, fish trap, plates and other handicrafts making, sticks, huts, tool handles, fishing rods, hunting materials making etc. in the area.
- The harra and bahera fruits are important constituents of well known medicinal composition.
- Trifala' and as such the fruits are being collected and sold by the primitive societies traditionally in the area.
- Tribal mostly collect, wild mango tubers, siali leaves and broom grass from the forest for self-consumption and selling in local market.

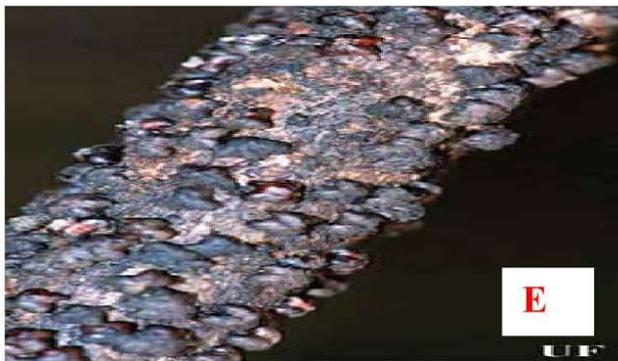
**Table 2:-** List of common NTFPs recorded from the Palamu Tiger Reserve (Betla National Park) areas In Jharkhand.

S.N.	Common Name	Botanical Name	Part Used	Own consumption/ Sale	Month in which harvested/ collected	Observation (with respect to climate change)
1	Mahuwa	<i>Madhuca longifolia</i>	Flower	Both	Mar-April	The flower get destroyed due to untimely rains/hail storms at the time of harvesting
2	Bel	<i>Aegle marmelos</i>	Fruit	Sale	Feb-March	Yield reduced
3	Amla	<i>Emblica officinalis</i>	Fruit pulp	Sale	Dec-Jan	Yield reduced due to fewer trees, past over-logging
4	Khajoor patta	<i>Phoenix sylvestre</i>	Leaf	Both	Nov.-Feb.	Reduced
5	Aam	<i>Mangifera indica</i>	Fruit	Both	May	Reduced
6	Imli	<i>Tamarindus indica</i>	Fruit	Both	May	Reduced
7	Dhawai fool	<i>Woodfordia fruticosa</i>	Flower	Sale	Feb.	More harvested today due to new demand
8	Mahua seed	<i>Madhuca indica</i>	Seed	Both	June	Less available due to less flowering & less eaten/ sold today due to no market, other oils promoted
9	Patal plate	<i>Bauhinia vahlii</i>	Leaf	Sale	Oct.-Mar.	Less collection today due to less profit, past over-

						harvest
10	Chireta/ Kalmegh	<i>Andrographis paniculata</i>	Stem	Sale	Nov.-Dec.	Reduced
11	Baans/Ba mboo	<i>Dendrocalamus strictus</i>	Stem	Both	Mar.-June	Yield reduced due to deforestation
12	Palash	<i>Butea monosperma</i>	Flower	Sale	Feb.	Reduced
13	Khair	<i>Acacia catechue</i>	Bark	Sale	Dec.-Feb.	Increased
14	Sal seed	<i>Shorea robusta</i>	Seed	Sale	May	Less collection today due to low market demand
15	Madhu	Honey	Liquid	Both	April, May October	Reduced now
16	Kendwa fal		Fruit	Consumption	May	Yield reduced due to fewer trees, past over- lapping
17	Bedipatta	<i>Diospyros melanoxyton</i>	Leaf	Sale	May	Yield increased
18	Pyarbeej/ chironji	<i>Buchanania lanzan</i>	Seed	Sale	April-May	Early harvesting, Lopping
19	Karanj Seed	<i>Pongamia pinnata</i>	Seed	Sale	February	More harvested today due to Demand
20	Neem seed	<i>Azadirachta indica</i>	Seed	Sale	May	Reduced
21	Seetafal	Custrd apple <i>Annona squamosa</i>	Fruit	Both	Sept.-Oct.	Reduced
22	Bahera	<i>Terminalia bellerica</i>	Fruit rind	Sale	Jan	Reduced
23	Bhelwa	<i>Semecarpus anacardium</i>	Fruit	Sale	Dec.-Feb.	Reduced collection due to less market demand
24	Ber	<i>Zizyphus mauritianna</i>	Fruit	Both	May	Due to deforestation reduced
25	Jamun	Guava plum <i>Syzygium cumini</i>	Fruit	Both	May-June	Reduced
26	Jalebi fal	Sweet Tamarind-	Fruit	Both		At present reduced
27	Madhu	Honey	Liquid	Both	April, May October	Reduced now.
28	Satavar	<i>Asparagus racemosus</i>	Root	Sale	Dec.-Mar.	Reduced now.
29	Harar	<i>Terminalia chebula</i>	Fruit	Sale	Dec.-Jan, Feb	Reduced now.
30	Ool	<i>Amorphophallus sylvatica</i>	Root	both	Oct-Dec	Reduced now
31	Koinar	<i>Bauhinia purpuria</i>	leaf	both	July-Dec.	Reduced
32	Kusum	<i>Schleichera oleosa</i>	seed	Both	July-Aug	Reduced
33	Khukhri	<i>Agaricus compestris</i>	whole	Both	Aug-Oct	Increased
34	Jirhul	<i>Indigofera arborea</i>	flower	Both	Oct-Nov	Reduced

### Study some important NTFPs found in PTR

The poor household pursued diverse sources of livelihood NTFPs collection being the lifeline of the study village with separate domain of livelihood related activities for women and men. Those puffed done by women included making of *sal* leaf plates, growing homestead vegetables, making rice, backyard poultry, selling eggs, bamboo crafts, weaving mats etc. Traditionally forests used to be a major source of livelihood but it is no longer so. In this category the most common livelihood are trading in timber, which is no more possible, at least legally. Now, the most common activity is collection and sale of non-timber forest products such as collection of fuel wood, honey, mahwa, amla, satawar root, doori, masroom, kusum, *sal* leaves, leafy vegetable and bamboo. In the study villages they collected dead leaves to make mats, which they sold in the market. The poor households earned by selling honey, mahwa, fuel wood, *sal* leaves, bamboo etc. in addition, roots and edible leaves were collected from the forest, which were sold and consumed by the poor households. Many village participants felt that there was need of training to process and items from forest product, such as bamboo and dead leaves. Since the forest area was being depleting and reducing in size, they suggested planting of more trees in the forest. Some important NTFPs found in PTR region shown in table 2 and Figure1.





**Figure 1:-** Most commonly NTFPs found in PTR and Betla National Park, Jharkhand: **A-B**, *Tendu leaves*.; **C-D**, *Mahua flower*. **E-F**; *Lac*, **G-H**; *Saal leaf plate*, **I**; *Mahua Seed (Doori)*, **J**; *Aam chuur (Khatti)*, **K-L**; *Khajoor leaves and Mat*, **M**; *Seetafal*, **N**; *Muhlaam leaves*.

### **Economic Values of NTFPs for Source of income of Livelihoods**

Economics of NTFPs include costs and returns involved in NTFPs collection and marketing. The opportunity cost of labor is estimated considering average labor man days involved in NTFPs collection. Opportunity cost is an important economic concept that measures the economic cost of an action or decision in terms of what is given up to carry out that action. For example, the opportunity cost of labour for the tribal is often measured using wage rate in off season (INR.140/day). The cost of time spent for NTFPs collection is imputed from the opportunity wage rate prevailing in the study area. The gross income per household derived from the sale of products, was calculated by considering difference between total quantity collected and sold. Net returns from NTFPs are calculated using a simple concept as the difference between gross returns and costs excluding the opportunity costs of labour and transportation costs. Quantities of the supplied NTFPs with their local market values were recorded separately. Quantification of the extracted forest products was done by weighing the head load and per capita per day consumption was calculated by the following formula [11]. Table 3 shows the market price

of different NTFPs and gross income and Net income of peoples from different NTFPs and it is found that maximum income of peoples from Katha, lac, tendu leaf and mahua flowers.

**Table 3:-** Market sale price (MSP) and Income of local peoples from most NTFPs collected from Palamu Tiger Reserve (Betla national Park) areas in Jharkhand.

NTFPs	Quantity sold (Kg)	MSP declared by the Government (Rs/Kg)	Gross returns (INR)	Transportation cost (INR) and others	Net Returns (INR)	Uses/Remarks
Mahuwa flower	100Kg (after drying)	30/Kg	3000	30.00	2970	Used for making wine.
Lac of plash plant	100 kg	70/kg	7000	100.00	6900	Used for making bangles and other ornaments.
Lac of Beer plant	100kg	100/kg	10000	100.00	9900	Used for making bangles and other ornaments
Lac of Kushum plant	100kg	230/kg	23000	100.00	22900	Used for making bangles and other ornaments
Kattha	1kg	230/100gm	2300	50.00	2250	Used for paan and medicine.
Tamarind (Imali)	100kg	25/kg	2500	30.00	2470	Making khati
Amla	100kg	40/kg	4000	50.00	3950	make pickle, use on hair
Tendu Patta	1,000 bundle	One bundle comprises 100 leaves cell @ Rs. 80/- to 100	1000	00.00	1000	It is used for making beedi. Government purchase the leaf via tender process
Rugra	100kg	60/kg	6000	100.00	5900	As vegetable.
Satwaar	1kg	100/kg	100	30.00	70	It is used for local medicine
Karenj	100kg	25/kg	2500	100.00	2400	It is used for oil.
Mahua seed (Doori)	100kg	25/kg	2500	100.00	2400	It is used for edible oil and medicine.
Khjoor leaves	10 bundle	75/bundle	750	-	750.00	Peoples used for making the mats and house.
Bamboo (Baans)	1pice	60-70/pice	-	-	65-70	Local peoples used for making house
Gum (Lassa)	100kg	70/kg	70000	100	6900	It comes from different plant such as peaar.
Siali (Mohlaam) leaf	100 kg	30/kg	30000	-	3000	Local peoples used for making umbrella. Government also purchase the leaf via tender process.
Dhaoi fool	100kg	20-25/kg	2500		2500	Used for making colours
Saal fool(sarai)	100kg	15-20/kg	2300	100	2200	Used for making colours
Saal leaf	1000 pice	Rs100/100 leaf	10000		1000	Used for making plates
Hara and Bahera	100kg	40/kg	4000	100	3900	Used as medicine
Karil	100kg	80/kg	8000	200	7800	It is used as vegetable
Jethhi kand	100kg	20-25/kg	2200	-	2200	mainly korwa Tribal used as a food
Honey	10 kg	155/kg	1550/-	-	1550.00	Used for medicine
Beer	10kg	35/kg	350	-	350.00	Used as fruit
Sitafal	10 pice	10/pice	100	-	100.00	Used as fruit
Jamun	10kg	80/kg	800	-	800.00	Used as fruit
Phutkal	10kg	40/kg	400	-	400.00	Used as vegetable
Kussum	10kg	32/kg	320	-	320.00	Used as fruit
Mango unripe	10kg	40/kg	400.00	-	400.00	Used for khatti
Chironjee	10kg	100/-kg	1000		1000.00	Used as eating.
Karanj Sed	10kg	21/-	210	-	210.00	Used for oil.

### Some other income generating activities

Landless and poor people and women's of PTR and BNP areas depend largely on natural resources for their lively hood. Table 4 shows household annual income from NTFPs collection and it is found that the average annual income of each family in Barwadih block is 25000, in Mahuddar block is 20000, in Garu block is also 20000 and in Manika block is 30000/- per year. Some important other activity other than NTFPs collection has been recorded in study areas are (a)Animal husbandry:- Piggery, Poultry, Bee keeping, Dairy, Pisciculture etc. (b) Collage Industry:-Tailoring, cycle Rickshaw, Pump and hand pump repairing and maintenance; cycle repairing, Lac and Sericulture, Leaf Plate Marking. (c) Artisans:- Mat weaving, Pottery, Black Smithy, Carpentry, carpet weaving, basket weaving, Rope making, Wooden Toys and crafts Making (d) Land use:- Agriculture, Horticulture, vegetable production, floriculture.

**Table 4:-** Occupation of the Respondents and annual income from different NTFPs covered Under the Study areas

S. No.	Block	Occupation	Main NTFPs	Average annual income(Rs.)
1.	Barwadih	Agriculture, animal husbandry like goat, hen, cow etc. and collection of NTFPs	Tendu leaves, mahua flowers, sal seed, tamarind fruit,lac	25,000/-
2.	Garu	Agriculture, labor work and collection of NTFPs	Mahua flower, Sal seed, Bamboo,lac	20,000/-
3.	Mahuadanr	Agriculture, animal husbandry and collection of NTFPs	Siali , mango, tamarind, kusum fruits, lac	20,000/-
4.	Manika	Agriculture, labor work, animal husbandry and collection of NTFPs	Mahua flower, Sal seed, Tendu leaves, katha, lac	30,000/-

### Seasonality of collection of important NTFPs in the study area

The seasonality collection of NTFPs developed during group discussion presented in Table 5. The matrix reflects that villagers depend on fuel wood and fodder round the year, however, major NTFPs are available for around 3-4 months. Dependency of tribal's on NTFPs in rainy months (July, Aug, Sept and Oct) is least, only a few items (khukhri ,sitafal, chiraita) is collected during this season. This is because of dependency of families in farming activities in monsoon months across the villages. Also, absence of proper storage facilities prohibit villagers to collect the items from the forest. Summer, spring and autumn seasons witness a large quantum of NTFPs influx in the sample villages.

### Effect of Climate Change on NTFPs

The changing climatic patterns in India, such as increased temperatures and changes in rainfall patterns, is predicted to have strong impacts on livelihood and biodiversity in the country. It is widely recognized that climate change has caused substantial impacts on forest ecosystems by causing shifts in vegetation types, phenology and the reproductive biology of various trees, shrubs and herbaceous plant species and altering the frequency intensity, duration, and timing of fire, drought, insect and pathogen outbreaks [12-14]. The study conducted in Palamu Tiger Reserve (Betla national Park) areas in Jharkhand observed a significant change in the phenology of local mahua: a gradual shift in fruiting and flowering period from mid-March to mid-February on phonological changes in mahua [15]. The shift in the flowering season of mahua reflects a discernible change in the local forest ecology. The study argue that during mid-February, the agricultural season is about to end and farmers are preoccupied with harvesting their produce. Mahua is an important commodity in villages of Jharkhand. January-February is important phase of formation of kunchi (early stage of bud) and March and April is important months for the flower collection. The initiation of bud affects due to excess cold in January- February. Rain, thunderstorm and cloudy weather during harvesting time makes the flowers drop prematurely or destroys flowers, and some flowers turn upward and do not even fall. Also, cloudy weather at times poses a great problem with the mahua flower not being dried properly (shown in table 6). It loses its colour and turns black and also prone to insect infestation and fetch low prize in the market. The tribal's in PTR shared their observation of less availability of different local mushrooms and putoo if there are cases of less and scanty rain during monsoon months. The tribal's in study area indicated towards decline of lac and gum due to high days. Various studies also highlight the impact of changing climate on availability of NTFPs in the forest. For instance, climate change reduced the honey collection by up to 90% [16], reduced lac yield by 8% per year from 2007-11 [17], mahua and mango yield is also known to have reduced due to climate change in [18]. In spite of the fact that the declining production of NTFP is a very serious problem for forest

communities, as well as for maintaining biodiversity, the regeneration of NTFP has attracted very little attention. Various forestation programmed in India mainly focus on plantation of timber and gives ambitious task to forest department to increase forest cover of the country.

**Table 5:-**Seasonality of NTFP's collection recorded in the Palamu Tiger Reserve (Betla National Park) areas in Jharkhand.

Non-Timber Forest Products (NTFPs)	Forest	Months											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Mahua ( <i>Madhuca latifolia</i> ) flower				Green	Green	Green							
Mahua ( <i>Madhuca latifolia</i> ) seed						Red	Red	Red					
Lac				Red	Red	Red							
Fuel wood		Green	Green	Green	Green	Green	Green						
Tooth brush Sal ( <i>Shorea robusta</i> ), Karanj ( <i>Pongamia pinnata</i> ), Neem ( <i>Azadirachta indica</i> ), Mahua ( <i>Madhuca latifolia</i> )		Blue	Blue	Blue	Blue	Blue	Blue						
Jirhul ( <i>Indigofera arborea</i> ) flower		Yellow	Yellow	Yellow	Yellow								
Bhelwa ( <i>Semecarpus anacardium</i> )					Green	Green	Green						
Sal ( <i>Shorea robusta</i> ) seed						Yellow	Yellow	Yellow					
Sal ( <i>Shorea robusta</i> ) leaf		Red	Red	Red	Red	Red	Red						
Koinar ( <i>Bauhinia purpuria</i> ) tender leaf					Red	Red	Red						
Kusum ( <i>Schleichera oleosa</i> ) seed								Green	Green	Green			
Jamun ( <i>Syzigium cumini</i> )							Red	Red					
Chironji ( <i>Buchanania lanzan</i> ) seed					Yellow	Yellow							
Kachnar ( <i>Bauhinia variegata</i> ) flower													
Jackfruit ( <i>Artocarpus heterophylus</i> )				Red	Red	Red	Red						
Mango ( <i>Mangifera indica</i> )							Red	Red	Red				
Ber ( <i>Zizyphus mauritiana</i> )		Red	Red										
Karanj ( <i>Pongamia</i> )		Green	Green	Green									
Tendu ( <i>Diospyros melanoxylon</i> ) fruit				Yellow	Yellow	Yellow							
Rugra ( <i>Lycoperdon spp.</i> ) and khukhri ( <i>Agaricus campestris</i> )								Red	Red	Red			
Chiraita ( <i>Swertia angustifolia</i> )			Yellow	Yellow	Yellow								
Harra ( <i>Terminalia chebula</i> )		Red	Red	Red									
Bahera ( <i>Terminalia belerica</i> )		Red	Red	Red									
Bel ( <i>Aegle marmelos</i> )					Red	Red	Red	Red					
Bhelwa ( <i>Semecarpus anacardium</i> )					Yellow	Yellow	Yellow	Yellow					
Toont ( <i>Morus alba</i> )		Yellow	Yellow	Yellow									

**Table 6:-** Climate variability and its effect on NTFPs observed by livelihood communities in Palamau Tiger Reserve and Betla National Park areas Jharkhand.

Indicators of change in climate variables	Changes/deviation observed by the community	Impacts
<b>Winter pattern</b>		
Late arrival of winter	Earlier, winter use to start from September last week but in last few year feeling of winter starts only in October	Affects the production of Rabi crops such as wheat, Gram, peas etc
Very cold	Excessive cold for a few days in December and January. However, day temperature is comparably warm	Affects the production of Potato and growth of lac kits.
Increase foggy days	Increase in foggy days in January	In some years one of the major cash, generating pulses, Arhar is badly affected in flowering time, farmers are not even able to recover seeds.
<b>Summer pattern</b>		
Temperature	Rise in day temperature starts from February first week, extreme hot in April, May and June. Overall increase in day temperature round the year	Drying of surface water bodies and drinking water shortage, affects the growth of tendu leaves.
Pre-monsoon shower	Decreased cases of shower in May and first week of June.	Drying of surface water bodies and drinking water shortage
Unseasonal rains	Unseasonal rains during spring/ summer	Impact on flowers of forest produce like mahua.
<b>Rainfall pattern</b>		
Late arrival of monsoon, uncertain rain-deficit/ excess or scanty rain	Normally monsoon reaches by June last week and continues till October-November. Currently arrival of monsoon rain is uncertain.	Late arrival of monsoon affects land preparation, sowing of paddy and millet is delayed and production decreases. Untimely rain destroy standing crop and harvested produce
	Excess- rain for few days at the time of seed sowing	The seeds sown in barren slope without soil work gets washed away at early stage Gully erosion, land side, ridges of the agri land are washed away
	Previously, July - August months received good amount of rain fall but currently scanty/deficit rains are there	Difficulty in transplantation of paddy. If by mid-August no or scanty rains than farmers leave paddy field fallo
	Untimely rain (for few days) especially at harvesting time (Oct/Nov)	Resulting in crop loss. Use of hybrid seeds is increasing owing to uncertainty in rain - perceived to have better adaptability.

## CONCLUSION

For this study extensive field surveys were made during the year *i.e.* from December 2015- January 2016 for PTR region of all four blocks (Barwadih, Garu, Mahuadanr and Manika block) of the Latehar district and six villages from each circle were selected for the study and conclude that the maximum population leaving in Barwadih and minimum in Garu and maximum literacy in Mahuadanr and minimum in Manika block. The population is dominated by scheduled tribal's of Oraon, Cheros, Munda, Birjia, Korwa, Kherwar, Asur, Birhor etc. The commonly found NTFPs in the study area are - tendu leaves, saal seeds, sal leaves, mahua flower, katha, amla, harra, gum, lac, tamarind, Siali (mohulam) leaves, etc. The most common activity of livelihood is collection and sale of non-timber forest products such as collection of fuel wood, honey, mahwa, amla, satawar root, doori, masroom, kusum, *sal* leaves, leafy vegetable and bamboo. In the study villages they collected dead leaves of khajur to make mats, which they sold in the market. The poor households earned by selling honey, mahwa, fuel wood, *sal* leaves, bamboo etc. in addition, roots and edible leaves were collected from the forest, which were sold and consumed by the poor households. Household annual income from NTFPs collection is found in Barwadih block is 25000, in Mahuddar block is 20000, in Garu block is also 20000 and in Manika block is 30000/- per year of each family. The contribution of NTFPs is 35% in Barwadih, 30-35 % in Garu, 40% in Mahuadanr and 40-50%

in Manika block of annual income of livelihood. Some important other activity other than NTFPs collection has been recorded such as in Animal husbandry, Collage Industry, Artisans and Land use. It is also observed that the major NTFPs are available for around 3-4 months in year and variability of climate affects the NTFPs.

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