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Natural and converted ecosystems in Simlipal Biosphere Reserve: Linkages and impact

Shekhar Upadhyay[1], S. K. Sahu[1], G. K. Panda[2] and V. P. Upadhyay[3] Ψ

[1]Department of Environmental Science, Sambalpur University, Sambalpur, India
[2]Utkal University, Bhubaneshwar, India
[3]B1-303, New LIC Colony, Maitri Vihar, Bhubaneswar, India

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ABSTRACT

The present study was conducted in the Simlipal Biosphere Reserve, Odisha, India, which presents a typical example of Mahanadian bio-geographic zone. Four villages from core zone, three villages in buffer zone and five villages in peripheral zone of the biosphere reserve were selected for the agro-ecosystem linkage study. These tribal villages are located at different altitudes where agriculture is the main source of livelihood. The extent of agriculture area and forests across these villages vary significantly; both total land area and uncultivable land being highest in peripheral villages. The core villages are highly dependent on agriculture and carrying capacity at present seems to be enough to support existing human population. All the tribes in core villages practice sustainable methods of collection of forest produce as per their need. The Non-Timber Forest Products (NTFP), food, firewood and medicinal plants are the main requirements of the forest dependent tribal communities of Simlipal. Data on NTFP, food, fuel wood, kerosene consumption and medicinal plants were collected to understand their significance to the livelihood of tribal communities. The Santal, Kolha and Munda tribals are the resident of core zone villages and are primarily agrarian tribes whose dependency on NTFP is high compared to other tribes. The main wild leafy vegetables are Mata saga (*Antidesma acidum*), Gadri saga (*Alternanthera sessilis*), Pita or Khatta Saga (*Mallotus nudiflorus*), Koilari saga (*Bahunia purpurea*), Saijana saga (*Moringa oleifera*), Mati or Sankha saga (*Rungia pectinata*) etc. The NTFP collected by tribals in core zone are more compared to buffer and peripheral villages and these are used mainly for household consumption besides small scale sale in local markets. However, the peripheral villages are mainly market driven societies as they have easy access to market places. Agriculture in core village is much more energy efficient than buffer and peripheral zones. Because of higher human and livestock population and availability of marketing channel, the total annual consumption of NTFPs was much higher in comparison to peripheral and buffer areas. We collected first-hand field data on medicinal plants collected from the forest by all village communities as per requirement to cure various ailments. We recommend strengthening the protection mechanism in forest blocks surrounding the buffer and peripheral villages and also implementation of policies on eco-development and modern agriculture to reduce dependency on forests.

1. Introduction

In developing countries like India, the rural sector with a high population density and a high level of poverty exerts tremendous pressure on natural resources for food, fodder and fuel. A large number of Asian farmers pursue crop cultivation to get the basic food, cloth, education and health care (IFAD, 2004; UNESCAP, 2002; IFPRI, 2002). The major components of village ecosystem such as land, human being and livestock are always in a delicate balance with energy mediating their inter-relationship (Nisanka and Mishra, 1990a; Reddy, 1981; Revelle,1976; Chandola, 1976). An ecosystem operates under a set of definite rules and regulations and any diversion from that set of rules makes the ecosystem converted or modified. Human activity such as hunting and gathering, agriculture, building of cultural landscapes etc. makes an ecosystem converted. Since the

Ψ *Corresponding author; Email*: vpupadhyay@gmail.com

agro-ecosystems are modified by human beings to produce foods, fibers and other agro products, these are also termed as converted ecosystems (Conway, 1987). Agro-ecosystem is a producer-consumer system in which human being attempts to direct the flow of energy and materials through crop, cattle and humans. Therefore, information about the agricultural crops and animals is essential for agro ecosystem analysis. In agro ecosystems, a large number of operations are performed and controlled by man and these require a lot of energy inputs (Buringh,1985). The fuel-based agriculture is not sustainable in long run (Rappaport, 1967,1971). An agricultural system will be considered to be sustainable if its productivity is maintained in long run, natural resources driving the agricultural production processes are conserved and profitability of production and financial income of the farmers are guaranteed (Neher, 1992; Kessler, 1994). The agriculture ecosystems are the most disturbed systems because of typical intense management and disturbance of specific farming practices (Cox and Atkins, 1979). Mitchell (1979) highlighted the basic structure and other functional attributes of labour-intensive Indian agriculture and also developed methodologies to analyse the Indian agro ecosystem. Low productivity of livestock deprives the villagers from livestock-based income this is due to scarce vegetation base and fodder availability (Semwal *et al.*, 2004). Many of the native indigenous crops have become extinct in the areas where Tribals prefer high yielding variety and adopting fuel energy based agricultural practices (Maikhuri *et al*, 2001). Several studies have been done on agro-ecosystems in India (Toky and Ramakrishnan, 1981, 1982; Mishra and Ramakrishnan, 1981, 1982; Singh and Singh, 1984; Singh 1989; Sharma, 1989) and these are useful in increasing our understanding on agro-ecosystems. In Odisha, works of Patel (1985); Fernandes *et al.* (1988); Nisanka and Mishra (1990, a, b); Nayak and Mishra (1991); Sahoo and Mishra (1992); Nayak *et al.* (1993); Patro and Panda (1994); Mishra and Dash (2000); and Dash and Mishra (2001) provide a deep understanding of various factors and their effects on functioning of agro-ecosystems.

Attempts to generate data on structure and functioning of ecosystems of Simlipal Biosphere Reserve are confined to survey, identification and taxonomy (Patnaik and Jena, 1995; Kanungo, 1985; Panigrahi, 1985 and Saxena and Brahmam,1988, 1989), medicinal plants (Panigrahi, 1985; Tribedi *et al.*, 1982), fauna and wildlife (Anonymous, 1990; Prusty and Singh, 1996); Climate (Das, 1989; Sahu, 1985), tribal people and biodiversity (Mahajan, 1983; Rao *et al* (1984) and rare, endangered and endemic flora and fauna (Nayar and Sastry, 1987). Senapati and Sahu (1969) and Das and Das (1997) provided historical information on Similipal. The phytosociological analysis of Simlipal forests has been studied by Mishra (2002), Mishra *et al* (2004), Das (2004, a, b), Das and Das (1968) and Dash (1998) but little attention has been given for systematic research on existence and functioning of converted ecosystems within Simlipal. This study is a systemic analysis of converted ecosystem and changes brought about by human beings covering agriculture, animal husbandry, collection of fuelwood and minor forest products, conversion of forest land for other purposes, tourism etc. An attempt has been made to find out the linkages between tribal and natural resources and to study the practices of settled agriculture cultivation by the tribals in detail with reference to landform, climate and geographical phenomena.

2. Study area and methodology

The Simlipal Biosphere Reserve is located in Mayurbhanj district of Odisha, India. Important townships around Simlipal Biosphere Reserve are Baripada and Udala on Eastern side and Jasipur, Karanjia and Thakurmunda on the Western side. The bordering districts of Mayurbhanj are Balasore and Keonjhar at the east and southwest directions respectively and Midnapore (Westbengal) and Singhbhoom (Jharkhand) at the northeast and northwest directions respectively (Das, 1998). The Mayurbhanj is the largest district of Odisha with an area of about 10,418 sq. km. of which 42.16% (4392.12 sq. km.) is forest area. It is predominantly a tribal district having 56.6% of its population as schedule tribe. A total of 131 castes and tribes were reported in Mayurbhanj District Gazetteers (Senapati and Sahu, 1969). The major tribes residing in Simlipal Biosphere Reserve are Ho or Kol, Kharia, Mankiria or Birbor, Munda, Santals Bhathudi, Bhumij and Manali. The schedule caste and other backward caste of Simlipal Biosphere Reserve include Ghasi, Gaud or Mahakud, Mahato, Teli, Bindhani and Ganda. The Simlipal Biosphere reserve is located between 21^0 30' to 22^0 08' North latitudes and 86^0 05' to 86^0 37' East longitude. The area of Simlipal Biosphere reserve is 4374 sq. Km. of which 845 sq. Km. is core zone of Simlipal tiger reserve (STR), 2129 sq. km. of buffer zone (1905 sq. km. of STR buffer + 77 sq. Km. of Nato reserve forest and 147 sq. km. of Satkosia reserve forest) and 1400 sq. km. of transitional zone or peripheral zone (Srivastava and Singh, 1998).

2.1. The sample villages

There are several villages located inside the Simlipal Biosphere reserve. Most of the villages are established in the valley areas. There are four revenue villages in core zone, 61 revenue villages in buffer zone and about 1200 villages in peripheral zone. A through survey of Simlipal Biosphere Reserve was done to get the representative village

and a total of twelve sample villages were selected for the study. All the four villages from core zone (Jenabil, Jamunagarh, Kabatghai and Bakua. are in Gudgudia Grampanchayat of Jasipur block), three villages out of total 61 villages in buffer zone (Gudgudia village in Gudgudia Grampanchayat, Nawana in Astakumar Grampanchayat and Barehipani in Barehipani Grampanchayat of Jasipur block) and five villages out of 1200 villages in peripheral zone (Jamuani in Podagarh Grampanchayat of Jasipur block, Lulung in Kochilaghati Grampanchayat of Samakhunta block, Kadamsul in Kolialum Grampanchayat of Kaptipada block, Ghodabindha in Hathigora Grampanchayat of Thakurmunda block and village Patiapada in Champajhar Grampanchayat of Thakurmunda block) were selected.

2.2. Geographical settings of sample villages

The village Jenabil is located on the southeastern part of Simlipal plateau and is about 65 Km from the block head quarter Jasipur. The village is called Jenabil, after the name of its first settler Jena Kol. The altitude of Jenabil is 870 m mean sea level(msl) and is surrounded by thick forests. The second village Jamunagarh is at an elevation of about 800 meters msl. Jamunagarh is a valley area surrounded by mixed Sal forest having shunted tree growth. The village Kabatghai is located nearer to the boundary of the core with elevation of Kabatghai is 671 meters from msl and is surrounded by dense woodland forests consisting of mainly Sal. The village Bakua has highest elevation of 918 meters and is also surrounded by Sal dominated dense forests. The buffer zone village Gudgudia, Nawana and Barehipani are located at about 600, 740 and 710 meters from msl, respectively and is surrounded by dense woodland. Barehipani has the famous Barehipani water fall. All these three buffer study villages are important meeting centers of the buffer zone villages.

The peripheral villages represent a mixture of culturally advanced as well as of backward communities. The first Ghodabindha is located at an elevation of 360 meters msl on a slopping ground between two seasonal streams namely Seem Nadi and Chirupad Nadi, surrounded by a degraded but pure stand of Sal. The village Jamuani is located at the northwestern foothill of Simlipal, 0.5 Km from buffer zone boundary. One river flows through the village fulfilling the water needs of villagers during summer. The topography of Jamuani village is a rolling plain land having an elevation of about 460 meters msl, The forest surrounding the village is degraded. The village Kadamsul is located at 70 meters msl on the southeastern foothill of Simlipal, in Kolialum grampanchayat of Kaptipada block. The village is well connected with Khunta by means of a fair weather road. The vegetation is more or less degraded scrubland because of prevailing dry weather conditions, coarse textured soil and rugged terrain. The fourth village Lulung is situated at the northeastern foothill of Simlipal surrounded by hills on three sides and can be approached through Rangamatia and Balideha dam. The Palpala River, which passes through Lulung, is the sole source of fishing, bathing and washing of clothes. The adjoining hills are rich in limestone. The last village Patiapada is located in the foothill zone of southwestern flank of Simlipal, Salandi River flows touching the village boundary and the village is surrounded by dense woodland. The terrain of village is undulating plain land having some waterfalls in the forest near the village.

2.3. Methodology and data collection

The primary data was collected through household survey, group discussions, and field check. The sources of secondary data were Census of Odisha, Forest Department, Directorate of Economics and Statistics, Odisha Tourism Department and Revenue Department. The maps and toposheets were also collected from Survey of India and National Atlas Thematic Mapping Organization (NATMO). The household survey is widely used tool for collecting primary data. A household survey was undertaken between October, 2003 to October, 2004. The villages were surveyed in different months of the year on a well-structured questionnaire. The questionnaire was prepared after a thorough review of earlier works of Singh (1989), Sharma (1989), Nisanka and Mishra (1990 a, b), Nayak and Mishra (2002), Mishra and Dash (2000), Sahoo and Mishra (1992), Dash and Mishra (2001) and Nayak *et al.* (1993). Bhasin and Bhasin (1997) provided some basic ideas to design the questionnaire. The survey was intended to find out household structure and family size (male, female and children), living conditions of household's viz. types of houses, number of doors, windows and rooms in each house, major drinking water sources etc., livestock reared by household such as cattle (cow, goat, buffalo, ox, sheep), poultry birds (hen, duck, peacock, dove) and pets (cat, dog) and size of landholdings, major and minor crops grown there. The study generated data on quantity of firewood and kerosene used for cooking and lighting purpose, household consumption of rice, oil and salt etc., major and minor forest produce collected by household and money earned, information on Tribal culture and tradition and basic amenities such as education, food, clothings and health care and their availability to them

3. Results and discussion

The Non-Timber Forest products (NTFP), food, fuel (fuel wood and kerosene) and medicinal plants are the main requirements of the forest dependent tribal communities of

Simlipal. A list of plants with local name, scientific name and common use has been given in Table 1. A zone wise analysis of NTFP, food, fuel wood, kerosene consumption and medicinal plant's use has been done to have information about their importance for the livelihood of Tribal communities (Table 2-5). The Santal, Kolha and Munda tribals are the resident of core zone villages. They are primarily agrarian tribes whose dependency on NTFP is low compared to Kharia Tribes. The NTFP collected by tribals in core zone are mainly used for household consumption and a very little is sold in the market. The main wild leafy vegetables (saga) are Mata saga (*Antidesma acidum*), Gadri saga (*Alternanthera sessilis*), Pita or Khatta Saga (*Trewia nudiflora*), Koilari saga (*Bahunia purpurea*), Saijana saga (*Muringa pubicens*), Mati or Sanka saga (*Pachyrrhizus erosus*) etc. Some of other saga, whose botanical name could not be found, but collected and used by the Tribals in the core zone of Simlipal are Binda saga, Kitagini saga, Kankari saga, Muri Saga, Serali saga, Lendung saga and Leper saga. The range of wild leafy vegetables collection was 0.08 to 1.5 kg/day/household in core zone. The average and total wild leafy vegetables collection was 0.79 kg/day/household and 68 kg/day in core zone (Table 2) and these leafy vegetables are collected for household consumption only. The main wild seeds collected in core zone of Simlipal are Rimiri (*Protium serratum*), Siali (*Bahuinia vahlii*), Kusum (*Schleichera oleosa*) and Jamun (*Syzygium cumini*). The range of wild seeds collection in core zone was between 0.17 to 11.67 kg/day/household. The average and total wild seeds collection was 1.17 kg/day/household and 100.38 kg/day in core zone (Table 2). Among wild seeds collected in core zone Kusum seed are sold in market and rests are used for domestic consumption. The wild fruits collected in core zone of Simlipal are Anola (*Phyllanthus emblica*), Harida (*Terminalia chebula*), Bahada (*Terminalia bellirica*), Aamba (*Mangifera indica*), Jackfruit (*Artocarpus heterophyllus*) and Raiphal (*Dillenia pentagyna*). The range of wild fruits collection in core zone was 0.17 to 18.61 kg/day/household. The average and total wild fruits collections were 2.60 kg/day/household and 224 kg/day in core zone (Table 2). Among wild tubers and roots only Jungle alu or Mati alu and Boitadu (*Dioscorea* species and *Curcuma* species) are the main collection in core zone. The collection of wild tubers and roots in core zone ranged between 1.00 to 3.33 Kg/day/household. The average and total wild tubers and roots collection are 0.54 kg/day/household and 47 kg/day in core zone (Table 2). Champa (*Magnolia champaca*) is the main wild flower collected in core zone. Honey is collected in two seasons. A number of mushrooms such as Bada chhatu, Rutuka, Handiphuta, Gobara, Tundi, Bhurkunda kana, Dha kana, Kendu kana, Jamu kana, Panasa kana, Achundi kana, Mayurachualia, Angarpoda, Palua, Siali kana, Jadi kana, Champa kana, and Aamba kana are collected. Honey and mushrooms are collected for both domestic as well as for sale in haat. The range of grasses, flowers, honey and mushrooms collection in core zone was 0.08 to 1.50 kg/day/household. The average and total grasses, flowers, honey and mushrooms collected in core zone was 0.59 kg/day/household and 51 kg/day. Collection of Chana grass (*Imperata cylindrica*) was surprisingly avoided by core zone villagers (Table 2). Rice and edible oil are two staple foods of core zone villagers. The annual rice consumption by households per hectare of cropland owned was 7.51, 8.07, 37.37, and 45.29 quintals in Jenabil, Bakua, Jamunagarh and Kabatghai villages respectively (Table 3). However, the annual edible oil consumption by core zone villagers was 6, 16, 26 and 42 kg/hectare in Bakua, Jenabil, Jamunagarh and Kabatghai villages respectively (Table 3). The fuel wood consumptions by household per ha of crop land owned in core zone villages were 25,807; 39,805; 73,768 and 3, 93,607 kg/ha/year in Bakua, Jenabil, Jamunagarh and Kabatghai respectively. The range of fuel wood consumption was 25,807 to 3,93,607 kg/ ha/ year (Table 3). The average fuel wood consumption in core zone was 1,33,247 kg/ ha/year. The high fuel wood consumption in Kabatghai may be due to inhabitant of Santal tribe who are relatively more advanced and their paddy processing method requires heavy fuel wood. Kerosene is the only source of lighting in all the core zone villages of Simlipal. The kerosene consumptions (liter/hectare of crop land/ year) by core zone villagers were 31, 36, 122, and 195 in Bakua, Jenabil, Jamunagarh and Kabatghai villages respectively (Table3).

The Kharia and Mankiria tribals are the main hunters and gatherers of Simlipal. Most of the Kharias resides in Gudgudia village of buffer zone and some villages in peripheral zone. Mankiria live a life of Transhuman while Kharias are settled. Gudgudia villagers are provided with Indira Awas by Kharia and Mankiria Development Authority (KMDA). Kharias take agriculture as their subsidiary occupation as they have no technical knowhow of agricultural practices. The life of these primitive hunters and gatherers is comparatively harder than the people dependent on agriculture. They also preprocess the Non timber forest products NTFPs to fetch higher price in the market. The NTFP collected by Kharia are mainly wild vegetables, wild seeds, wild sap and gums, wild fruits, wild tubers and roots, wild grasses. Medicinal plants and fishes also substantiate the income of these Tribal people. A number of wild leafy vegetables collected from the forest are mainly used for domestic consumption. These are Sanka saga (*Rungia pectinata*), Gadri saga (*Alternanthera sessilis*), Pita saga or Panigramari (*Mallotus nudiflorus*), Koilari saga (*Bauhinia purpurea*), Saijana saga (*Moringa oleifera*), Mati or Mata

saga (*Antidesma acidum*) and Zinka saga etc. The range of wild leafy vegetables collection in buffer zone varied from 0.1 to 0.6 kg/day/household. The average and total wild leafy vegetables collections were 0.13 kg/day/household and 332 kg/day in the buffer zone (Table 2). The principal wild seeds collected by Kharias of Gudgudia village in buffer zone are Rimiri (*Protium serratum*), Siali (*Bauhinia vahlii*), Ghurdu (*Gardenia gummifera*), Kusum (*Schleichera oleosa*), Sal (*Shorea robusta*), Kendu (*Diospyros melanoxylon*), Jamun (*Syzygium cumini*), Bela (*Aegle marmelos*), Jambira (*Citrus medica*) and Kandhia etc. The average daily collection of wild seeds ranged from 0.67 to 0.23 kg/day/household, except Sal (5 kg/day/household) that have some market value. The total wild seeds collected in the buffer zone were 1481 Kg/day (Table2). Panaria gum (*Elaeocarpus stipularis*) and Siali gum (*Bauhinia vahlii*) are the main wild saps and gum collected by the Tribals of buffer zone. The daily collection of saps and gums was about 1 kg or liter/day/ household. The total wild sap and gum collected in buffer zone was around 2554 kg/day (Table 2). A number of wild fruits collected from the forests by Kharias include Chara Koli (*Buchanania cochinchinensis*), Chunkari (*Ziziphus rugosa*), Ghuira (*Vachellia leucophloea*), Mahua (*Madhuca longifolia* var. *latifolia*), Anola (*Phyllanthus emblica*) and Rajara. The average daily collection of wild fruits ranged from 0.2 to 1 kg/day/household and total wild fruit collected in the buffer zone was 639 kg/ day (Table 2). Mundai alu, Pinkara, Rasa, Laddu, Pittadu and Karu alu are main wild tubers collected by Kharias from the forests of Simlipal. Most of the wild tubers belong to *Dioscorea* genus and the main species collected are *Dioscorea glabra*, *D. pubera*, *D. bulbifera* and *D. belophylla* etc. The average daily collection of these wild tubers and roots ranged from 0.2 to 0.5 kg/day/household, except jungle alu (*Curcuma* species) 7 kg/day/household. Pala or arrowroot prepared from these wild tubers and roots are used for domestic consumption as well as for sale. The total wild tubers and roots collection in buffer zone was 2809 kg/ day (Table 2). Chana grass (*Imperata cylindrica*) is the main wild grass collected by Kharias, used to lay off roofs of huts. The average daily collection of Chana grass was 10 kg/day/household. The total collection of Chana grass in buffer zone was about 6385 kg/day (Table 2). A number of Mushrooms as Bada chhatu, Rutuka, Handiphuta, Gobara, Tundi, Bhurkunda kana, Dha kana, Kendu kana, Jamu kana, Panasa kana, Achundi kana, Mayurachualia, Angarpoda, Palua, Siali kana, Jadi kana, Champa kana, and Aamba kana are collected by the villagers of buffer zone. The flowers honey and mushrooms collection was also done only for domestic consumptions. The staple food of buffer zone villages are rice and edible oil. The annual rice consumption by households per hectare of cropland owned were 4.28, 10.39 and 13.48 quintals for Barehipani, Nawana and Gudgudia villages respectively (Table 4). However, the annual edible oil consumption by buffer zone villages was 3.99, 5.99 and 91.00 kg/hectare in Barehipani, Gudgudia and Nawana villages respectively (Table4). Rice is a major crop in Odisha and it commands over 78% of total cropped area in Odisha. The average rain fed rice yield in hilly Tribal villages of Odisha is less than Meghalaya (Toky and Ramakrishnan, 1981) and coastal villages of Odisha (Nisanka and Mishra, 1990b). However, all these Indian villages are better than most western based villages (Spedding, 1975; Pimental and Pimental, 1979; Pimental *et al.*, 1973) from an energetic point of view. The fuel wood consumptions by households per ha of cropland owned in buffer zone villages were 15,612; 84,686 and 1,20,433 kg/ha/year in Barehipani, Nawana and Gudgudia respectively (Table4). The range of fuel wood consumption was 15,612 to 1,20,433 kg/ ha/ year. The average fuel wood consumption in buffer zone was 73,577 kg/ ha/year. Very high fuel wood consumption in Gudgudia village was because of high requirements to fulfill the needs of ever-growing population and fuel wood intensive paddy processing methods. The kerosene consumption in buffer zone villages were 26, 42, and 47 (liter/ hectare of cropland owned/year) in Barehipani, Nawana and Gudgudia villages respectively (Table 4). In village ecosystem, fuel energy consumption is derived directly or indirectly from biomass (Nisanka and Mishra, 1990, b). The fuel wood collection requires a good deal of human energy, because of depleting forest resources, which is used for cooking and boiling to feed human as well as cattle.

In peripheral zone, there is no definite pattern with respect to time or space for collection of NTFP (Table 2), so data on NTFP from families are not available. The distance and market demand are the main deciding factors for NTFP collections. Few villagers collect Sal leaves, Mahua Flowers (*Madhuca longifolia* var. *latifolia*), Anola (*Phyllanthus emblica*), Kusum (*Schleichera oleosa*) and Karanj seeds for sale in the market. Wild leafy vegetables like Sajana saga, Khatta saga, Koilari saga etc are collected for domestic consumption. Very rarely they collect wild fruits like Mango, Jackfruit, or wild flowers like Champa (*Magnolia champaca*). Some of the peripheral villagers are constrained to go up to 30 Km deep in the forest for NTFP collections. Sal leaves are stitched in to leaf cups and plates there by providing job for about six to eight months to rural Tribal women in the peripheral zone. The traders usually visit the peripheral areas to procure the processed NTFP like Sal seeds, Karanj seeds, Mahua, etc. Rice constitutes the staple food of peripheral zone villagers. The annual rice consumption by households per hectare of cropland owned were 5.74, 8.13,

10.72, 12.89, and 72.41 quintals in Patiapada, Ghodabindha, Kadamsul, Jamunai and Lulung villages respectively (Table 5). However, the annual edible oil consumptions by peripheral zone villages were 1.99, 3.00, 5.00, 5.99 and 19.99 kg/hectare/ year in Kadamsul, Patiapada, Lulung, Ghodabindha and Jamuani villages respectively (Table5). The fuel wood consumptions by household per hectare of cropland owned in peripheral zone villages were 21,453; 30,374; 51,912; 58,093 and 59,388 kg/ha/year in Patiapada, Jamuani, Ghodabindha, Kadamsul and Lulung respectively (Table 5). The range of fuel wood consumption was 21,453 to 59,388 kg/ ha/ year. The average fuel wood consumption in peripheral zone was 44,244 kg/ ha/year (Table 5). The high fuel wood consumption in Lulung may be due to intensive paddy processing and illegal selling and/or transport of fuel wood to neighboring townships. The Kerosene consumption in peripheral zone villages were 31, 45, 51, 65 and 68 (liters/ha of cropland owned/ year) in Patiapada, Jamuani, Kadamsul, Ghodabindha and Lulung villages respectively (Table 5). The fuel consumption is a complex phenomenon affected by agricultural practices as well as by various cultural, social and economic factors (Fernandes *et al*, 1988). Most of households in villages of Odisha use dung cakes due to its easy availability (Nisanka and Mishra, 1990, b; Krishna, 1984). The Tribal villages in India derive most of total village energy from the forest (Nayak *et al*, 1993; Gangwar and Ramakrishnan, 1989; Rabindranath *et al.*, 1981). Therefore, Indian village ecosystem mainly depends on dung cakes, agricultural residue and plant litter on one hand and animal energy for agriculture on other. In India the 80 million animals provide two third of power requirement of villages (Shiva, 1991). The difference in the use of biomass energy could be attributed to difference in per capita income, socio-economic conditions, availability of resources and technical knowhow (Rao *et al*, 2005). The main cropping practices being used in the Tribal village of India are valley cultivation, shifting cultivation (Guda Bari) and home garden cultivation. Minor millets, red gram and niger are the crops of shifting cultivation (Guda Bari), vegetables and species are the main crops of bari or the field near the house while paddy dominates in valley agriculture. Human and drought power are major energy input in valley agriculture while human labour is the only source of energy in shifting cultivation. The bullocks are the dominant draughts power in rural India accounting for 83% of animal work (Revelle, 1976). In hilly Tribal villages, almost all agricultural yields are consumed within village and remaining need is fulfilled by the forest (Dash and Mishra, 2001).

A number of medicinal plants are collected from the forest by all village communities as per requirement to cure various ailments. Some of the plants having important medicinal constituents are given in Table 1. These medicinal plants are used as Ayurvedic drugs in a variety of ailments. The local Vaidyas prepares the medicine for a number of health related problems starting from simple headache, or stomach ache to snake bite. The local Tribal people prefer the Vaidyas for their day to day health related problems. In case of severity the patients are sent to hospitals located at the town in periphery. Medicinal and aromatic plants, which the locals extracted for their own uses have good market. But the people in villages do not market these products in general mainly due to restrictions and also lack of support. Similar situation exists in central Himalayan villages and several researchers have recommended for Supporting people to cultivate these plants through eco-development activities and providing assured market opportunities that will help in reducing extractions from wild and ensure economic opportunities with the access to market for this produce (Maikhuri *et al*. 2001a & 2003a).

Fishes are relished by all communities of Simlipal but quantitative data on fish collection and consumption was not available with communities. The principal fishes captured in the rivers/ponds of Simlipal are Seula (*Channa marulius*), Magura (*Clarias batrachus*), Kau or Kari (*Anabas testudineus*), Korandi (*Puntius species*), Kantia (*Mystus seenghala*), Gadisa (*Channa panctatus*), Tudi or Turi (*Mostocembelus armatus*), Balia (*Wallago attu*), Bakura (*Catla catla*), Rohi *(Labeo rohita*), Singi (Heteropheurtes fossils) and Chenga or Chengo (Chhana gachua) etc. All of these fresh water fishes are captured mainly for household consumption. The Tribals also lack the technical knowhow to preserve fishes for future consumption. The only restriction for fishing is that the fishes should not be captured during their breading period.

From the above data of three village ecosystems, it is evident that Forests are a vital source of energy to village ecosystems which play a crucial role in making them sustainable. Tribal are always presented as the encroachers and destroyers of natural resources. But that is not true in case of Simlipal Biosphere reserve. In fact, they are the managers of forests who are managing it since ages for their livelihood. Now a days the primary hunters and gatherers of Simlipal Biosphere reserve are facing stiff competition from other tribes. On agricultural front they are the learners. The major dependency of village ecosystem on forest is in the form of fuel wood. In central Himalayan region also the Fuel and fodder are the major dependencies of people on the forests (Rao *et al*., 2005). Fence wood and non-timber forest resources (NTFP) plays a crucial role in making the village ecosystem sustainable by providing employment to

the unskilled labour force, alternative source of food, medicine and other household requirement. In Simlipal Biosphere reserve the Tribals and forest are intimately connected and the Tribal traditions and customs are very tightly interwoven with nature and Tribal people always pay due regard and respect to the natural laws or rules of the nature. A number of their deities are from natural assets such as Mountains, Trees, Sun, Earth, Rivers etc. They always live in fear of the wrath of deities in the event of break of laws knowingly or unknowingly. There are several rituals, traditions and customs (beliefs) which prohibits the Tribal people to over exploit the forest. The kols or Ho's that form the majority in core, buffer and peripheral zone villages of Simlipal Biosphere reserve, had a large number rituals / traditions for resource conservation and their proper utilization. The Kharia and Mankiria are the main hunters and gathers of Simlipal Biosphere reserve while all the other tribes including kols are agrarian communities. Some of the rituals / traditions governing the natural resources, conservation and proper utilization are noteworthy. No forest produce can be collected without observing Kabadi or Jungle Puja by Kharias and Maghuani Puja by other tribes. In other wards nobody dares to enter into the forest after Makara festival till the completion of Maghuani Puja. During pregnancy, both wife and husband refrain from entering into the forest until the pollution is over. In case of death of a Tribal, all the kins and family members are tabooed to enter into the forest till the period as mandated comes to an end. All the Kharias practice judicious methods to collect forest produce such as they don't dig out all the underground roots and tubers, instead they left some part of it for regeneration, leafy vegetables and medicinal produce are collected as per the need. The bee hives situated on tall trees on cliffs cannot be exploited without prior propitiation of hill sprits. Places of origin of hill streams are considered a sacred place and no forest produce extraction activities are allowed and there. Milking of cow is considered as a sin among kols. Making of nuisance in the forest and wearing red colour cloth is prohibited as it will attract wild animals as elephant, tigers etc. In most of the tribes the non-vegetarian diet is prohibited in the days of pollution.

Among NTFPs, the number of wild leafy vegetables wild fruit and mushrooms collected in core zone was higher than buffers and periphery. Relocation of Kharias in the buffers zone had increased the human pressure on NTFPs and other forest resources as they are facing stiff competition from fellow Kols and other tribes. The average daily collection of wild leafy vegetables and wild seeds and fruits per households was high but the total collection in the villages of buffer zone was higher than villages of core zone. The wild saps and gums are not collected in core zone. The collection of wild tubers and roots, wild grasses, flowers, honey and mushrooms was also high in buffer zone which is due to Kharias Tribes and a large population of other tribes. In peripheral zone, the market exposure of the tribes transformed their life style to some extent. The peripheral villagers have to covers large distance to collect NTFPs. The fuel wood consumption was highest in core zone followed by buffer zone and peripheral zone. In rural areas of India about 180 million tons of biomass fuel is used for cooking through insufficient and smoky cook stoves and cooking and lighting energy constitute 75 % of total energy used in India (Rajvanshi, 2003). The average fence wood consumption was highest in buffer zone followed by peripheral zone and core zone. Technically unskilled Kharias and Kolhas make a high fence wood energy input in buffer zone. In buffer zone, the villagers have high dependency on forest as they lack other sources of livelihood, besides having comparatively skilled labour force as far as primary operations are concerned. Though the market provides very less energy to the village ecosystem but that is very crucial as it meets demand for food, edible oils, kerosene, salt, fertilizer, pesticides, seeds of hybrid varieties (Sarakari Dhan) etc. The villagers of Simlipal Biosphere reserve purchase these items from the respective block head quarter and local weekly markets/haat. The high dependency on market in peripheral zone is due to good roads, and comparatively better economic conditions of Tribals. There are linkages between rural peripheral villages and local market town and a good connectivity by means of roads convey a set of benefits like lager market for agricultural and non-agricultural products, improved access to agricultural inputs, improved access to amenities as health, education, safe drinking water, modern building material for houses, additional source of livelihood such as remittances and markets for farm labour and better access to goods for consumption, new opportunities to sell goods and services.

In Simlipal Biosphere Reserve, the villagers sell their agricultural and non-agricultural (mostly forest products) products in local markets. A large part of these marketing follow the barter system as it improves their cultural ties also. The most sold products are edible oils, honey, ropes, mats, forest leaves, leaf cup plates, Mahua flowers, Sal, Kusum, Karanj seeds, Sal and Siali gum etc. The capacity of forest seems to have reached its optimum or may have crossed its limit in buffer zone to support huge population. The dependency on forest components is highest in buffer zone followed by peripheral zone and core zone of Simlipal Biosphere reserve. The Tribal tradition plays a key role in structure and functioning of agro ecosystem in Tribal villages. Women perform the major manual works including all domestic activities (Patel, 1985). The native people are

in an utter state of helplessness and non-responsive towards the resource management (Joshi *et al.,* 1997). A policy intervention to provide food grains to meet the requirements of these villages better eco-development services to discourage collection of wild germplasm and take up alternate livelihood works, will reduce pressures in SBR. The tradition of growing the paddy crop only is a serious obstacle, which needs to be discouraged in order to infuse some ecologically sustainable and economically viable forms of agriculture. The practice of straying cattle into the fields and forests restricts the regeneration of growing of forest crops. The misconception behind not milking of cows in Kol tribes is that they consider it as sin and hence are deprived of livestock based income and energy. The wide spread use of intoxicating drinks are the main evils behind the civil crimes in Tribal pockets of Odisha. It also weakens the economic conditions of the households (Nayak, 2003). The ever-increasing human pressure on the forest in buffer and periphery requires more attention in terms of making innovative policies and programmes to benefit these communities.

Table 1.

List of plants of Simlipal Biosphere Reserve with local name, scientific name and common use.

Serial No	Local Name	Botanical name	Uses
1	Achchu	*Morinda coreia*	Medicinal plant
2	Agni Jahar	*Clausena excavata*	Medicinal plant
3	Amba	*Mangifera indica*	Multipurpose plant
4	Ambada	*Spondias mangifera*	Edible sour fruits
5	Amla	*Phyllanthus emblica*	Multipurpose plant
6	Aprajeta	*Clitoria ternatea*	Medicinal plant
7	Arjuna	*Terminalia arjuna*	Medicinal plant
8	Asan	*Terminalia alata*	Timber/fuel plant
9	Ashok	*Saraca asoca*	Medicinal plant
10	Ata	*Anaona squamosa*	Fruits are eaten
11	Athandi	*Combretum roxburghii*	Medicinal plant
12	Bagh-lucha	*Martynia annua*	Medicinal plant
13	Bana kapas	*Azanza lampas*	Medicinal plant
14	Bana kapasia	*Kydia calycina*	Produces fibre
15	Bana khira	*Xylia xylocarpa*	A medicinal plant
16	Banabasanga	*Wendlandia tinctoria*	Medicinal plant
17	Banahaldi	*Curcuma* sp.	Rhizome is eaten
18	Banamalli	*Barleria strigosa*	Medicinal plant
19	Baragad	*Ficus benghalensis*	Multipurpose plant
20	Barbhanga	*Cissus quadrangularis*	Medicinal plant
21	Barhakani	*Pterospermum acerifolium*	Medicinal plant
22	Beguni	*Vitex negundo*	Fuel plant
23	Bela	*Aegle marmelos*	Fruits are eaten
24	Bhada	*Terminalia bellirica*	Medicinal plant
25	Bhalia	*Semecarpus anacardium*	Therapeutic *Uses*
26	Bhuin champa	*Ochna obtusata*	Medicinal plant
27	Bhuin kadam	*Sphaeranthus indicus*	Medicinal plant
28	Bhuin neeba/ Kalmegh	*Andragraphis paniculata*	Medicinal plant
29	Bhurkunda	*Hymenodictyon orixense*	Medicinal plant
30	Bichhuati	*Mucuna pruriens*	Herbal drug
31	Borokoli	*Ziziphus jujuba*	Seeds are eaten

32	Brahami	*Bacopa monneiri*	Medicinal plant
33	Chai	*Piper retrofractum*	Medicinal plant
34	Champa	*Magnolia champaca*	Flowers are used
35	Champati	*Poyalthia cerasoides*	Pharmacological value
36	Chana grass	*Imperata cylindrica*	Used for thatching
37	Chara koli	*Buchanania cochinchinensis*	Seeds are eaten
38	Chattu	Macrofungi	Bulbs are eaten
39	Chhachina	*Alstonia scholaris*	Medicinal plant
40	Chimura, Anantamul	*Hemdesmus indicus*	Medicinal plant
41	Chirata	*Swertia chirata*	Medicinal plant
42	Chiuri	*Garcinia xanthochymus*	Ayurvedic medicine
43	Chunkuli	*Ziziphus rugosa*	Fruits are eaten
44	Dambaru	*Gardenia latifolia*	Medicinal plant
45	Deku sindur	*Buttneria herbacea*	Medicinal plant
46	Dhaw	*Anogeissus latifolia*	Ayurvedic medicine
47	Diba guda	*Elaeagnus latifolia*	Medicinal plant
48	Dimuri	*Ficus racemosa*	Fruits are eaten
49	Dom sal	*Miliusa velutina*	Ayurvedic medicine
50	Eksira	*Schrebera swietenioides*	Ayurvedic medicine
51	Gadri saga	*Alternanthera sessilis*	Leaves are eaten
52	Gaisira	*Asparagus racemosus*	Ayurvedic medicine
53	Gambhar	*Gmelina arborea*	Medicinal plant
54	Ganga siuli	*Nyctanthes arbortrists*	Medicinal plant
55	Ghurudu	*Gardenia gummifera*	Fruits are eaten
56	Gillri Phula	*Indigofera cassioides*	Flowers are used
57	Gilo	*Entada phaseoloides*	Ayurvedic medicine
58	Girdhini	*Sterculia urens*	produces fibre
59	Goosebery	*Phyllanthus emblica*	Medicinal plant
60	Guadhania	*Millettia extensa*	Folklore Medicine
61	Gudi Koim	*Mitragyna parvifolia*	Bark And Roots
62	Guhira	*Vachellia leucophloea*	Fruits are eaten
63	Haldu	*Haldina cordifolia*	Medicinal plant
64	Harada, kasaphal	*Terminalia chebula*	Medicinal plant
65	Hijala, Jinjala	*Barringtonia acutangula*	Medicinal plant
66	Hopo	*Cochlospermum religiosum*	Flosses used as kapok
67	Jada bindhi	*Ricinius communis*	Seeds provide oil
68	Jamurol	*Syzygium jambos*	Ayurvedic medicine
69	Jambira	*Citrus medica*	Fruits are eaten
70	Jamun	*Syzygium cumini*	Fruits are eaten
71	Jangli angura	*Cissus vitiginea*	Medicinal plant
72	Jarhi	*Ficus amplissima*	Medicinal plant
73	Jattiko	*Woodfordia fruticosa*	Ayurvedic medicine
74	Jautha	*Artocarpus lacucha*	Medicinal plant
75	Jhili Phula	*Shuteria involucrata*	Flowers are used

76	Jia	*Cipadessa baccifera*	Medicinal plant
77	Jia	*Lannea coromandelica*	Ayurvedic medicine
78	Kadam	*Neolamarckia cadamba*	Ayurvedic medicine
79	Kadiputtu saga	*Murraya koenigii*	Leaves are eaten
80	Kalchia	*Glochidion zeylanicum*	Medicinal plant
81	Kamalagundi	*Mallotus philippinensis*	Yields oil
82	Kanta alu	*Dioscorea glabra*	Rhizome is eaten
83	Kanta mali	*Ventilago denticulata*	Medicinal plant
84	Kanta parasi	*Embelia tsjeriam-cottam*	Medicinal plant
85	Karanj	*Pongamia pinnata*	Multipurpose plant
86	Karati	*Melastoma malabathricum*	Medicinal plant
87	Kari Durkuri	*Erycibe paniculata*	Medicinal plant
88	Karuna	*Psydrax dicoccos*	Medicinal plant
89	Kasa alu	*Dioscorea pubera*	Rhizome is eaten
90	Kasi	*Bridelia retusa*	Medicinal plant
91	Kath kusum	*Garuga pinnata*	Medicinal plant
92	Kedar Jhawar	*Cleome monophylla*	Medicinal plant
93	Kedar Patta	*Skimmia laureola*	Medicinal plant
94	Kendu	*Diospyros melanoxylon*	Multipurpose plant
95	Khejur	*Phoenix sylvestris*	Economic use
96	Koilari saga	*Bauhinia purpurea*	Leaves are eaten
97	Koorsana	*Celastrus paniculata*	Medicinal plant
98	Kuchila	*Strychnos nux-vomica*	Medicinal plant
99	Kuduchi	*Holarrhena pubescens*	Medicinal plant
100	Kukur gadia	*Dioscorea puber*	Rhizome is eaten
101	Kultha	*Grewia tilliaefolia*	Produces fiber
102	Kulthi	*Macrotyloma uniflorum*	leguminous plant
103	Kumbi	*Careya arborea*	Produces fiber
104	Kusum	*Schleichera oleosa*	Multipurpose plant
105	Lodha	*Symplocos racemosa*	Multipurpose plant
106	Macha ranka	*Pavetta indica*	Medicinal plant
107	Madan mast	*Hybanthus enneaspermus*	Medicinal plant
108	Magaki	*Ailanthus excelsa*	Multipurpose plant
109	Mahua	*Maduca longifolia* var. *latifolia*	Multipurpose plant
110	Makar kendu	*Diospyros malabarica*	Multipurpose plant
111	Mamuri saga	*Flacourita ramontchi*	Leaves are eaten
112	Mata saga	*Antidesma acidum*	Leaves are eaten
113	Moi	*Lannea coromandelica*	Antimicrobial
114	Munda noi	*Argyreia nervosa*	Medicinal plant
115	Mutri lata	*Smilax zeylanica*	Medicinal plant
116	Muturi	*Flemingia* sp.	Ayurvedic medicine
117	Nageshwar Phula	*Mesua ferrea*	Fruits are eaten
118	Neem	*Azadiracta indica*	Medicinal plant
119	Noi palasa	*Butea superba*	Ayurvedic medicine

120	Padashi	*Cleistanthus collinus*	Ayurvedic medicine
121	Pai jam	*Syzygium nervosum*	Fruits are eaten
122	Palasa	*Butea monosperma*	Medicinal plant
123	Palka Juti	*Rhinacanthus nasutus*	Medicinal plant
124	Palo	*Curcuma aromatica*	Fruits are eaten
125	Panaria gum	*Elaeocarpus stipularis*	Gum is eaten
126	Panasa	*Artocarpus heterophyllus*	Fruits are eaten
127	Pani alu	*Dioscorea oppositifolia*	Medicinal plant
128	Panjan	*Ougeinia oojeinensis*	Ayurveda herb
129	Paruli	*Stereospermum chelonoides*	Great medicinal value
130	Phir-phira	*Ichnocarpus frutescens*	Medicinal plant
131	Phutguri	*Streblus taxoides*	Medicinal plant
132	Piasal	*Pterocarpus marsupium*	Timber/fuel plant
133	Pipal	*Ficus religiosa*	Multipurpose plant
134	Pita alu	*Dioscorea bulbifera*	Rhizome is eaten
135	Pita saga, Panigamari	*Mallotus nudiflorus*	Leaves are eaten
136	Rai Phula	*Dillenia pentagyna*	Flowers are used
137	Raj jehula	*Elaeodendron glaucum*	Medicinal plant
138	Ram Dantani	*Smilax lanceifolia*	Medicinal plant
139	Rimili	*Protium serratum*	Medicinal plant
140	Rimiri	*Garuga pinnata*	Seeds are eaten
141	Rohini	*Soymida febrifuga*	Medicinal plant
142	Saijana saga	*Moringa oleifera*	Leaves are eaten
143	Sal	*Shorea robusta*	Multipurpose plant
144	Salai	*Boswellia serrata*	Provides gum
145	Sanchi kurchi	*Wrightia tomentosa*	Traditional medicine use
146	Sanka saga	*Rungia pectinata*	Leaves are eaten
147	Sarpagandha/Patalgaruda	*Rouvolfia serpentina*	Medicinal plant
148	Satawari	*Asparagus racemosus*	Medicinal plant
149	Setakata arak	*Cleome gynandra*	Medicinal plant
150	Siali	*Bauhinia vahlii*	Multipurpose plant
151	Sidha	*Legerstromia parviflora*	Multipurpose plant
152	Simili	*Bombax ceiba*	Multipurpose plant
153	Sinkari/pichrangi/mura	*Helicteres isora*	Medicinal plant
154	Sirish	*Albizia odoratissima*	Multipurpose plant
155	Sisoo	*Dalbergia latifolia*	Multipurpose plant
156	Sujuni	*Dalbergia paniculata*	Multipurpose plant
157	Sunari	*Cassia fistula*	Medicinal plant
158	Sunsuni saga	*Marsilea quadrifolia*	Leaves are eaten
159	Suturi	*Vigna radiata*	Leguminous plant
160	Tal	*Borassus flabellifer*	An Ayurvedic Herb
161	Tentuli	*Tamarindus indica*	Fruits are eaten
162	Toon	*Toona ciliata*	Multipurpose plant
163	Tunga alu	*Dioscorea belophylla*	Rhizome is eaten

Table 2.

Average daily collection (Kg/day) of Non Timber forests Products by villagers in Simlipal Biosphere Reserve

		PERIPHERAL ZONE	BUFFER ZONE		CORE ZONE	
S/n	Items		Period of collection	Av. daily collection	Period of collection	Av. daily collection
1	**Wild leafy vegetables**					
a	Sanka saga	NA	Jan.- March	0.60	Jan.-March	1.25
b	Gadri saga	NA	Jan.- March	0.10	Jan.- March	0.67
c	Pita/ Khatta saga	NA	Jan.- June	0.27	Jan.- June	1.00
d	Zinka saga	NA	Jan.-June	0.27	NA	
e	Koilari saga	NA	April- May	0.33	Oct.- Nov.	1.00
f	Saijana saga	NA	year Round	0.10	year Round	1.50
g	Mati/ Mata saga	NA	Jan.- June	0.17	January- June	1.00
h	Binda saga	NA	NA	0.00		1.50
i	Kitagini saga	NA	NA	0.00	Dec.- Feb.	1.00
j	Kankiri saga	NA	NA	0.00	April to May	1.33
k	Muri Saga	NA	NA	0.00	NA	0.50
l	Serali Saga	NA	NA	0.00	NA	0.17
m	Lendung Saga	NA	NA	0.00	NA	0.08
n	Leper Saga	NA	NA	0.00	NA	0.10
	Av. collection	NA	NA	0.13	NA	0.79
	Total collection	NA	NA	332	NA	68.00
2	**Wild seeds**					
a	Rimiri	NA	June	0.07	June	0.17
b	Siali	NA	February	0.23	February	0.33
c	Khandia	NA	December	0.07	NA	0.00
d	Jambiro	NA	December	0.07	NA	0.00
e	Zelleri	NA	year round	0.07	NA	0.00
f	Ghurdu	NA	February	0.17	NA	0.00
g	Kusum	NA	August	0.17	August	11.67
h	Kendu	NA	April	0.17	NA	0.00
i	Sal	NA	June	5.00	NA	0.00
j	Jamun	NA	August	0.17	August	0.67
k	Bela	NA	August	0.17	NA	0.00
	Av. collection	NA		0.58		1.17
	Total collection			1481.00		100.38
3	**Wild sap and Gums**					
a	Panaria	NA	March-April	1.00	NA	0.00
b	Simili gum	NA	March-April	1.00	NA	0.00
	Av. collection	NA		1.00		0.00
	Total collection	NA		2554.00		0.00

4	**Wild fruits**					
a	Chara	NA	June	0.20	NA	0.00
b	Chunkari	NA	June	0.20	NA	0.00
c	Ghuera	NA	June	0.20	NA	0.00
d	Rajara	NA	November	0.20	NA	0.00
e	Mahua	NA	March	1.00	NA	0.00
f	Anola	NA	February	1.00	February	0.33
g	Harada	NA		0.00		0.17
h	Bahada	NA		0.00		0.17
i	Mango	NA		0.00		8.33
j	Jackfruit	NA		0.00		18.61
k	Raiphal	NA		0.00		1.00
	Av.collection	NA		0.25		2.60
	Total collection			639.00		224.00
5	**Wild Tubers and Roots**					
a	Mundai alu	NA	April	0.50	NA	0.00
b	Pinkara	NA	December	0.20	NA	0.00
c	Rasa	NA	December	0.20	NA	0.00
d	Ladu	NA	December	0.20	NA	0.00
e	Pitaddu	NA	December	0.20	NA	0.00
f	Jungle/Mati alu	NA	Feb.- March	7.00	Feb.- March	3.33
g	Karu alu	NA	July	0.50	NA	0.00
h	Baitadu	NA		0.00		1.00
	Av. collection			1.10		0.54
	Total collection			2809.00		47.00
6	**Wild grasses, Flowers, Honey and Mushrooms**					
a	Channa ghasa		January	10.00	NA	0.00
b	Champa			0.00		0.08
c	Honey			0.00		0.77
d	Chattu			0.00		1.50
	Av.collection			2.50		0.59
	Total collection			6385.00		51.00

NA=Not available

Table- 3.

Food, fuel and kerosene consumption in core zone of Simlipal Biosphere Reserve

S/n	Parameters	Jenabil	Jamunagarh	Kabatghai	Bakua
1	Fuel wood (Quintals/ha/year)	398.05	737.68	3936.07	258.07
2	Rice (kg/ha/year)	7.51	37.37	45.29	8.07
3	Edible oil (kg/ha/year)	15.99	26.00	42.02	5.99
4	Kerosene (liters/ha/year)	36.00	122.00	195.00	31.00

Table- 4.

Food, fuel and kerosene consumption in buffer zone of Simlipal Biosphere Reserve

S/n	Parameters	Gudgudia	Barehipani	Nawana
1	Fuel wood (Quintals/ha/year)	1204.33	156.12	846.86
2	Rice (kg/ha/year)	13.48	4.28	10.39
3	Edible oil (kg/ha/year)	5.99	3.99	91.00
4	Kerosene (liters/ha/year)	47.00	26.00	42.00

Table 5.

Food, fuel and kerosene consumption in peripheral zone of Simlipal Biosphere Reserve

S/n	Parameters	Jamuani	Ghodabindha	Kadamsul	Lulung	Patiapada
1	Fuel wood (Quint./ha/yr)	303.74	519.12	580.93	593.88	214.53
2	Rice (kg/ha/year)	12.81	8.13	10.72	72.14	5.74
3	Edible oil (kg/ha/year)	19.99	5.99	1.99	5.00	3.00
4	Kerosene (liters/ha/year)	45.00	65.00	51.00	68.00	31.00

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