



Forest biomass flow for fuel wood, fodder and timber security among tribal communities of Jharkhand

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Abstract

The study investigated extraction and consumption pattern of fuel wood, fodder and timber and forest biomass flow for fuel wood, fodder and timber security among tribal communities in Bundu block of Ranchi district in Jharkhand (India). The study is based on personal interviews of the selected respondents through structured interview schedule, personal observations and participatory rural appraisal tools *i.e.* key informant interviews and focus group discussions carried out in the sample villages, using multi-stage random sampling technique. The study revealed that the total extraction of fuel wood from different sources in villages was 2978.40 tons annum⁻¹, at the rate of 0.68 tons per capita annum⁻¹, which was mostly consumed in cooking followed by cottage industries, heating, community functions and others. The average fodder requirement per household was around 47.77 kg day⁻¹ with a total requirement of 14227.34 tons annum⁻¹. The average timber requirement per household was computed to be 0.346 m³ annum⁻¹ accounting for a total timber demand of 282.49 m³ annum⁻¹, which is mostly utilized in housing, followed by agricultural implements, rural furniture, carts and carriages, fencing, cattle shed/ store house and others. Forest biomass is the major source of fuel wood, fodder and timber for the primitive societies of the area contributing 1533.28 tons annum⁻¹ (51.48%) of the total fuel wood requirement, 6971.55 tons annum⁻¹ (49.00%) of the total fodder requirement and 136.36 m³ annum⁻¹ (48.27%) of the total timber requirement. The forest biomass is exposed to enormous pressure for securing the needs by the aboriginal people, posing great threat to biodiversity and environment of the region. Therefore, forest biomass conservation through intervention of alternative avenues is imperative to keep pace with the current development and future challenges in the area.

Key words

Fodder, Forest biomass, Fuel wood, Timber, Tribe

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Introduction

Fuel wood, fodder and timber are the forest products most commonly used by the rural masses in different countries like India (Sharma *et al.*, 1989). Fuel wood is the universal source of energy, accounting for 60 % of the total fuel requirement in rural India (Pandey, 2002). On the other hand, livestock too is an important component of rural economy and agriculture in the country. The quality and quantity of livestock predominantly depends on the type of fodder, its quality and availability. Similarly, timber is extensively used for various purposes like housing,

agricultural implements, rural furniture, fencing, hutments, scaffolding, poles *etc.* in rural India. Thus, there is an intense demand of fuel wood, fodder and timber in rural sectors which plays an important role in socio-economic, cultural, farming and geo-environmental conditions of a region. These three types of usages at the same time are the major factors in forest and biodiversity degradation (Christopher *et al.*, 2009).

Forests represent a key component of available national and regional biomass supply in rural India. Exploitation of forest biomass is a common way for fuel wood, fodder and timber

security among forest dwellers (Khanduri *et al.*, 2002). Indiscriminate withdrawal of forest biomass is the main cause of forest degradation and environmental instability (Nabita *et al.*, 2007; Chandra *et al.*, 2008). Excessive forest biomass extraction broadens the gap between biomass increment and biomass removal resulting in localized shortages and un-sustainability of forest resources (IPCC, 2003). As the availability of forest biomass is inadequate, forest cover is limited and forest productivity is diminishing, forest biomass developments through various interventions need to be designed to cope with future pressure and to stop the further forest degradation.

Forests of Bundu block in Ranchi district of Jharkhand state have multifarious uses and constitute an important source to cater to all basic needs of life, whether it is birth, marriage, livelihood or death among tribal communities. The main tribal communities in the block are *Munda*, *Oraon* and *Lohara*. They are socially, educationally, economically and politically backward with accompanying impediments of illiteracy, poverty, malnutrition, superstitions, addictions, ignorance and exploitation (UNDP, 2002). They have their own ways of life, traditions, cultural identities and customary modes of living, closely intertwined with nature. The dependency of human populations in the forest biomass for running their livelihoods and meeting their household needs of fuel wood, fodder and timber is tremendously high and is a century old practice. The dependency of rural households on forest biomass and their diverse patterns of use have become an important topical issue in developing economies (Sapkota and Oden, 2008). On the other hand, the precise information of extraction and consumption of fuel wood, fodder and timber at national level is required for policy making and programme planning, which is very sketchy (Anon., 2011). Keeping these facts in view, the present study was conducted to explore the estimates of extraction of fuel wood, fodder and timber from various sources, assess the proportions of fuel wood, fodder and timber consumption for various purposes and ascertain biomass flow from forests for fuel wood, fodder and timber security among tribal communities in Bundu block of Ranchi district in the Jharkhand state.

Materials and Methods

Study area : The study was conducted in Bundu block (Fig. 1) of Ranchi district in Jharkhand during 2009-2010. The area lies on the undulated surface of Chhotanagpur plateau, with a total geographic area of 25097 ha. The locality falls under Bundu Range of Khunti Forest Division, with mostly northern tropical dry deciduous forests (5B/C2) as per classification of Champion and Seth (1968). The climate is tropical with three distinct seasons, summer, monsoon and winter. Average annual normal rainfall is 1413.60 mm, the mean minimum temperature is 24°C and mean maximum temperature is 37.2°C (Anon., 2009b).

Land use pattern and socio-economic profile of the sample villages : The sample villages have considerable percentages of

forest areas ranging between 11.83 to 42.81 %. The average land area under cultivation is 53.06 % of the total geographical area in the sample villages. Majority (75.74%-100%) of the population in villages are dominated by schedule tribes with an average sex ratio of 1028.22. The literacy rate varied between 24.52 to 44.87 %. Average size of land holding per household was found to be 1.89 ha. The percentage of main workers was 43.48 to 61.71 %. The sample villages have a very low infrastructure development. The educational, medical, social, economic, agriculture, irrigation, communication and transportation facilities are very poor (Anon., 2009b). The land use pattern and socio-economic profile of the sample villages is summarized in Table 1.

Household survey : Multi-stage random sampling technique was applied to select villages and respondents. Nine sample villages namely, Korda, Jojoda, Husirhatu, Banaburu, Nehalgar, Ghagrabera, Hesapiri, Roredih and Kuchidih having around 10 percent sampling intensity of the block were selected using simple random sampling technique (Ray and Mondol, 2004). A sample consisting of 164 respondents having 20 % of the total number of households comprising all categories of land holders was drawn by simple random technique from the sample villages for household survey. Household heads were treated as respondents. The data on the extraction and consumption pattern of fuel wood, fodder and timber and forest biomass flow in terms of fuel wood, fodder and timber were collected by personal interviews of the respondents, through a well-structured pre-tested interview schedule developed for the purpose, personal observations of the interviewer and participatory rural appraisal tools *i.e.*, key informant interviews and focus group discussions (Mukherjee, 1993). The collection and consumption estimates of fuel wood, fodder and timber were made at each homestead by requesting the respondents to quantify the amount of fuel wood, fodder and timber they collected from various sources and used daily for various purposes. The average annual per capita fuel wood, fodder and timber extraction and consumption were estimated by dividing household quantity by the number of individuals/ cattle in the family and calculations were made by multiplying the figures with the total population of the sample villages. Suitable statistical tests like mean (\bar{x}) and percentage (%) were used for analysis of the data (Snedecor and Cochran, 1967).

Results and Discussion

Total extraction of fuel wood from different sources in the surveyed population was found to be 2978.40 tons annum⁻¹, @ 0.68 tons per capita annum⁻¹. Out of the total extraction, 1533.28 tons annum⁻¹ secured from forests, 663.29 tons annum⁻¹ from traditional agroforestry, 450.04 tons annum⁻¹ from community forestry and rest 331.79 tons annum⁻¹ from homestead forestry (Table 2). On the whole, about 51.48 % of the fuel wood requirement was met from nearby forests and the rest 48.52 % of the fuel wood the tribal people relied on other sources such as traditional agroforestry, community forestry and homestead forestry. The local inhabitants collect dead and dry tree lops and

tops, twigs and branches, dry shrubs and leaves freely from the forests. The important trees and shrubs mostly used as fuel wood were: *Shorea robusta*, *Mangifera indica*, *Artocarpus heterophyllus*, *A. lacoocha*, *Terminalia belerica*, *T. arjuna*, *T. chebula*, *T. tomentosa*, *Cassia fistula*, *Ficus bengalensis*, *F. glomerata*, *F. religiosa*, *Semicarpus anacardium*, *Anogeissus latifolia*, *Mallotus philippinensis*, *Syzygium cumini*, *Bauhinia variegata*, *B. purpurea*, *Adina cordifolia*, *Diospyros melanoxylon*, *Acacia catechu*, *A. nilotica*, *Schleichera oleosa*, *Madhuca indica*, *Ougeinia dalbergiodes*, *Butea monosperma*, *Pterocarpus marsupium*, *Litsaea polyantha*, *Buchanania lanzan*, *B. angustifolia*, *Boswellia serrata*, *Bombax ceiba*, *Albizia procera*, *A. lebbeck*, *Lagerstroemia parviflora*, *Zizyphus jujuba*, *Dendrocalamus strictus*, *Pongamia pinnata*, *Aegle marmelos*, *Azadirachta indica*, *Spondias mangifera*, *Tamarindus indica*, *Anthocephalus cadamba*, *Cedrela toona*, *Morus alba*, *Dalbergia sissoo*, *Bambusa arundinacea*, *Careya arborea*, *Gmelina arborea*, *Melia azedarach*, *Alstonia scholaris*, *Annona squamosa*, *Antidesma diandrum*, *Indigofera arborea*, *Alangium*

salviifolium, *Carissa carandus*, *Phoenix acaulis*, *Lantana camara*, *Clausena excavata*, *Emblca officinalis*, *Zizyphus mauritiana*, *Carissa opeca*, *Schrebera swietenoides*, *Vitex negundu*, *Xylosoma longifolium*, *Wrightia tomentosa*, *Croton oblongifolius*, *Elaeodendron glaucum*, *Casearia graveolens*, *Nyctanthes arbortristis* and few others. The tree preference for fuel wood among local people and availability of these fuel wood species in the area influence their contribution in total fuel wood consumption.

The fuel wood collected was mostly consumed in cooking (2419.35 tons annum⁻¹) followed by cottage industries (227.85 tons annum⁻¹), heating (204.32 tons annum⁻¹), community function (93.52 tons annum⁻¹) and the rest 33.36 tons annum⁻¹ for other purposes such as household rituals e.g. marriage, child birth, child christening, death, ancestral worship etc. and religious functions namely, worship of God and Goddess, festivals, coercing of evil spirits and witchcraft etc. (Table 2.). Cooking is the major area where 81.23 % of the total fuel wood is consumed

Forest resource map of Bundu Block

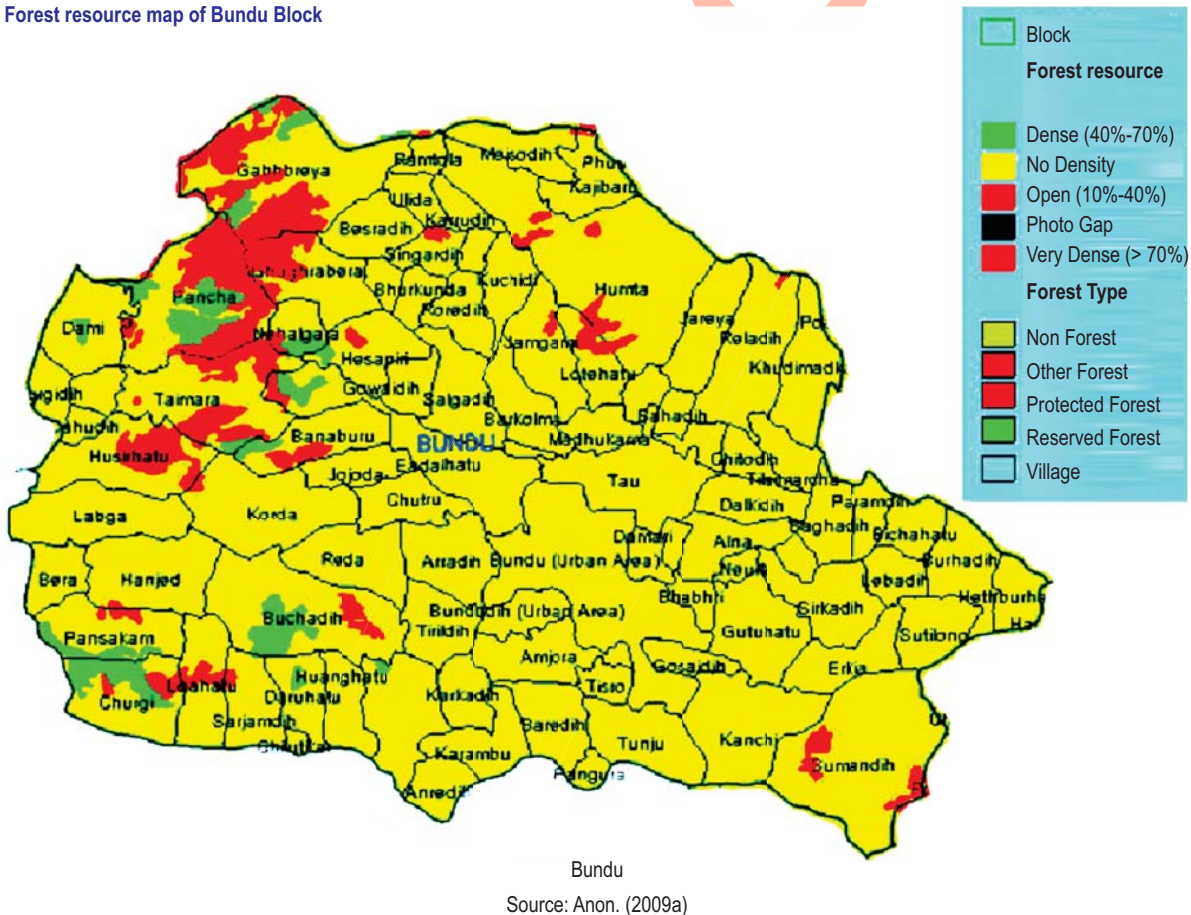


Fig. 1 : Location of the study area in Bundu block of Ranchi, India

whereas combined share of cottage industries, heating, community function and other purposes in total fuel wood consumption was calculated to be 18.77 % only. The fuel wood was consumed mostly for cooking food and preparing feed for cattle and pig, cottage industries namely, preparation of parboiled (*Usna*) rice, rice flakes (*Chura*), puffed rice (*Murhi*) and parched rice (*Lava*), brewing *mahua* (*Madhuca latifolia*) liquor, distillation of rice liquor (*Handia*), preparation of iron tools, bakery, pottery,

brick manufacture, preparation of folk medicines, hotels, tea stalls etc., heating, community functions e.g. festivals, feasts etc. and some other purposes such as marriage, child christening, washing clothes by boiling with detergents and fuel wood ashes etc.

Fuel wood was the principal source of energy constituting maximum share in total bio-fuel (fuel wood, dung cake, biogas, charcoal and crop waste) consumption among the tribal people,

Table 1 : Land use pattern and socio-economic profile of the sample villages in Bundu block of Ranchi, India

Particulars	Villages								
	Korda	Jojoda	Husirhatu	Banaburu	Nehalgara	Hesapiri	Roredih	Kuchidih	Ghagrabera
Land use (ha)									
Village area	617.58	185.40	497.63	322.49	143.33	308.23	195.59	211.67	397.02
Forest	264.37	21.93	242.84	65.56	31.03	54.20	24.48	44.79	70.30
Cultivable waste	115.85	22.56	15.58	19.99	24.41	16.39	20.26	39.25	33.22
Other uses	27.48	23.10	25.77	21.36	15.07	22.22	20.74	26.43	42.12
Net sown	209.88	117.81	213.44	215.58	72.82	215.42	130.11	101.20	251.38
Irrigated	11.18	18.06	11.89	77.12	2.02	3.90	1.25	10.73	35.34
Un-irrigated	198.70	99.75	201.55	138.46	70.80	211.52	128.86	90.47	216.04
Human Population (no.)									
Households	196	60	110	122	63	83	34	77	71
Total population	973	305	629	682	360	431	161	378	467
Male	400	125	292	294	148	183	62	156	202
Female	424	138	264	279	143	190	76	154	208
Children	149	42	73	109	69	58	23	68	57
Sex ratio									
ST	1080	1104	897	973	893	1000	1277	1000	1030
SC	-	-	-	821	-	-	-	-	-
Others	973	-	1091	1056	1308	1778	1067	920	-
All	1060	1104	904	949	966	1038	1226	987	1030
Literacy (no.)									
Total	241	118	248	239	77	146	55	76	180
Male	190	74	172	173	57	95	33	55	126
Female	51	44	76	66	20	51	22	21	54
Caste structure (no.)									
ST	678	263	533	434	231	348	107	262	410
SC	-	-	-	102	-	-	-	-	-
Others	146	-	23	37	60	25	31	48	-
Land holding (households)									
Landless	17	2	2	5	5	-	-	5	-
Marginal	102	24	52	45	29	28	10	34	22
Small	44	18	24	36	17	26	9	24	18
Medium	25	10	22	28	9	18	8	9	16
Large	8	6	10	8	3	11	7	5	15
Employment status (no.)									
Total workers	481	158	252	313	142	224	60	171	253
Main	319	111	121	296	65	131	28	104	140
Marginal	162	47	131	17	77	93	32	67	113
Non-workers	343	105	304	260	149	149	78	139	157

Source: Anon. (2009b)

constituting a vital input for all productive economic activities (Sarmah and Arunachalam, 2011; Sati and Song, 2012). The local people generally depended on fuel wood for those purposes as they had less access to other energy sources such as LPG, kerosene, coal *etc.* (Bijalwan *et al.*, 2011). The major forms in which fuel wood was consumed in domestic works and rural industries were billets, twigs, wood shavings, saw dust and even leaves. In addition to fuel wood, people also relied on animal dung and crop residues for household energy requirements. The findings were not unusual and a significant number of studies across the world had demonstrated the dependence of forest dwellers on forests for fuel wood security (Negi *et al.*, 1996; Singh and Sundriyal, 2009; Islam *et al.*, 2011; Banyal *et al.*, 2013).

This study revealed substantial pressure on forests for meeting fuel wood requirement of the tribal people due to easy accessibility of forest resources and lack of low cost alternative sources of energy supply. The current production of fuel wood from forests, traditional agroforestry, community forestry and homestead forestry in the study area was inadequate and could not combat fuel wood demand of population in the on-going scenario (Sivaji, 2009). Some alternative interventions were required to be implemented efficiently to keep pace with the current development and future challenges (Gupta, 2002).

The total livestock population in the villages was 9895, of which 1089 were bullocks, 1662 cows, 392 buffaloes, 2519 goats, 187 sheeps, 287 pigs, 3546 poultry, 204 ducks and 09 turkeys (Table 3.). The livestock sector, apart from contributing to food and nutritional security, had good potential for improving the socio-economic condition of the people. The tribal people reared livestock for animal products such as milk, ghee, meat, dung,

manure *etc.* ploughing, religious sacrifices, entertainment, propitiation of gods and celebrations. The forests in vicinity of the villages offered plenty of grazing grounds with enough fodder availability for livestock rearing.

There was no managed pasture or fodder production unit in the surveyed area. Grazing in nearby forest areas was common practice among all the livestock owners. The livestock owners grazed their animals from dawn to dusk to provide sufficient feed to their livestock. As regards stall feeding, the livestock farmers generally used paddy straw, fodder grasses, weeds and other agricultural residues collected from agricultural fields and homesteads, lops and tops of trees and shrubs and by-products of cereals and pulses, bran, oil cakes *etc.* for their livestock. Such poor feeding reduced the quality and quantity of livestock products resulting in low economic return.

The average fodder requirement per household was estimated to be 47.77 kg day⁻¹ with an annual requirement of 14227.34 tons of fodder in the region. The livestock owners procured about 7255.79 tons of fodder annum⁻¹ inclusive of about 4277.39 tons annum⁻¹ paddy straw and 2978.40 tons annum⁻¹ green grasses, weeds and other agricultural residues from agricultural fields and homesteads for their animals (Table 4). Forest grazing was the main source of fodder availability contributing 6971.55 tons of fodder annum⁻¹ (49.00%) of the total fodder requirement. Low economic condition, unavailability of pastures or fodder production unit and ignorance towards green fodder production resulted in higher intensity of grazing in the forests of this area. To relieve forests from the pressure of over-grazing alternate source of fodder production should be developed and the existing land resources should be efficiently

Table 2 : Fuel wood extraction and consumption in the sample villages of Bundu block in Ranchi, India

Source	Extraction			Consumption	
	Quantity (Tons annum ⁻¹)	Percentage	Purpose (Tons annum ⁻¹)	Quantity	Percentage
Forests	1533.28	51.48%	Cooking	2419.35	81.23%
Traditional agroforestry	663.29	22.27%	Cottage industries	227.85	7.65%
Community forestry	450.04	15.11%	Heating	204.32	6.86%
Homestead farming	331.79	11.14%	Community function	93.52	3.14%
-	-	-	Others (Household rituals, religious function and washing clothes)	33.36	1.12%
Total	2978.40	100%	Total	2978.40	100%

Table 3 : Livestock composition in the sample villages in Bundu block of Ranchi, India

Particular	Livestock									Total
	Bullock	Cow	Buffaloes	Goat	Sheep	Pigs	Poultry	Duck	Turkey	
Population	1089	1662	392	2519	187	287	3546	204	09	9895
Percentage	11.01	16.80	3.96	25.46	1.88	2.90	35.84	2.06	0.09	100

Source: Anon. (2009b)

Table 4 : Fodder availability and consumption in the sample villages of Bundu block in Ranchi, India

Availability		Consumption	
Fodder	Quantity (Tons annum ⁻¹)	Animal	Quantity (Tons annum ⁻¹)
Paddy straw	4277.39 ^a	Bullock	3974.85
Green grasses, weeds, other agricultural residues, tree foliage etc.	2978.40 ^b	Cow	6066.30
Forest herbage (Grazing)	6971.55 ^c	Buffaloes	1716.96
Others (Oilseed cakes, bran etc.)	N.A.	Goat + Sheep	2469.23
Total	14227.34		14227.34 ^d

^a@ 28 quintals ha⁻¹; ^b@ 10 kg Household⁻¹ day⁻¹; ^c14227.34 – 7255.79 (4277.39 + 2978.40) = 6971.55; ^d@10 kg day⁻¹ bullock⁻¹ or cow⁻¹, @ 12 kg day⁻¹ buffalo⁻¹, @ 2.5 kg day⁻¹ goat⁻¹ or sheep⁻¹ (Singh et al., 2008); N.A. = Not Available

Table 5 : Timber extraction and consumption in the sample villages of Bundu block in Ranchi, India

Source	Extraction			Consumption	
	Quantity (m ³ annum ⁻¹)	Percentage	Purpose	Quantity (m ³ annum ⁻¹)	Percentage
Forests	136.36	48.27%	Housing	124.66	44.13%
Traditional agroforestry	69.09	24.46%	Agricultural implements	82.71	29.28%
Community forestry	41.33	14.63%	Rural furniture	35.25	12.48%
Homestead forestry	35.71	12.64%	Carts and carriages	17.60	6.23%
-	-	-	Fencing	10.23	3.62%
-	-	-	Cattle shed/ store house	9.10	3.22%
-	-	-	Others (Scaffolding/ ladder/ cremation etc.)	2.94	1.04%
Total	282.49	100%	Total	282.49	100%

exploited to get additional grass fodder, tree foliage, herbage etc. in the area. Contribution of forest biomass in mitigation of fodder requirements of rural areas was emphasized by several workers (Bijalwan et al., 2011; Panta et al., 2011; Sati and Song, 2012; Ajake and Enang, 2012).

The villagers primarily required small timber for house construction and repair, agricultural implements, rural furniture, hutments and fencing in the surveyed area. It was observed that 10 small timbers having a length of 3-5 m and a diameter of 8-13 cm were commonly utilized annually to meet household timber requirement. The average timber requirement per household was worked out to be 0.346 m³ annum⁻¹, accounting for a total timber demand of 282.49 m³ annum⁻¹. The neighbouring forests (136.36 m³ annum⁻¹) were the main source of timber supply followed by traditional agroforestry (69.09 m³ annum⁻¹), community forestry (41.33 m³ annum⁻¹) and homestead forestry (35.71 m³ annum⁻¹) among the tribal population (Table 5).

The forests alone contributed 48.27 percent of the total timber requirement while the remaining 51.73 percent of the timber requirement was fulfilled by traditional agroforestry, community forestry and homestead forestry. *Bambusa arundinacea* and *Dendrocalamus strictus* collected from bamboo stand played a vital role as house building material especially for roofing. The results enunciated that there was a considerable

pressure on forests for meeting timber requirement of the aboriginal people. Acute poverty, low literacy and awareness, substandard socio-economic conditions, traditional severity, easy accessibility of forests among tribal people and availability of inadequate markets, communication and transportation facilities in the area hindered them to access substitute of timber for their household consumption.

The timber extracted was mostly utilized in housing (124.66 m³ annum⁻¹), followed by agricultural implements (82.71 m³ annum⁻¹), rural furniture (35.25 m³ annum⁻¹), carts and carriages (17.60 m³ annum⁻¹), fencing (10.23 m³ annum⁻¹), cattle shed/ store house (9.10 m³ annum⁻¹) and others such as scaffolding/ ladder/ cremation etc. (2.94 m³ annum⁻¹) by the tribal people of the area (Table 5). Construction of *katcha*, mixed or *pucca* houses, making agricultural implements such as ploughs, harrows, rollers, clod-crushers, tool handles etc., manufacture of low cost rural furniture such as chairs, stools, desks, tables, benches, beds, shelves, lockers etc. are the main sectors where major fraction of the timber was consumed. Requirement of timber for other purposes such as carts and carriages making, fencing of agricultural fields and homesteads, preparation of cattle shed/ store house and making scaffolding, ladder etc. and cremation was comparatively low. Important tree species utilized to meet day by day timber requirement were *Shorea robusta*, *Dalbergia sissoo*, *Gmelina arborea*, *Pterocarpus marsupium*,

Acacia nilotica, *Anogeissus latifolia*, *Ougeinia dalbergioides*, *Mangifera indica*, *Artocarpus heterophyllus*, *A. lacoocha*, *Terminalia belerica*, *T. arjuna*, *T. chebula*, *T. tomentosa*, *Mallotus philippinensis*, *Syzygium cumini*, *Albizia procera*, *A. lebeck*, *Lagerstroemia parviflora*, *Zizyphus jujuba*, *Pongamia pinnata*, *Aegle marmelos*, *Azadirachta indica*, *Tamarindus indica*, *Anthocephalus cadamba*, *Cedrela toona* and *Melia azedarach* etc. A number of workers have earlier reported enormous pressure on forest biomass for timber security among rural communities (Sapkota and Oden, 2008; Sarmah and Arunachalam, 2011; Sati and Song, 2012).

Forest biomass was the major source of fuel wood, fodder and timber for primitive societies of the area contributing 1533.28 tons annum⁻¹ (51.48%) of the total fuel wood requirement, 6971.55 tons annum⁻¹ (49.00%) of the total fodder requirement and 136.36 m³ annum⁻¹ (48.27%) of total timber requirement (Fig. 2). Thus, fuel wood, fodder and timber biomass flow from forests to the sample villages was excessive as compared to the national estimates of fuel wood (27.14%), fodder (38.49%) and timber (6.62%) flow (Anon, 2011), creating threat to biodiversity conservation and ecological stability of the adjoining forests of the area. Over-utilization of forest biomass by local populace is leading to depletion of forest resources and diminished biomass productivity which, in turn, induced socio-economic and livelihood stress.

The entire population traditionally depended mostly on forest biomass for their fuel wood, fodder and timber security having no any alternate source to replace the forest biomass for their daily uses in the region. The current trend of forest biomass flow could not meet the future need of increasing human and animal population. The threat to forest biomass sustainability and environmental degradation could be avoided by the intervention of alternative avenues like biogas production, agroforestry plantation of multipurpose trees and shrubs (MPTS) on

agricultural bunds, energy plantation of MPTS, pasture development, timber plantation of Gamhar (*Gmelina arborea*) and teak (*Tectona grandis*) and establishment of block plantation of bamboos (*Bambusa arundinacea* and *Dendrocalamus strictus*) on cultivable waste land, transformation of traditional agroforestry and homestead forestry to modern and efficient utilization and management of village common lands. The implementation of these interventions would relieve the pressure of fuel wood, fodder and timber on forest biomass to a great extent in the area. The earlier studies of Sharma *et al.* (1989), Kumar *et al.* (2010), Ajake and Enang (2012) and Sati and Song (2012) focusing on forest biomass flow, reported widespread use of forest resources by rural households to meet their daily fuel wood, fodder and timber needs.

The findings reflect that fuel wood, fodder and timber security of tribal communities have traditionally been dominated by forest biomass. Forest biomass is experiencing very huge pressure for securing fuel wood, fodder and timber demands of the aboriginal people, creating severe biodiversity and environmental stress. The tribal people are in underprivileged condition, having very limited infrastructure restricting them to access substitute of forest biomass for their household consumption. Therefore, forest biomass conservation is imperative to keep pace with the current development and future challenges. There is massive potential to relieve biomass pressure on forests and mitigate environmental stress by the intervention of alternative avenues like biogas production, agroforestry plantation, energy plantation, pasture development, timber plantation, block plantation of bamboos, transformation of traditional agroforestry and homestead forestry to modern and efficient exploitation of village common lands. The intervention visualized needs to be implemented efficiently for fuel wood, fodder and timber security of tribal people and ecological stability in the study area.

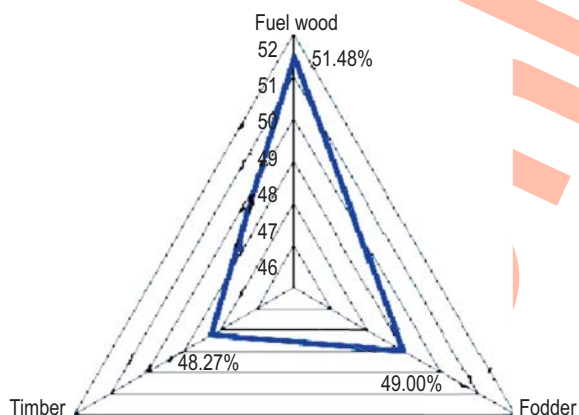


Fig. 2 : Forest biomass flow for fuel wood, fodder and timber security in the sample villages of Bundu block in Ranchi, India

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