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Conservation Crisis in Marat Longri Wildlife Sanctuary, Assam, India

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Study Area: Marat Longri Wildlife Sanctuary, India

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Abstract

People-forest interactions in protected area have been debated around the world. The present study evaluates land-use pattern, diversity and utilization of forest resources in Marat Longri Wildlife Sanctuary (WLS) using semi-structured interview, remote sensing, and Global Information System (GIS) techniques. Such study can have many implications on people-forest interactions in the sanctuary and promote symbiotic approach in dealing with biodiversity conservation in protected area. Marat Longri WLS is indispensable to forest dwellers for subsistence and livelihoods. The result of pair-wise ranking revealed *jhum* (3160) is the major threat to forest cover followed by illegal felling (2850), agricultural expansion (2346), encroachment (2211) and collection pressure (2080). To reduce dependence on Marat Longri WLS, domestication of wild plants and other agroforestry systems can augment food production and realize other needs of forest dwellers.

Introduction:

Today, forest degradation is amongst the major global environmental issue by which vast areas of forest cover are being lost on a daily basis. The Convention on Biological Diversity (CBD) calls for the establishment of a system of Protected Areas (PA) to conserve the biological diversity (Krishna & Reddy, 2010). But in contrast, many PAs in the world are degrading and losing the very values for which it was originally established (CBD, 2004). The sample study of protected areas at the global level has shown that 1% of PAs are secure in long-run (CBD, 2004); because many PAs are inhabited by the human. They claimed such areas as their homeland, source of subsistence and livelihoods. The rationing and control over resource utilization and other human activities in PAs lead to misunderstanding and conflicts between PA Managers and people. The existence of human race is only ensured by conservation of PA which encompasses conservation and protection of biological diversity, natural gene pools, biogeochemical processes and the natural cycles acting as power of resilience to sustain life on earth. The United Nations Framework Convention on Climate Change (UNFCCC) 2009 and 2010 encourages developing countries to identify the land-use pattern and forestry activities, in particular, those that are linked to the drivers of deforestation and forest degradation, and to assess their potential contribution to the climate change (Latawiec &

Agol, . Despite its relevance, quantitative national-level information on drivers and activities causing deforestation and forest degradation are widely unknown in many developing and under-developed countries. Most scientific research are based on local-scale studies or regional to global assessments (Geist & Lambin, 2001; De Fries *et al.*, 2010, Boucher *et al.*, 2011), highlighting the importance of differences between proximate or direct drivers and indirect causes. In recent times, Remote Sensing and Geographical Information System (GIS) techniques are becoming an assessment and management tool for observing the changes in the forest cover, classification of forest and the ecosystems by using Forest Transition Model (Assessment Method). It also helps to prioritise the efforts of conservation and mitigation of the issues by integrating the spatial and non-spatial information (Salem, 2003; Ambastha & Jha, 2010; Pattanaik *et al.*, 2010; Roy *et al.*, 2013). Marat Longri Wildlife Sanctuary (WLS) in Karbi Anglong district, Assam provides an apt case for investigating people-forest interactions. About 98 villages belonging to seven ethnic groups are located within and on the fringe of the sanctuary. The forest resources are the main source of subsistence and livelihoods to the inhabitants as agricultural land is limited and food production is not adequate for the whole year. This demands higher dependence on forest resources for food, livelihood,

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construction and other requirements (Kar & Borthakur, 2007; Phangchopi *et al.*, 2014, 2015). Land-use pattern particularly slashes and burn agriculture (*Jhum*), encroachment and conversion of forest into agricultural land are major factors contributing to a loss of biodiversity, over-exploitation and habitat modification or fragmentation in this PA. Forest status map of 2012 for the sanctuary showed large-scale fragmentation and encroachment (Fig.-1). In the above context, there is a pressing need for effective conservation strategy in Marat Longri WLS without disrupting the socio-cultural practice of the forest inhabitants. Also, it is important to understand how the spatial distribution of disturbance regimes reached its current state for initiating effective measures of conservation. The state of Assam located in the north-east of India has an area of 78,438 km² and based on the satellite data analysis by Assam Remote Sensing Application Centre (ARSAC) the state had an area of 19,766.38 km² (25.2%) under forest-cover during 1980-82 and subsequently declined to 17,263.87 km² (21.98%) for which the status of PAs is not bright. The Reserved Forests occupy around 15,030.18 km² accounting for 19.14 percent of the State's total geographical area (Talukdar, 2014). Though the national goal is to have a minimum of one-third of the total geographical area of the country under forest or tree cover but the shrinkage of Reserve forest or PAs (which is considered to be natural forest) is a major concern in the present day. The scenario within the notified PAs reveals a gloomy state in terms of degradation during last two decades under various biotic pressures. The present study evaluated the land-use pattern, diversity, and utilization of forest resources in Marat Longri WLS. The study further assessed drivers of forest/habitat degradation and suggests for an exigent conservation of the sanctuary.

Materials and methods:

Study area: Marat Longri Wild Life Sanctuary was established on 17th April 2003 with a geographical area of 451.00 km². The sanctuary comprises four Reserved Forests (RF); namely - Mijungdisa RF, Disama RF, Kaki RF and Inglongkiri RF. The sanctuary is an integral part of Dhansiri-Lumding elephant reserve and the famed Inglongkiri sacred grove. The vegetation is of semi-evergreen and moist-deciduous types. Important fauna include *Pyxidea mouhotii*, *Manouria emys*, *Python molurus*, *Ophiophagus hannah*, *Hoolock hoolock*, *Macaca*

nemestrina, *Macaca arctoides* and *Trachypithecus pileatus*. *Dimocarpus longam*, *Gnetum gnemon* and *Rhaphidophora calophylla* (endemic to Northeastern region of India) are significant flora. About 98 villages belonging to seven ethnic groups (Karbi, Dimasa, Hmar, Garo, Chakma, Nepali and Adivasi) are located with 52 villages inside the sanctuary and 46 villages in the fringes of the sanctuary. As per 2011 census, the

population figure is 4361 (male: 2283; female: 2078). Population record of ethnic groups in the Sanctuary is not adequate as no such information is available in local forest department. The people practice *Jhum* farming by clearing forest and other vegetation. Food insecurity being a common problem for scarce agricultural land, they often exploit forest resources to supplement food scarcity, nutritional and other requirements.

Data collection and Analysis: Indian Remote Sensing (IRS) P6 LISS-IV multi-season datasets of 2013 have been used to infer vegetation types and land-use mapping on 1: 50,000 scale in addition to Landsat images. Village land boundaries were studied with the help of maps from local Forest Department. Geo-referenced Survey of India maps and layers were uploaded into a GIS program (ArcGIS 10.1) to create and integrate information with aerial photograph and data collected in the field. Eighty farmers from the four RFs were interviewed (semi-structure) to record land-use pattern and extraction of resources from forests; this is followed by visits to *Jhum* fields and forest areas for personal observation of the anthropogenic activities. Informants were selected on the criterion that, the farmer been practicing *Jhum* agriculture for ten or more years. To understand threat perceptions to forest cover and biodiversity, a pair-wise ranking was carried out and the number of possible pairs was calculated using the relation $N(N-1)/2$, where N is the number of factors (threats). Data were presented in table and graph.

Results and Discussion:

Diversity and utilization of forest resources in Marat Longri WLS : Forest dwellers in Marat Longri WLS are farmers and essentially depend on the protected area for subsistence and livelihoods. Major use categories of forest products included food, medicines, construction, fuelwood and fodder. Besides, they use forest land as grazing fields for domestic animals. However, utilization of plant resources is more prominent over animal resources. Following semi-structured interview and forest walks the present study, ninety-three (91) plants

Figure-1: a) Various forest types in Marat Longri WLS
b) Satellite image showing same in Marat Longri WLS

RESEARCH ARTICLE

with dietary use were recorded from ethnic groups residing in the sanctuary. Almost all parts are consumed-leaves (36), tender shoot (24), fruits (30), tuber (9), bark (6), inflorescence (5), petiole (2), root (4), whole plant (2), seed (2), stem (1) and stolon (1) (Fig. 2). Enumeration of plants used by ethnic groups is presented in Table 3. Tubers of *Dioscorea* species are the most extensively collected plant resource during the scarcity of the staple food. In addition to food value, many forest resources have trade value in local markets and generate income for poor families. Many wild plants are used for primary health care and forty-one (41) plants from the sanctuary listed in local pharmacopeia are used for treatment of varied ailments like ear-ache, fever, cough and cold, rheumatism, dysentery, burns, cuts, wounds, skin diseases, eye-complaints, jaundice, poisons and many others (Phangchopi *et al.*, 2015). Herbal prescriptions are diverse and being administered as juice, maceration, decoction, paste, ash, poultice, fumes, oil, gum, resin, etc. Some plants (*Spilanthes paniculata*, *Amomum aromaticum*, *Blumia lanceolaria*) are used in aroma therapy and as baths.

Figure-2: Pie graph showing distribution of plant parts used as food by local inhabitant.

Habitat degradation: Change in land-use pattern particularly *Jhum* (shifting cultivation) and agricultural expansion, encroachment, unsustainable collection practices, illegal felling and animal grazing are potent threats to the sanctuary. The *Jhum* (Fig. 3) practice begins with the clearing of a patch of forest vegetation and subsequent burning of the dried biomass (slash). Farmers operate minimum tilling with crude implements and sow seeds of multiple crops, paddy being the major one. After one or two crops farmers shift to a new forest plot to start another *Jhum* cycle. The *Jhum* operations lead to loss of forest cover and fragmentation of habitat. Along with mature trees, many biota like epiphytes, lianas, arboreal animals and microbes are also eliminated. Fragmentation prevents free movement of fauna and depletion of their natural habitat and niche. Due to the removal of vegetation, the soil is exposed and prone to erosion during monsoon. Surface run-off removes the top soil rendering the soil infertile. This compels farmers to shift from one

Figure-3: *Jhum* activities inside Marat Longri WLS

Figure-4: Agricultural expansion in Marat Longri WLS

place to another in search of a new fertile plot of land. The soil becomes barren for many years and provides a perfect platform for invasion by exotic species or weeds. *Jhum* also contributes to the emission of a large volume of carbon to the atmosphere. Low lying areas, valleys, and marshes are converted to agricultural land (Fig. 4) leading to further loss of potential habitats. Open livestock grazing has hindered regeneration of forest and converted natural forest into grassland (Fig. 5). Unsustainable collection pressure has been the cause of loss of many wild edible resources. The majority of the collectors are female and children; being unable to climb up onto the tree cut the trunk for harvesting the leaves and fruits (example *Dillenia indica*, *Garcinia* species, *Parkia roxburghii* etc.). Such activity leads not only the loss of the tree but also causes loss of habitat for many epiphytic plants and arboreal animals. In the case of *Parabaena sagitta*, *Rapidophora callophyla* and *Momordica charantia* whole plant are uprooted to collect leaves and fruits. Illegal extraction of timber (Fig. 6) is a major intervention in the forest ecosystem. As mature trees are felled, the source of seeds decreases and flora and fauna are displaced. As stated by informants, encroachment, monoculture and agricultural expansion are a major threat to the sanctuary. Forests have been encroached for human settlements (Fig. 7) the trend being most alarming in Kaki and Mijungdisa RFs (Table 1). *Jhum* operations have resulted in the clearing of more forest areas; agricultural expansion has destroyed low-lying or marshy habitats.

Table 3: Diversity of wild plant foods used by ethnic groups in Marat Longri WLS.

S.n.	Botanical name	Family	Parts used	Uses
1.	<i>Albizia myriophylla</i> Benth.	Mimosaceae	Bark	Fermentation starter cake
2.	<i>Aegle marmelos</i> (L.) Corr.	Rutaceae	Fruit	Eaten raw, purgative, cattle feed
3.	<i>Alpinia allughas</i> (Retz.) Rosc. Griseb.	Zingiberaceae	Tender shoot	Vegetable
4.	<i>Alternanthera philoxeroides</i> (Mart.)	Amaranthaceae	Tender shoot	Vegetable, paste for cattle wounds.
5.	<i>Alternanthera sessilis</i> (L.) R.Br. ex D.C.	Amaranthaceae	Tender shoot	Vegetable, juice given in jaundice and liver problem
6.	<i>Amorphophalus sylvatica</i> (Roxb.) Schott.	Araceae	Tuber	Cooked with dry fish or alkali, pig feed
7.	<i>Amphineuron opulentum</i> (Kaulf) Holtt.	Thelypteridaceae	Leaf	Vegetable, insecticides.
8.	<i>Antidesma acidum</i> Retz.	Euphorbiaceae	Leaf	Vegetable
9.	<i>Artocarpus lakoocha</i> Roxb.	Moraceae	Bark, leaf	Masticatory, fodder
10.	<i>Azadirachta indica</i> A. Juss.	Miliaceae	Leaf	Chutney, medicine for skin disease and pimples
11.	<i>Baccaurea ramiflora</i> Lour.	Euphorbiaceae	Fruit, leaf	Leaf as vegetable, fruit eaten raw, fodder
12.	<i>Bambusa</i> sp.	Poaceae	Tender shoot, leaf	Vegetable, fodder
13.	<i>Bauhinia racemosa</i> Lamk.	Caesalpiniaceae	Leaves, tender shoot	Chutney, fodder
14.	<i>Bauhinia variegata</i> L.	Caesalpiniaceae	Leaf	Chutney, fodder
15.	<i>Blumea</i> sp.	Asteraceae	Leaf	Vegetable, medicine for rheumatic fever, also used as painkiller
16.	<i>Callicarpa arborea</i> Roxb.	Verbenaceae	Bark	Masticatory
17.	<i>Calotropis gigantea</i> (L.) R. Br. Ex Ait.	Asclepiadaceae	Leaf	Cooked along with alkali
18.	<i>Capsicum frutescens</i> L.	Solanaceae	Fruit, leaf	Vegetable, spice, medicine for caught.
19.	<i>Centella asiatica</i> (L.) Urban	Apiaceae	Leaf	Vegetable, raw leaf is consumed to relief stomach disorder.
20.	<i>Cephalandra indica</i> Naud.	Cucurbitaceae	Fruit	Vegetable, also eaten raw, cattle feed
21.	<i>Cinnamomum verum</i> Presl.	Lauraceae	Bark	Spice
22.	<i>Citrus maxima</i> (Burm.) Merr.	Rutaceae	Fruit	Eaten raw
23.	<i>Citrus</i> sp.	Rutaceae	Fruit	Eaten raw
24.	<i>Clerodendrum colebrookianum</i> Walp.	Verbinaceae	Tender shoot	Vegetable, medicine for hypertension
25.	<i>Coix gigantea</i> J.G. Konig ex Roxb.	Poaceae	Whole plant, fruit	Famine food, fodder
26.	<i>Colocasia esculenta</i> (L.) Schott	Araceae	Stolon, petiole, leaf	Vegetable, pig feed
27.	<i>Combretum roxburghii</i> Spreng.	Combretaceae	Bark	Masticatory
28.	<i>Commelina benghalensis</i> L.	Commelinaceae	Tender shoot	Vegetable, cattle feed
29.	<i>Costus speciosus</i> (Koen.) J.E. Smith	Zingiberaceae	Rhizome, stem, leaf	Vegetable, boiled root juice for urinary stone cases, hot fomentation of stem juice is used as ear-drop against ear-ache
30.	<i>Croton joufra</i> Roxb.	Euphorbiaceae	Leaf	Fermentation starter cake
31.	<i>Deeringia amaranthoides</i> (Lamk.) Merr.	Amaranthaceae	Tender shoot	Vegetable
32.	<i>Dillenia indica</i> L.	Dilleniaceae	Fruit	Vegetable, medicine for dysentery
33.	<i>Dillenia pentagyna</i> Roxb.	Dilleniaceae	Fruit	Eaten raw
34.	<i>Dillenia scabrella</i> Roxb.	Dilleniaceae	Fruit	Eaten raw
35.	<i>Dioscorea alata</i> L.	Dioscoreaceae	Tuber, leaf	Famine food, fodder
36.	<i>Dioscorea esculenta</i> (Lour.) Burk.	Dioscoreaceae	Tuber, leaf	Famine food, fodder
37.	<i>Dioscorea glabra</i> Roxb.	Dioscoreaceae	Tuber, leaf	Famine food, fodder
38.	<i>Dioscorea pentaphylla</i> L.	Dioscoreaceae	Tuber, leaf	Famine food, fodder
39.	<i>Diplazium esculentum</i> (Retz.) Sw.	Athyriaceae	Leaf	Vegetable
40.	<i>Eilingeralo roglosa</i> (Gagnet.) R.M.Sm.	Zingiberaceae	Root	Masticatory
41.	<i>Emblica officinalis</i> Gaertn.	Euphorbiaceae	Fruit	Eaten raw, medicine for hair fall, stomach trouble
42.	<i>Enhydra fluctuans</i> Lour.	Asteraceae	Tender shoot	Vegetable, used in stomach trouble, paste of leaf for skin disease, consumption of raw leaf is good for eye site, fodder
43.	<i>Ficus hispida</i> L.f.	Moraceae	Leaf	Vegetable
44.	<i>Garcentia lancifolia</i> Roxb.	Clusiaceae	Fruit	Eaten raw
45.	<i>Garcinia pedunculata</i> Roxb.	Clusiaceae	Fruit	Eaten raw
46.	<i>Garcinia tinctoria</i> (DC.) W.F. Wight	Clusiaceae	Fruit	Eaten raw
47.	<i>Gnetum gnemon</i> L.	Gnetaceae	Fruit, leaf	Vegetable, fruit eaten after roasting
48.	<i>Gymnopetalum cochinchinense</i> (Lour.) Kurtz	Cucurbitaceae	Fruit, leaf	Chutney

S.n.	Botanical name	Family	Parts used	Uses
49.	<i>Hodgsonia macrocarpa</i> (Bl.) Cogn. [	Cucurbitaceae	Seed	Chutney
50.	<i>Homalomena aromatica</i> Schott	Araceae	Leaf, tuber	Vegetable, pig feed
51.	<i>Houttuynia cordata</i> Thunb.	Saururaceae	Leaf	Vegetable
52.	<i>Ipomoea aquatica</i> Forsk.	Convolvulaceae	Tender shoot, leaf	Vegetable, leaf juice is given for blood purification, fodder
53.	<i>Laportea interrupta</i> (L.) Chew.	Urticaceae	Leaf, root	Leaf as vegetable, roots as anthelmintic, vegetable, fodder
54.	<i>Lasia spinosa</i> (L.) Thw.	Araceae	Leaf	Vegetable
55.	<i>Mangifera sylvatica</i> Roxb.	Anacardiaceae	Fruit	Eaten raw; fodder
56.	<i>Maranta arundinacea</i> L.	Marantaceae	Tuber	Famine food, to increase lactation.
57.	<i>Momordica charantia</i> L.	Cucurbitaceae	Leaf, fruit	Vegetable, juice for dysentery; leaf in fermentation starter cakes.
58.	<i>Momordica cochinchinensis</i> (Lour.) Spreng	Cucurbitaceae	Fruit, tender shoot	Vegetable
59.	<i>Monochoria hastata</i> (L.) Solms	Pontederiaceae	Tender shoot, leaf	Vegetable, leaf juice for curing boils, fodder
60.	<i>Murraya koenigii</i> (L.) Spreng	Rutaceae	Leaf	Vegetable, curry flavour, medicine for constipation
61.	<i>Musa sapientum</i> L.	Musaceae	Tender petiole, spathe, fruit	Vegetable, beer is prepared from ripe fruit, urtative, pig feed
62.	<i>Nephelium longana</i> Camb.	Sapindaceae	Fruit	Eaten raw
63.	<i>Nymphaea lotus</i> L.	Nymphaeaceae	Root, seed	Seeds are edible, root juice given in piles
64.	<i>Oenanthe javanica</i> (Blume) DC.	Apiaceae	Tender shoot	Vegetable
65.	<i>Olaxa cuminata</i> Wall. Ex Benth.	Olcaceae	Tender shoot	Vegetable
66.	<i>Oroxy lumindicum</i> (L.) Vent.	Bignoniaceae	Tender shoot, fruit, bark	Vegetable, leaf juice for jaundice, bark past for cattle wound
67.	<i>Oxalis corniculata</i> L.	Oxalidaceae	Whole plant	Vegetable, antidote, medicine for dysentery, fodder
68.	<i>Paederia scandens</i> (Lour.) Merr.	Rubiaceae	Tender shoot, leaf	Vegetable, medicine for constipation and dysentery, fodder
69.	<i>Parabaena sagittata</i> Miers.	Menispermaceae	Leaf, tender shoot	Vegetable
70.	<i>Parkia timoriana</i> (DC.) Merr.	Mimosaceae	Fruit	Chutney
71.	<i>Phlogacanthus thyrsoformis</i> (Hard.) M.N.	Acanthaceae	Tender shoots, inflorescence	Chutney, medicine for dysentery
72.	<i>Physalis peruviana</i> L.	Solanaceae	Fruits, tender shoot	Vegetable
73.	<i>Piper thomsonii</i> Hook. f.	Piperaceae	Leaf	Eaten with betel nut
74.	<i>Pogostemon pubescens</i> Benth.	Lamiaceae	Tender shoots	Vegetable
75.	<i>Reidia hamiltoniana</i> (Mueller) Cowan.	Euphorbiaceae	Tender shoot, fruit.	Vegetable
76.	<i>Rhynchosyche ellipticum</i> (Dietr.) A. DC.	Gesneriaceae	Leaf	Vegetable
77.	<i>Sapindus mukorossi</i> Gaertn.	Sapindaceae	Fruit	Eaten raw
78.	<i>Sauropus androgynus</i> Merr.	Euphorbiaceae	Leaf	Vegetable
79.	<i>Smilax glabra</i> Roxb.	Smilacaceae	Tuber	Famine food
80.	<i>Solanum nigrum</i> L.	Solanaceae	Tender shoot	Vegetable
81.	<i>Solanum torvum</i> Sw.	Solanaceae	Fruit	Vegetable
82.	<i>Spilanthes calva</i> DC.	Asteraceae	Inflorescence, tender shoot	Vegetable, edicine for tooth ache and cough
83.	<i>Spondias pinnata</i> (L. f.) Kurz	Anacardiaceae	Fruit	Eaten raw
84.	<i>Tabernaemontana divaricata</i> (L.) Br. Ex Roem. & Schult.s	Apocynaceae	Fruit	Eaten after roasting
85.	<i>Tamarindas indica</i> L.	Caesalpiniaceae	Fruit, leaf	Leaves as vegetable, fruit eaten raw, fodder
86.	<i>Terminalia chebula</i> Retz.	Datiaceae	Fruit	Eaten raw, edicine for caught, dysentery, pest is apply on scalp to reduce hair fall.
87.	<i>Vernonia cineria</i> (L.) Less.	Asteraceae	Tender shoot	Vegetable
88.	<i>Xanthium strumarium</i> L.	Asteraceae	Leaf	Vegetable
89.	<i>Zanthoxylum oxyphyllum</i> Edgew.	Asteraceae	Tender shoot	Vegetable
90.	<i>Zingiber zerumbet</i> (L.) Rose ex Sm.	Zingiberaceae	Inflorescence	Vegetable
91.	<i>Zizyphus mauritiana</i> Lamk.	Rhamnaceae	Fruit	Eaten raw, curry, making pickle

Human oriented various activities inside Marat Longri Wild Life Sancturay

Figure-5: Animal grazing land

Figure-6: Illegal extraction of timber

Figure 7: Human encroachment

Table-1: Encroachment position in Marat Longri WLS as on 1st January 2014

S. No.	Name of Reserve Forest (RF)	Total area (km ²)	Encroach-ment (%)	No. of houses	No. of Encroacher
1	Kaki RF	118.38	24.29%	314	1750
2	Disama RF	116.42	25.65%	170	994
3	Mijungdisa RF	109.18	70.96%	246	1381
4	Inglongkiri RF	44.77	40.82%	37	236

(Source: GIS and Remote Sensing Lab. PCCF Office, Diphu. Directorate of Statistical Office, Diphu).

Table 2: Fragmentation status (percent) of the four Reserve Forests in Marat Longri WLS

• Forest class	Kaki	Disama	Mijungdisa	Inglongkiri
• Very dense forest	0.32	11.50	1.86	12.07
• Moderately dense forest	8.44	24.12	13.75	13.58
• Open forest	34.86	40.10	1.16	38.36
• Non-forest	42.97	23.69	46.59	35.98

(Source: GIS and Remote Sensing Lab. PCCF Office, Diphu)

Pair-wise ranking of five factors (*Jhum*, collection pressure, illegal felling, agriculture expansion, and encroachment) (Table 3) highlighted people perception on forest degradation in the Marat Longri [M1] WLS. The total sum of each factor (calculated using the relation $N(N-1)/2$) varied among informants of different RF. The result of pair-wise ranking revealed *Jhum* (3160) is the major threat to forest cover followed by illegal felling (2850), agricultural expansion (2346), encroachment (2211) and collection pressure (2080). This trend is mainly due to increase demand for arable land by the burgeoning human population. In summary, all the above factors contribute towards the decline of forest cover directly or indirectly and loss of biodiversity there-in.

Indian Remote Sensing (IRS) P6 LISS-IV multi-season datasets of 2014, revealed that the Marat Longri WLS has an existing forest cover of only 40.43 percent. The sanctuary is under pressure from encroachment; about 40.43% (approx.) of the sanctuary area has been cleared for settlement and agricultural activities (Table 1). Out of the four Reserve Forest constituting the sanctuary,

Mijungdisa RF topped the list with the highest loss of forest cover (i.e. 70.96%) which is followed by Inglongkiri RF (40.82%), Disama RF (25.65%) and Kaki RF (24.29%). Fragmentation status of the four RFs is shown in Fig. 6. The main reason for the loss of forest cover is due to shifting cultivation (*Jhum*) as vast tracts of hilly slopes have been badly denuded and extension of encroachment in some area.

Conclusion:

It has been observed that biological and economic importance of Marat Longri WLS has been partially realized or assessed. Forest dwellers have certain rights to forest resources however, there is lack of balance in utilization and conservation of forest biodiversity; large scale clearing of forest vegetation is reminiscent of this. In spite of legal status, illegal activities are abundant and widespread in the sanctuary. The present report provides a quantitative assessment of the disturbances threatening RFs of the sanctuary. This information can be useful to develop and propose opportunities for improving protection of the protected area. Unless proper strategies are put in place, threats to the forests and its biodiversity will remain and the very objectives of establishing the sanctuary will fail miserably. With the loss of these forests, Marat Longri WLS will lose an invaluable natural heritage and a major economic resource. The consequences of this loss would likely be devastating for the people, the economy, and the biodiversity of Karbi Anglong district. More engagement with forest dwellers is needed to create strong mass awareness about forest conservation and its benefits. There is a need to look for present land-use pattern with alternative agroforestry system that will carter the needs of local inhabitants and lessen pressure on forest resources. Domestication of forest plants in homestead gardens in one way can help in food production and economy; this will minimize dependence on forest products and reduce conflicts with wildlife.

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