Forest Sub Regions of the world and Population: Prioritization of Forest Sub Regions of the World (1990-2020)

Narender Kumar*
* Senior Engineer, Defense Software Product Division, Rolta India Ltd, 160101, Chandigarh.

Abstract- In general the relationship of human being with natural resources is not in good health. The forest as it is enviable natural resources also suffers in relationship. Forests on the mercy of human being therefore the study have been taken to conclude the forest and population relationship. The study is carried out for forest sub regions and their prioritization for further planning and management.

Keywords: forest cover, population, rural population.

I. Introduction

From few centuries human societies are exploiting the natural resources for socio –economic purpose. Forest as a natural resource has always been used and exploited by human societies at large.

Therefore, the survival without forest is merely a dream for human civilization. But in recent time decline in forest area is devastating the lively –hood of millions of people who are heavily dependent on forest and on forest resources directly or indirectly.

Despite human efforts, global forest has declined by 30 percent while 20 percent degraded for the period 2000 to 2010 (WRI research) [1]. With the fact of declining and degraded global forest cover, one billion people globally depend on forests for their livelihoods as on dated 2010 (http://www.wri.org/our-work/topics/forests)[2]. Along with above facts, in 2010, 60 percent of global forest cover lies in 7 Countries ((Russia, Brazil, Canada, the United States, China, Indonesia, and the Democratic Republic of Congo (formerly Zaire) (http://www.globalchange.umich.edu) [3]. From 2000 the annual average net loss has reached to 5.2 million hectare globally (FAO, 2010b) [4].

As the above facts and facets indicate importance of forest and their condition at present, it is necessary to make an effort to visualize the facts which are affecting forest. Therefore, the study is an attempt to present facts in understanding the relationship of forest area and population aspects. This may help to find out the gaps in forest change and impact of population as factor. Therefore study may help in generating some valuable figures to adhere some polices and suggestions.

i. Study Area

The World has been taken as study area. Further the World has been divided into 6 regions and 12 sub-regions (http://foris.fao.org) [7]. The administrative boundaries which were not taken for study due to no data value for any time period excluded from the study. Another exception made for the forest sub region the Antarctica which is not viable or forest and population growth and is with much land area. Due to these facts the Antarctica forest sub region seems to contribute more to the total land area, rather than other factors considered for study.

II. Objectives:

In the light of above given explanations for study below given objectives have been considered:

To evaluate the decade wise forest status at global scale.

To find out the relationship between forest area and population dynamic at forest sub region of the world.

To find out priority forest regions and forest sub region for action and policy making.

III.   Methodology:

The entire approach of the study is based on secondary data. The source of data is taken from World Bank website (http://api.worldbank.org) [5]. The data have been filtered as per the objectives of the research paper for a period of 1990-2020. The mapping and integration of tabular data with spatial world vector map (http://thematicmapping.org) [6] have been done in Arc Map version 9.2, GIS software. After that the data have been analyze and synthesize for different aspects such as InDIPtp, DIPrp, and PD with projected values for 2020 [Fig 1].

The data of administrative boundaries which does not have data for any decade are excluded from the study [Appendix 1]. The data for forest sub region the Antarctica also have been excluded from the study as it has merely share of world forest and population.
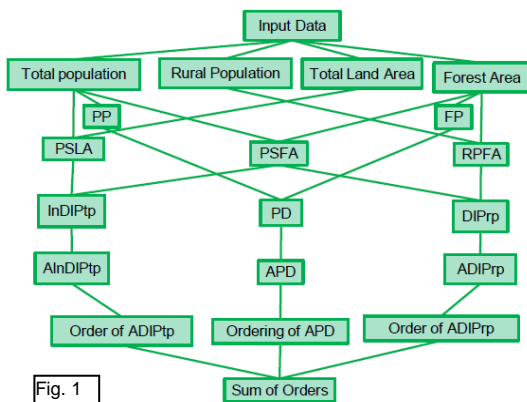

Fig. 1

IV.   Results:

i.   World Forest

The area under forest in the world is changing and declinging fastly. In 1990 it was 32.03 percent forest area which would be 30.70 percent in 2020 [Fig. 2]. Therefore a sharp decline of 1.33 percent would be from 1990 to 2020 [Fig.3]
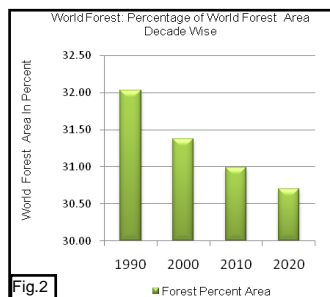

Fig.2

and is matter of much concern. The decline in forest area in 1990-2000 was 2.03 whereas it was 1.31 percent in 2000-2010 and it would be .95 for the period 2010-2020 [Fig 3]. The percent in decline shows the decline is coming down but it seems to too far from gain in forest area at global scale.
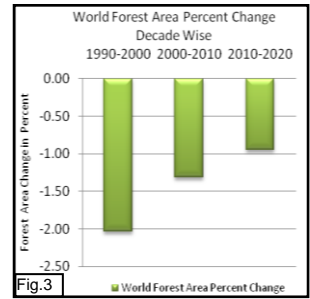

Fig.3

ii.   World Forest Area and Population

It is well known fact that population dynamics in number affects forests as the forests are taken by human being as resources. From 1990 to 2010 a similar trend was in spread of population on forest area and land area but in 2020 in would seems to be change as world population shows change in per square km spread of population [Fig.4]. In 1990 the ratio of population on forest per sq km and population on total land area was 1:3.15 which would be 1:3.20 in 2020. The rise in ratio indicates rise in population and decline in forest area. At global level the growing gap of both is an indicator of more pressure on forest area in near future

To precisely measure the relationship of population and forest area DIPrp (Differentiate Index of Rural Population) have been developed for Rural Population and InDIPtp (Differentiate Index of Total Population) for Total Population. The value near to 1 indicate more rural population spread on forest area whereas far value shows lesser spread of rural population on forest area. For InDIPtp near to value 1 is
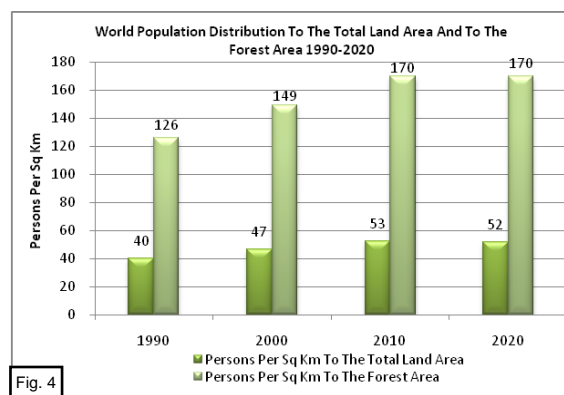

Fig. 4

considered as more suitable condition for forest and far values to 1 has been taken as unfavorable condition for forest.

The below given *DIP*s have been calculated:

InDIPtp = The InDIP is a result of Population Spread on Total Area (PSLA) to the Population Spread on Forest Area (PSFA).

*InDIP tp = Population Spread on Total Land Area (PSLA) [1]/ Population Spread on Forest Area (PSFA) [2] *100 or*

*InDIPtp = PSLA/PSFA*100*

     Where   [1] PSLA= Total Population/ Total Land Area and [2] PSFA= Total Population/ Total Forest Area

Same Index also been applied for Rural Population Spread on Forest Land to the Total Population Spread on Forest Land and it defined as:

DIPrp = The DIP is a result of Population Spread on Total Forest Area (PSFA) to the Rural Population Spread on Forest Area (RPSF).

*DIPrp= Population Spread on Forest Area (PSFA) [1]/ Rural Population Spread on Forest Area (RPSF) [2] *100 or*

DIPrp = PSFA/RPSF

   *Where   [1] PSFA= Total Population/ Total Forest Area and [2] RPSF= Total Rural Population/ Total Forest Area*

Then Average for InDIPtp and DIPrp for the period 1990-2020 have been calculated and termed as.*AInDIPtp and ADIPrp.*

AInDIPtp = Total of InDIP for a point of periods 1900-2020/(number of points of periods)

ADIPrp = Total of InDIP for a point of periods 1900-2020/(number of points of periods)

a. World Forest Area and Total Population
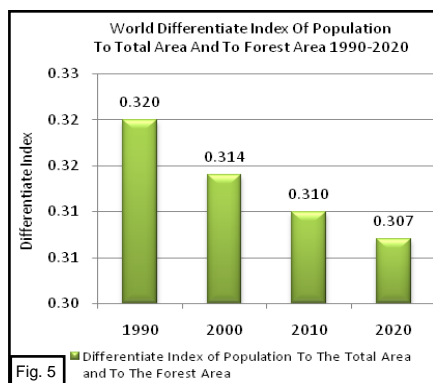
Fig. 5

In respect to the total population, in 1990, InDIPtp (Inverse Differentiate Index of Total Population) was 0.320 whereas in 2020 it would be 0.307 [Fig. 5]. But in 2020 it would not be a tremendous change in pattern of the population spread on forest area and on land area in the world. In 1990 the condition of forest area was in favor besides to other time period.

b. World Forest Area and Rural Population

The DIPrp (Differentiate Index of Rural Population) shows the gap between spread of total population to the forest area and rural population to the forest area. The values for world statistics far from 0 and starts from 0.5 or near to 0.5 shows more rural population proportion in population structure and hence more pressure and spread on forest land. It indicates forests are on edge of rural population [Fig. 6]. From 1990 to 2010 the differences seems to be reducing but after 2010 (0.486) it would seems be again (0.503) in

Fig. 6

2020 [Fig 6] as an indication of rise in rural population in the world.
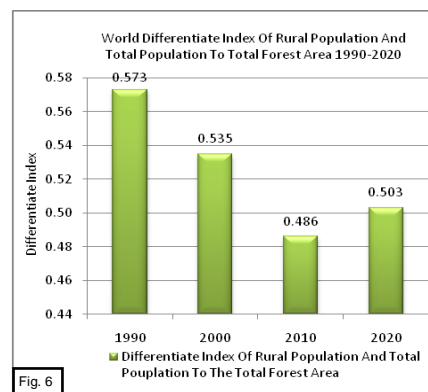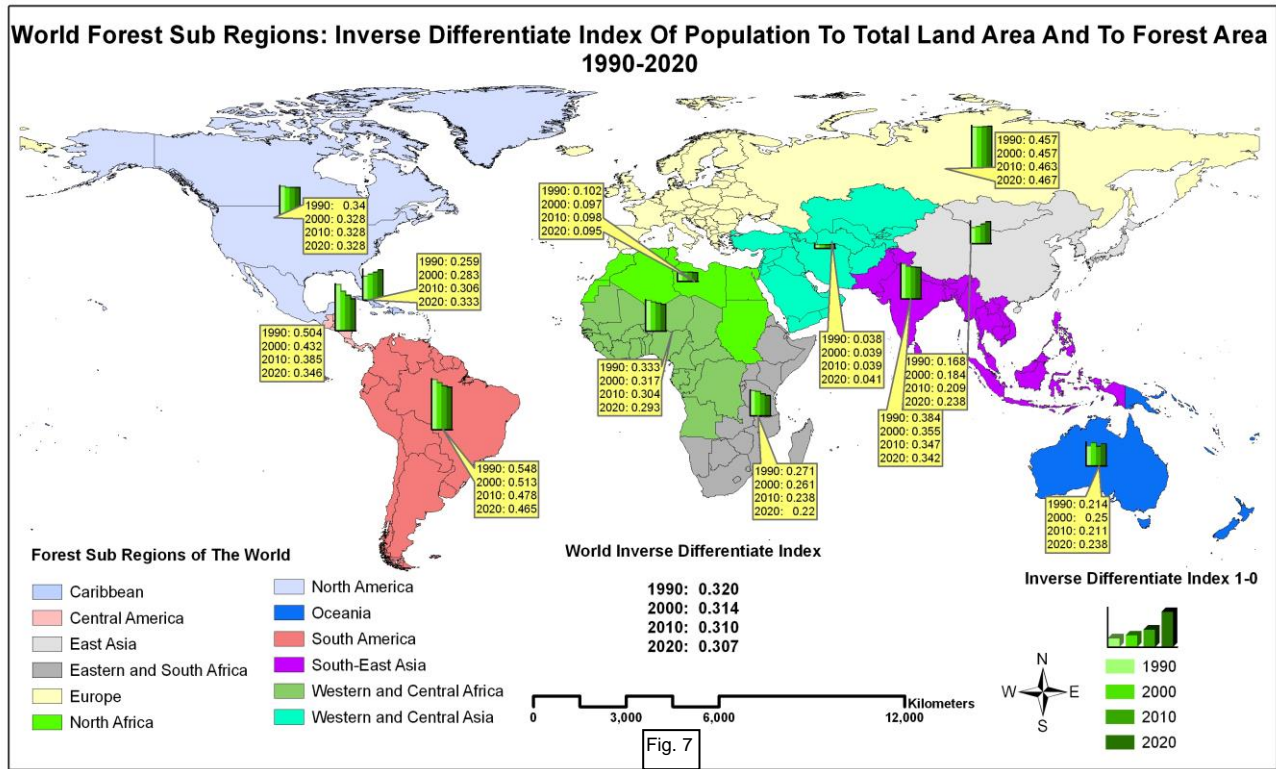
iii. World Forest Sub Regions and Population
a. World Forest Sub-Region and Total Population

As it is clear from the world statistics that the InDIPtp (Inverse Differentiate Index of Total Population) has decreasing trends means adverse effect on forest area. At a glance of forest sub regions, the sub regions varies in InDIPtp from 0.536 (South America) to 0.038 (Western and Central Asia) in 1990. It would be remain as a trend for 2020 as 0.490 and 0.040 respectively. Excluding East Asia with InDIPtp 0.17 in 1990 to moving to 0.24 in 2020 other forest sub regions are either has constant value or moving far from value 1. The most decreasing value for sub region is Central America which had 0.51 in 1990 and was 0.43 in 2010. It may follow

the similar trend with 0.34 in 2020 [Fig. 7]. The same trends are also

The forest sub region North America has lowest rural

Fig. 7

confirmed by the values for AInDIP [Fig. 12].

b. World Forest Sub-Region and Rural Population

population impact on forest with value of 0.26 in 1990 which would be 0.20 in 2020. The DIPrp indicates ¼ of total
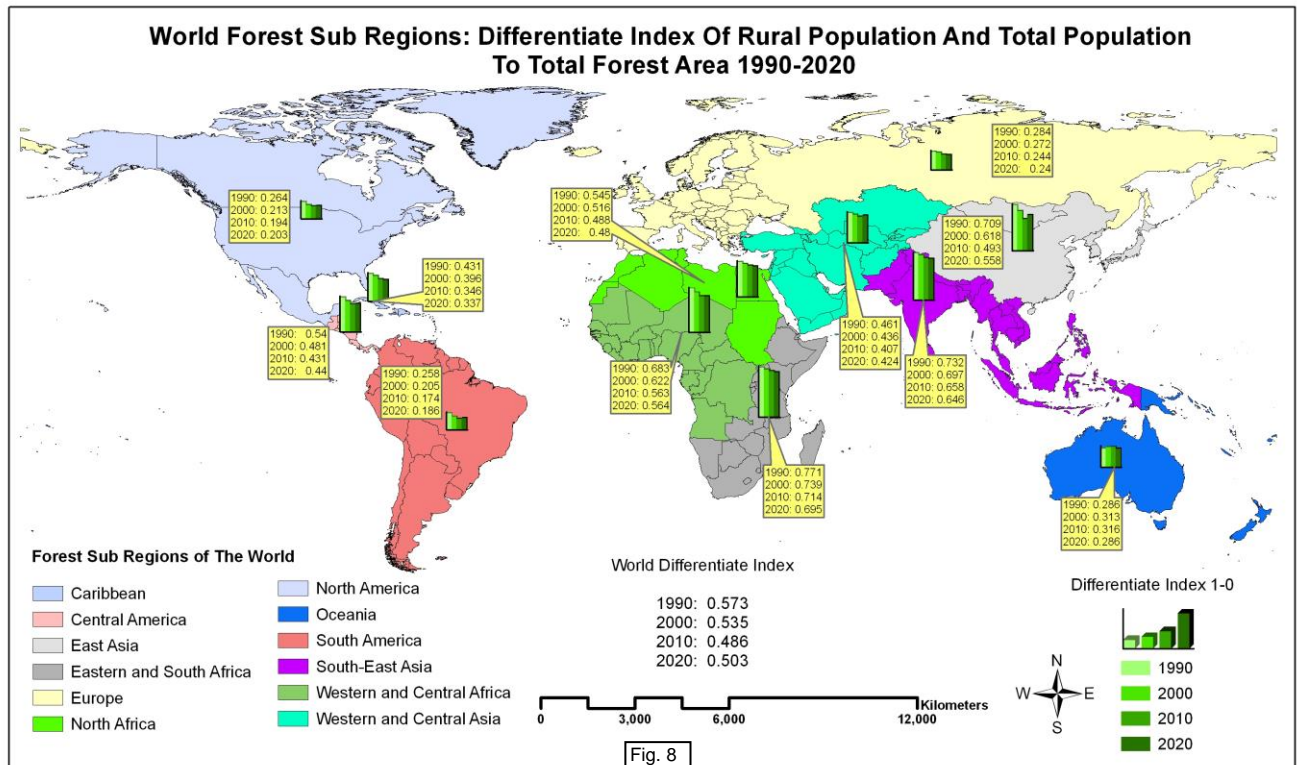
Fig. 8

population was rural population in 1990 and in 2020 it would be 1/5 which is matter of much concern at global scale [Fig.8]. Whereas, most affecting sub region is Eastern and South Africa which had 0.77 DIPrp in 1990 which was approximate triple to the North America Europe and North America stands on 1st, 2nd, and 3rd position from top, whereas from the bottom, Eastern and South Africa stands on 1st, South, East Asia, and East Asia stands 2nd position [Fig.8].

In support of InDIPtp and DIPrp, another effort have been made to evaluate the situation or relationship of forest and population by using resultant which is based on percent difference in forest to the population from the world total.

The Percent Difference is outcome of:

PD= Forest Percent – Population Percent***

*Forest Percent = Forest Area of Sub Region/ Forest Area of World*100

**Population Percent= Population of Sub Region/ Population of World*100

After that average for 1990 to 2020 have been calculated as mentioned below:

Average of PD (APD) for the period 1990-2020,
APD = Total of PD/ /(number of points of periods)

The two sub-regions South-East Asia, East Asia which makes 15.27 percent area of the world has 53.20 percent of population in 1990 and would be 52.99 percent in 2020 of world population and had 12.42 percent forest area in 1990 which would be 14.04 percent in 2020 [Fig.9]. Both the sub regions from 1990 to 2020 come in PD (Percent Difference) between -40.78 to -38.96 respectively [Fig.9]. Both the regions shows increase in population percent and decrease in forest percent and both stood high with -ve APD of -40.14 for the period of 1990-2020 [Fig. 10]. In contrast to the above, the three sub regions, Europe, North America and South America, has 46.42 percent of total world area and has 27.99 percent population in 1990 and would be 24.66 percent in 2020. These

three forest sub regions shares 63.11 percent forest area in 1990 and would have share 63.56 percent forest area of the world in 2020 [Fig. 9].

These three regions shows increase in forest percent with increase in population percent and in fact these three sub regions stood high with positive APD of 37.64 for 1990-2020 [Fig. 9].
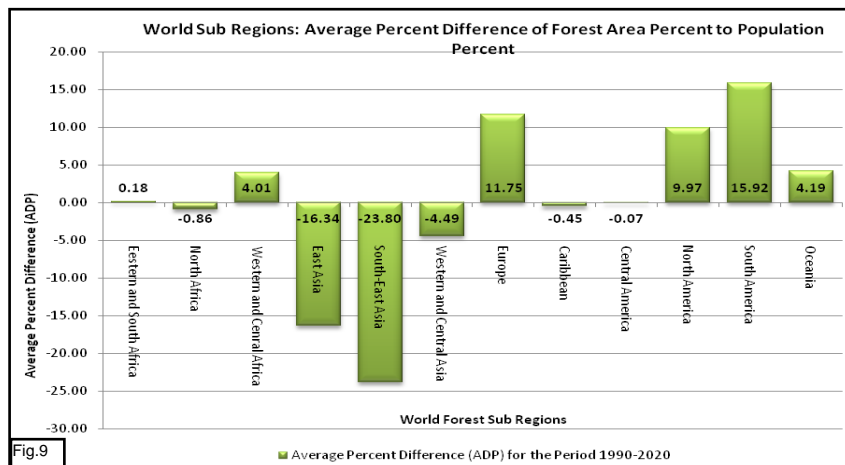

Fig.9

On the basis of ADP, the ADP for the period of 1990-2020 varies between -23.80 percent in 2020 to the 15.92 percent in 1990. Out of 12 forest sub regions, 6 sub regions has -ve values (-0.08 to – 23.80) whereas 6 regions has +ve values (0.18 to 15.92) [Fig. 9].

The South East Asia sub region stands low with -23.80 APD and East Asia follows the previous with -16.34 APD for the period 1990-2020 but the trends are bitter for the region Asia as its third forest sub region Western and Central Asia trailing the both forest sub regions (South East Asia, and East Asia) with -4.49 [Fig. 10]. The three Forest Sub Regions of Forest Region are making Asia as forest region more sever in population spread and in lesser forest area. Whereas, Forest Region Africa is on second to forest region Asia but it also has some positive APD in Western and Central Africa forest sub region (4.01 APD) [Fig. 9].

The other aspect of forest sub region /forest region South America has 15.92 APD which is much higher than else. The forest sub region /forest region Europe with 11.75 APD stands

second from the top order. Besides, these trends the forest region North Central America differs in trends for in its forest sub regions, excluding North America with 9.97 other two sub regions has –ve values i.e. -0.45 and -0.07 for Caribbean and Central America respectively [Fig. 9].

The 6 forest sub regions of the world which has –ve ADP value comprises of 30.58 percent of total land area of the world and 62.75 percent total population of the world. On other hand the forest sub regions which comes with +ve ADP shares 69.42 the world land area and 37.24 of world total population.

The above indicates that 1/3 land area of the world supports 1/6 of the population and hence have forest sub regions with –ve ADP and on the other hand forest sub region with +ve ADP has 1/7 land area of the world supports ¼ of the world population. Therefore, a relationship has come out with the help of ADP.

V.   Conclusions

At forest regions, South America and North Central America comes on the first and second position. In contrary to it Asia stands to last [Fig.10]. But for Africa as it is ahead to Oceania is sign of relief. But as the gap between first (6) and last (10) position is almost double is matter of concern at global level and shows imbalances in world forest distribution, total population distribution and rural population distribution [Fig. 10].

To come to a conclusion, ordering of the forest sub-region were been carried out to find out which forest sub region has favorable figures in respect to the world totals and to their own totals. In carrying out the ordering the number 1 to 12 have been given to all sub regions as per ascending numbers,

excluding AInDIPtp which has descending numbering. After that total of order numbers given for ADP, AInDIPtp and ADIPrp have been summed up. The emerging fact indicates that South America with total of 3 comes on first place which has topmost favorable population and forest relationship. The forest region/sub region, Europe with total of 7 and North America with total of 10 are following the South America but with wide gap of double to triple difference of totals from South America. These three forest sub regions have most favorable condition for forest in case of forest area, total population, and rural population.

In a sharp contrast to South America, Europe and North America the forest sub regions East Asia, North Africa and Western and Central Africa stated their position 1st, 2nd, and 3rd from bottom with totals of 30, 28, and 28 respectively [Fig.11].

The top 1st and bottom 1st has 10 times difference in total of orders. The study clearly indicate sub regions of Asia and Africa starts from the bottom and reaches to half, any sub

Fig. 10. World Forest Regions: Ordering of ADP, InDIPtp and DIPrp for the period of 1990-2020						
Forest Region	**ADP 1990-2020**	**Order ADP**	**Average InDiptp 1990-2020**	**Order InDiptp**	**Average DIPrp 1990-2020**	**Order DIPrp**	**Sum of Orders 1990-2020**
South America	15.92	**1**	0.50	**4**	0.20	**1**	**6**
North Central America	**9.45**	**3**	**1.05**	**1**	**1.08**	**4**	**8**
Europe	11.75	**2**	0.46	**5**	0.26	**2**	**9**
Africa	**3.33**	**5**	**0.67**	**2**	**1.85**	**6**	**13**
Oceania	4.18	**4**	0.23	**6**	0.30	**3**	**13**
Asia	**-44.63**	**6**	**0.60**	**3**	**1.72**	**5**	**14**

region from fails to make any position among top five even. Therefore, these regions come with more total population or more percent of rural population and with less forest area as the total of order values indicates. The above facts indicates imbalance in forest area and distribution of total population and rural population. The rural population which is taken as directly dependent on forest might be the matter of much concern in forest management.
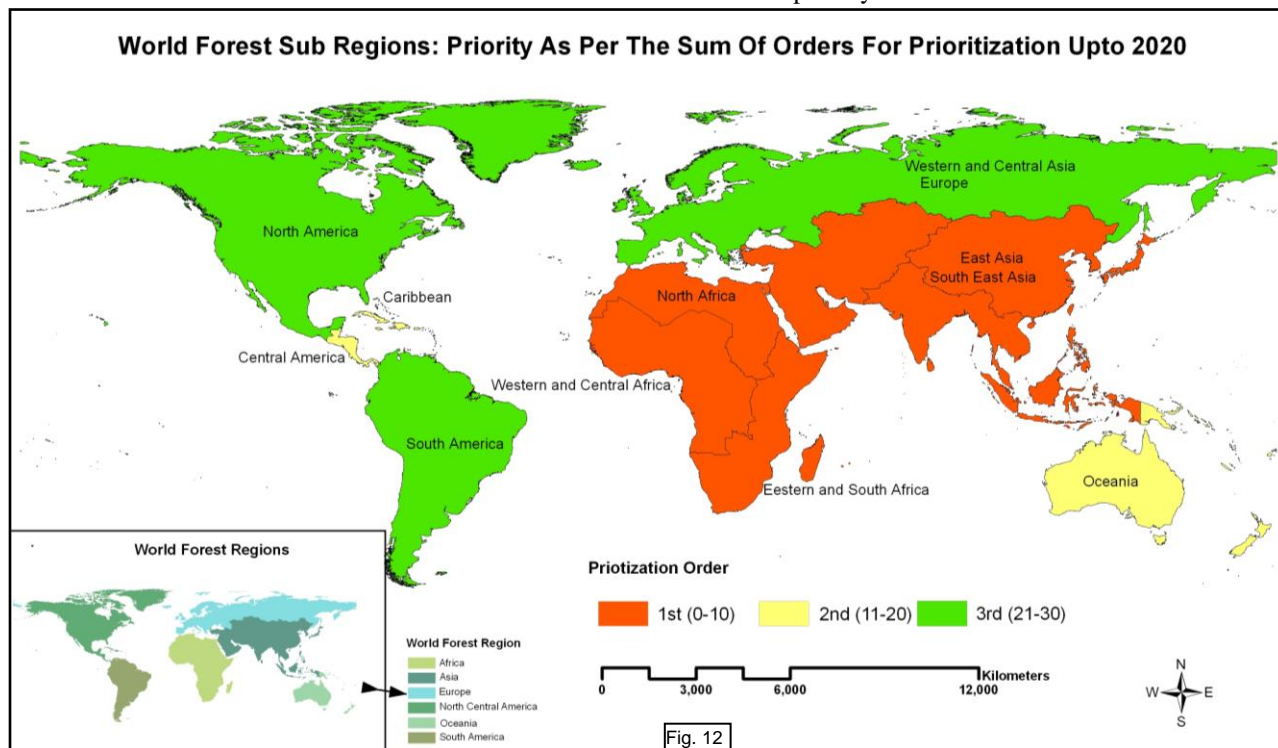
Further as per the results, the forest sub regions of the world have been categories in three categories which is based on sum of orders. Therefore, priority sub regions for policy making and for taking action are on the list. As the indicators indicate East Asia, North Africa, Western and Central Asia, South East Asia, Eastern and South Africa, Western and Central Africa respectively can be selected for any action and policy implementation [Fig.11]. To define the priority pattern of the forest of the world, the all forest sub regions have been categories in three categories [Fig.12]. The pattern indicates the need to starts from Africa and Asia forest regions. The more over the concern able is the coming of Oceania at 2nd place in priority. Therefore, in terms of area, 36.72 percent of the land area of the

world needs immediate concern for forest. The world has 7.10 percent land area as 2nd priority regions. Whereas, 56.18 percent land area of the world showing good indication as it comes in 3rd priority.

Fig. 11. World Forest Sub Regions: Ordering of ADP, InDIPtp and DIPrp for the period of 1990-2020								
Forest Region	Forest Sub Region	ADP (1990-2020)	Order ADP (1990-2020)	AInDIptp (1990-2020)	Order InDiptp	ADIPrp (1990-2020)	Order DIPrp	Sum of Orders
South America	South America	15.92	1	0.50	1	0.20	1	3
Europe	Europe	11.75	2	0.46	2	0.26	3	7
North Central America	North America	9.97	3	0.33	5	0.22	2	10
Oceania	Oceania	4.18	4	0.23	9	0.30	4	17
North Central America	Central America	-0.08	7	0.42	3	0.47	7	17
North Central America	Caribbean	-0.45	8	0.30	7	0.39	5	20
Africa	Western and Central Africa	4.01	5	0.32	6	0.61	10	21
Africa	Eastern and South Africa	0.18	6	0.25	8	0.73	12	26
Asia	South-East Asia	-23.80	12	0.36	4	0.69	11	27
Asia	Western and Central Asia	-4.49	10	0.04	12	0.43	6	28
Africa	North Africa	-0.86	9	0.10	11	0.51	8	28
Asia	East Asia	-16.34	11	0.20	10	0.60	9	30

Fig. 12

Summing up, the population is determining the forest area of the world and it need immediate control over population of the world which will be in favor of the world along with the management, and protection of forest area

References:

1. WRI research: http://www.wri.org/our-work/project/forest-and-landscape-restoration

2. WRI research: http://www.wri.org/our-work/topics/forests

3. Global Change https://www.globalchange.umich.edu/globalchange2/current/lectures/deforest/deforest.html

4. (FAO, 2010b). FAO. 2010b. *Global Forest Resources Assessment 2010 – main report.* FAO Forestry Paper No. 163.Rome. www.fao.org/docrep/013/i1757e/i1757e00.htm

5. http://api.worldbank.org: http://api.worldbank.org/datafiles/1_Topic_MetaData_en_EXCEL.xls\

6. http://thematicmapping.org: http://thematicmapping.org/downloads/world_borders.php\TM_WORLD_BORDERS-0.3.zip

   http://foris.fao.org/static/data/fra2010/FRA2010GlobaltablesEnJune29.xls

List of abbreviations:

APD: *Average of PD*

ADIPrp :   *Average of DIPtp*

AInDIPtp: Average of InDIPtp

DIPrp :   *Differentiate Index of Population (Rural population)*

InDIPrp: *Inverse Differentiate Index of Population (Total population)*

PD: *Ppercent difference*

PSFA: *Population Spread on Forest Area*

PSLA: *Population Spread on Total Land Area*

Author

Narender Kumar, Senior Engineer,

Defense Software Product Division,

Rolta India Ltd, 160101, Chandigarh

gisrsnaren@gmail.com

Annexure1

Sr. No.	Country Name	Forest Sub Regions	Land Area 2010
1	Belgium	Europe	30280.00
2	Luxembourg	Europe	2590.00
3	Marshall Island	Oceania	180.00
4	Northern Maria	Oceania	460.00
5	Palau	Oceania	460.00
6	Curacao	North Central America	444.00
7	Sint. Maarten (Dutch)	North Central America	34.00
8	Saint. Martin (French)	North Central America	54.00
9	Hong Kong SAR	East Asia	1042.00
11	Monaco	Europe	2.00
12	San Marino	Europe	60.00
13	Kosovo	Europe	10887.00
14	Qatar	Western and Central Asia	11590.00
15	Bermuda	North Central America	50.00
16	Cayman Islands	North Central America	240.00
17	Macao SAR, Chi	East Asia	28.00
18	Singapore	South East Asia	700.00
	World Total		**59101.00**
	World Percent		**0.05**