



# USING GINI COEFFICIENT FOR ANALYSING DISTRIBUTION OF COMMUNITY FORESTS IN NEPAL BY DEVELOPMENT AND ECOLOGICAL REGIONS

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## Abstract

*This paper assesses the distribution of community forests in Nepal by development<sup>1</sup> and ecological regions and makes a comparison of the situation across two years in Nepal. Community forests in Nepal are handed over without any threshold for per household forest area and an implication of such practice is increased inequality in the distribution of community forests. Using Gini coefficient as a measure of inequality, this paper concludes the Gini coefficient of community forestry distribution has slightly improved in the year 2009 as compared with that of the year 2007. It means that the distribution of community forests in Nepal is being directed towards equality. The provision of Initial Environmental Examination (IEE)/Environmental Impact Assessment (EIA) in community forests has acted positively for reducing inequality in the distribution of community forests. For moderating the coefficient, the paper dwells on the provision of limitations on handover of forest area based on per household forest area.*

**Keywords:** *Gini coefficient, inequality, community forests, household.*

## Introduction

Nepal extends 800 km east to west along the southern slope of the Himalaya. The country is divided into three ecological zones, namely the Tarai/ Inner Tarai (100-300 m above sea level), the Middle Hills (300-3000 m a.s.l.) and the High Mountains (above 3000 m a.s.l.). The Middle Hills, or Mahabharat Lekh, represent the region where Community Forestry (CF) is widespread. Most of the country's forest occurs in the Middle Hills. The Middle Hills also have the greatest ecosystem and species diversity.

Some equity aspects of CF have been much discussed in Nepal, as exemplified by a compendium of research papers published by Winrock

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<sup>1</sup> Nepal is divided into five development regions namely Eastern, Central, Western, Mid-Western and Far-Western regions as major administrative units.

International-Nepal in 2002.<sup>2</sup> The main concern expressed in these papers is that community forests are being handed over in a haphazard way without any consideration on equity aspects. Larger tracts of forests are being handed over to the Forest User Groups (FUGs) comprising fewer households, while a large number of households are included in smaller patches of community forests. This has led to a situation where material benefits are not accruing sufficiently to a large number of forest user households, whereas a few households are using forests indiscriminately.

It necessitates a serious empirical test on equality regarding community forest distribution across the development regions and ecological zones in Nepal. This paper aims to quantify the magnitude of inequality arising due to this discriminatory practice of handover of community forests in Nepal and compares the statistics across different years.

### **Materials and Method**

The national FUG database has been analysed using the data on community forests regarding the area of community forests and beneficiary households across the Tarai (including inner Tarai), Hills (Middle Hills) and High Mountains. The data regarding distribution of community forests has also been analysed on the basis of development regions. The Gini coefficient of distribution of community forests has also been calculated for 9 districts representing different ecological zones.

I am using a tool called *Gini concentration ratio* or simply *Gini coefficient* to assess inequality in the distribution of community forests in Nepal. The tool is named after the Italian statistician who first formulated it in 1912. It is an aggregate numerical measure of inequality ranging from 0 (perfect equality) to 1 (perfect inequality) and is used widely to assess income, land and education inequality. The higher the value of the coefficient, the higher the inequality of distribution; or vice versa.

In Nepal, it is feared by many scholars (Bhatta 2002a,b; Tiwari 2002 etc.) that larger tracts of community forests are handed over to small groups of forest users while a large number of households are accommodated as users in smaller patches of community forests. The users in the latter forests can get almost no material benefit from their community forests. Gini coefficient can be quite useful as a tool in such cases to find out whether the distribution of community forests in Nepal has remained equitable or is becoming more inequitable in recent years as feared by the mentioned scholars.

For grouped data, Gini coefficient is calculated by using the following formula (Kanel 1993):

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<sup>2</sup> See, for example, Bhatta & Tiwari, in the ensuing page.

$$G = \sum X_i Y_{i+1} - \sum X_{i+1} Y_i$$

Where  $X_i$  denotes the cumulative proportion of the population in the  $i$ th class interval, and  $Y_i$  denotes the cumulative proportion of the population in the  $i$ th class interval.

When the variables are measured as percentages, then both of them have to be divided by 100, in this case the above equation has to be written as:

$$G = 1/ (100)^2 [\sum X_i Y_{i+1} - \sum X_{i+1} Y_i]$$

### Results and findings:

The distribution of community forests and number of beneficiary households by development regions is given in Table 1. The table shows that highest number of Forest User Groups (FUG) is in the Western region while the lowest numbers of FUG are in the Far western region. Eastern development region has the largest area of community forests with highest number of beneficiary households while the Far western region falls in the least category on both counts.

Table 1. Distribution of Community Forests in Nepal by Development Regions

Development Region	No. of FUGs	CF Area (ha)	No. of Beneficiary Households
Eastern	2669	332948	330019
Central	3359	262392	401734
Western	3861	184205	432297
Mid Western	2594	288142	288309
Far Western	1956	161982	207416
Nepal	14439	1229669	1659775

The distribution of community forests and beneficiary households by ecological zones is given in Table 2. It can be seen from the table that Inner Tarai/Tarai has the least number of FUGs and least area of community forests while the spread of community forest both in term of handed over forest area and beneficiary households is highest in the Middle Hills.

Table 2. Distribution of Community Forests in Nepal by Ecological Zones

Ecological Zone	No of FUGs	CF Area (ha)	No of Beneficiary Households
High Mountain	2586	238403	263665
Middle Hills	10512	821717	1109490
Tarai/Inner Tarai	1341	169549	286620
Nepal	14439	1229669	1659775

The distribution of community forests in Nepal in year 2007 is given in Table 3. Scrutinizing the table shows that 63% of the households have community forests of less than 100 hectares and it constitutes only 28% of the total area of the community forest. The remaining 37% of the households have community forests larger than 100 hectares and such forests constitute 72% of the total area of the community forest. This suggests high inequality in the handing over of community forests to the local FUGs and consequently the *Gini coefficient* is 0.458. The detail of the calculation of *Gini coefficient* is given in the Annex 1. The larger sized community forests are in the hand of fewer households in comparison to smaller sized community forests in which a larger number of households are accommodated in the FUGs.

Table 3. Gini Coefficient of Community Forest Distribution by Size of the Forest in Nepal, 2007

Community Forest (1)	No of FUGs (2)	Total CF in ha (3)	Total # of HH (4)	Total area % (5)	Total HH % (6)
less than 10 ha	2943	15424.08	185,261	1.265	12.160
10 to 50 ha	5406	143064.49	489,733	11.734	30.970
50 to 100 ha	2614	187921.72	314,356	15.413	19.529
100 to 200 ha	1950	274314.25	272,579	22.498	17.815
200 to 500 ha	1131	334205.42	233,304	27.410	14.676
500 to 1000 ha	211	142554.11	58,195	11.692	3.571
more than 1000 ha	55	121787.88	21,883	9.989	1.280
Total	14310	1219272	1304614	100	100
Gini coefficient					0.458

Source: Author's computation from National FUG database, DoF, 2007.

Table 4. Gini Coefficient of Community Forest Distribution by Size of the Forest in Nepal, 2009.

Community forest (1)	No of FUGs (2)	Total CF in ha (3)	Total # of HH (4)	Total area % (5)	Total HH % (6)
less than 10 ha	2991	15291.9	196429	1.243578	11.83468
10 to 50 ha	5430	143642.9	502276	11.68142	30.26169
50 to 100 ha	2633	189341.1	328529	15.39772	19.79359
100 to 200 ha	1972	277492.9	302214	22.56646	18.20813
200 to 500 ha	1145	337759.2	249559	27.46747	15.03571
500 to 1000 ha	213	144121.3	59692	11.72033	3.596391
more than 1000 ha	55	122020.6	21076	9.923035	1.269811
Total	14439	1229670	1659775	100	100
Gini coefficient					0.451

Source: Author's computation from National FUG database, DoF, 2009.

In Table 4, the Gini coefficient of community forest distribution for year 2009 is given. The Table shows slight decrease in the percentage of households having community forests of size less than 10 hectares. However, there is no change in the percentage of area of forests of larger size (more than 1000 hectares) while the percentage of households having larger tracts of forests (> 500-1000 ha and >1000 ha) as community forests has slightly decreased. It shows that in comparison to 2007, the larger size community forests are not handed over in the year 2009. The mandatory provision of Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) can be attributed to this decrease in the handing over of large tract of community forests<sup>3</sup>. Consequently Gini coefficient has slightly decreased from 0.458 to 0.451. Nevertheless, this lowering is significant if we compare that with the Gini coefficient of community forestry distribution in Nepal reported by Sharma (2007) for the year 2004 (GC=0.445).

This slight decrease in the Gini coefficient between the two years implies that the mandatory provision, though having received its share of criticism, has nevertheless produced the desired result regarding the distribution of community forests in Nepal.

The details of the calculation of Gini coefficient for community forestry distribution in Nepal for the year 2009 is given in Annex 2.

<sup>3</sup> Recently amended Environmental Regulation in Nepal instituted the provision of Initial Environmental Examination to hand over community forests larger than 200 hectares while Environmental Impact Assessment is essential for handing over community forests larger than 500 hectares.

The statistics related to community forests for the year 2009 is given in Table 5, which shows no major changes in the per household community forest area as compared with the year 2007.

Table 5. Statistics Related with Community Forests in Nepal, 2009.

Community forest group (1)	Average CF in ha. (2)*	# HH in FUG (3)**	Per HH Forest in ha. (4)***
Less than 10 ha	5.11	65.67	0.08
10 to 50 ha	26.45	92.50	0.29
50 to 100 ha	71.91	124.77	0.58
100 to 200 ha	140.72	153.25	0.92
200 to 500 ha	294.99	217.96	1.35
500 to 1000 ha	676.63	280.24	2.41
More than 1000 ha	2218.56	383.20	5.79

Notes: \* Obtained from Table 4, dividing Column 3 by column 2; \*\* obtained from Table 4, dividing Column 4 by column 2, \*\*\* obtained by dividing column 2 of Table 5 by column 3 of the same table.

In this paper, I am also showing the results of Gini coefficient of community forests distribution by development regions (Table 6). The Far western development region has the highest Gini coefficient while the Western region has the lowest one. The Western region has the lowest Gini coefficient because 74% of the community forest areas which are smaller than 200 hectares are handed over to the 90% of the beneficiary households.

Table 6. Gini Coefficient of Community Forest Distribution in Nepal by Development Regions, 2009.

Development Region	Gini Coefficient
Eastern	0.452
Central	0.410
Western	0.398
Mid western	0.415
Far western	0.468
Nepal	0.451

The analysis of Gini coefficient of community forestry distribution by ecological zones for the year 2009 (Table 7) shows that the High Mountain region has the highest Gini coefficient, because 56% of the forest areas which are larger than 200 hectares are handed over to only 14% of the households while 44% of the forests which are smaller than 200 hectares are handed over

to 86% of the households. The Tarai and Inner Tarai has the lowest Gini coefficient.

Table 7. Gini Coefficient of Community Forest Distribution by Ecological Zones, 2009.

Ecological zones	Gini coefficient
Tarai/ Inner Tarai	0.349
Middle Hills	0.463
High Mountain	0.578
Nepal	0.451

Table 8. Gini Coefficient of Community Forest Distribution in Selected Districts of Nepal by Ecological Zones of Nepal

Tarai/ Inner Tarai		Middle Hills		High Mountain	
Dang	0.275	Ilam	0.355	Dolkha	0.405
Siraha	0.458	Kabrepalanchok	0.421	Jumla	0.678
Bardiya	0.215	Palpa	0.405	Solukhumbu	0.545
0.349		0.463		0.578	

We can see from Table 8 that among the Tarai districts Bardiya shows the lowest Gini coefficient while Siraha shows the highest value. In Siraha the community forests of size less than 200 hectares represent 26% of the community forest area and the area is handed over to 62% of the households, accounting for the highest Gini coefficient. In Bardiya such forests represent 93% of the area and is handed over to 98% of the households. Thus, the distribution of community forests can be regarded as one of the best in Bardiya among the selected Tarai districts. Similarly for Dang, the community forests smaller than 200 hectares represent 25% of the forests and are handed over to the 45% of the households.

Ilam presents an unique picture: due to the directives of the then king for registering the forests where cardamom had been cultivated under the title of private owners, there has been only 0.2% of the area under <10 hectares accommodating 3% of the households. The community forests of size smaller than 200 hectares represent 16% area of the community forests and accommodate 42% of the households. Hence Ilam represents the lowest Gini coefficient among the studied Middle Hill districts.

Among the High Mountain districts, Dolkha has the lowest Gini coefficient of community forestry distribution while Jumla has the highest value. In Dolkha, the community forests smaller than 200 hectares represent 47% of the area of community forests and accommodate 75% of the households. Similarly, in

Jumla such forests represent 30% of the area while accommodating 88% of the households. In Jumla, 63% of the community forests area is covered by forests >1000 hectares while only 7% of the households benefit from such forests. Consequently, the Gini coefficient of community forestry distribution is quite high.

### **Conclusion**

As a conclusion, it can be said that the calculated *Gini coefficient* for Nepal (for year 2009) has been slightly reduced as compared with that of the year 2007. The mandatory provision of IEE/EIA in community forests has produced this unintended but desired result. If there will be a provision of fixing limits (both small and large) to the size of community forests, it would definitely help in moderating the coefficient of distribution of community forests besides easing the task of monitoring increasing number of community forests. Hence, it is concluded that though the mandatory provision of environmental assessment in certain community forests is being criticised in every nook and corner of the country, it has definitely produced an unintended but desirable outcome in community forestry management in Nepal.

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## Appendices

Annex 1: Gini coefficient of CF distribution in Nepal by size of the forest, 2007.

Size of CF	No of Forests	Total area (ha)	Total # of HH
< 10 ha	2943	15424.08	200236
10.01-50 ha	5406	143064.49	509973
50.01-100 ha	2614	187921.72	321580
100.01 - 200 ha	1950	274314.25	293356
200.01 - 500 ha	1131	334205.42	241661
500.01 - 1000 ha	211	142554.11	58809
> 1000 ha	55	121787.88	21076
Total	14310	1219272	1646691

Size of CF	% of area	% of HH	$\sum X_i$	$\sum Y_i$	$\sum X_i Y_{i+1}$	$\sum X_{i+1} Y_i$
< 10 ha	1.265	12.160	9.989	1.280	48.45908	27.74864
10.01-50 ha	11.734	30.970	21.680	4.851	423.3471	238.1503
50.01-100 ha	15.413	19.529	49.091	19.527	1833.124	1397.899
100.01 - 200 ha	22.498	17.815	71.589	37.342	4071.291	3248.777
200.01 - 500 ha	27.410	14.676	87.001	56.871	7642.21	5615.111
500.01 - 1000 ha	11.692	3.571	98.735	87.840	9873.498	8784.01
> 1000 ha	9.989	1.280	100.000	100.000	0	0
Total	100	100			23891.93	19311.7
			$G=1/(100)^2 (23891.93-19311.7)$			
				G =	0.458023	

Annex 2: Gini coefficient of CF distribution in Nepal by size of the forest, 2009.

Size of CF	No of Forests	Total area (ha)	Total # of HH
< 10 ha	2991	15291.9	196429
10.01-50 ha	5430	143642.9	502276
50.01-100 ha	2633	189341.1	328529
100.01 - 200 ha	1972	277492.9	302214
200.01 - 500 ha	1145	337759.2	249559

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500.01 - 1000 ha	213	144121.3	59692
> 1000 ha	55	122020.6	21076
Total	14439	1229670	1659775

Size of CF	% of area	% of HH	$\sum X_i$	$\sum Y_i$	$\sum X_i Y_{i+1}$	$\sum X_{i+1} Y_i$
< 10 ha	1.243578	11.83468	9.923035	1.269811	48.28749	27.48297
10.01-50 ha	11.68142	30.26169	21.64336	4.866202	430.7443	238.9832
50.01-100 ha	15.39772	19.79359	49.11083	19.90191	1871.616	1426.515
100.01 - 200 ha	22.56646	18.20813	71.67729	38.11005	4150.375	3318.432
200.01 - 500 ha	27.46747	15.03571	87.07501	57.90363	7676.996	5718.355
500.01 - 1000 ha	11.72033	3.596391	98.75642	88.16532	9875.642	8816.532
> 1000 ha	9.923035	1.269811	100	100	0	0
Total	100	100			24053.66	19546.3
			$G=1/(100)^2 (24053.66 \cdot 19546.3)$			
				G=	0.451	