

## ASSESSMENT OF INEQUALITY TO FOREST RESOURCES ACCESS IN THE CONTEXT OF SUSTAINABLE RURAL DEVELOPMENT

Ivan OPENKO, Oleksandr SHEVCHENKO, Ruslan TYKHENKO, Oleg TSVYAKH, Yuliia MOROZ

National University of Life and Environmental Sciences of Ukraine, 17 Vasylykivska Str., 03040, Kyiv, Ukraine, Phone:+380636792954, Emails: ivan\_openko@ukr.net, shevchenko\_ov90@ukr.net, rvytyhenko@ukr.net, 2231738@i.ua, moroz@nubip.edu.ua

*Corresponding author:* ivan\_openko@ukr.net

### **Abstract**

*The current trends in rural development, sustainable use of nature, provision of comfortable ecological, economic and social conditions for the life of the population determine the solution to the problem of inequality within the respective state and between the countries as a whole. According to the results of the study of equality of supply with natural resources, in particular, forest land we have found that the greatest imbalance in the generation of gross income from the use of forest land is determined in the Steppe natural and climatic zone (GINI = 0,53) and the Kyiv and Sumy regions, the northern part of which is located in the Polissya zone, and the southern part of the administrative unit is located in the Forest-steppe zone (GINI = 0,92). It should be noted that on all other indicators the calculated Gini index indicates a low inequality in the provision of natural resources to the population, in particular, forestry lands in the context of all natural and climatic zones of Ukraine, which is a favorable factor for rural development, the formation of environmentally-safe conditions people living and decentralization. With the help of Gini index (inequality), it is possible to formulate a conceptual direction of transformation of ecological and economic mechanisms of forest land use, the mainstream of which should approach absolute equality in providing the population with natural resources, in particular, forestry, distribution of economic income from the implementation of forestry production. safe environment and social living conditions of people in newly created UTC.*

**Key words:** *inequality, forest resources, GINI – index, united territorial communities, decentralization, sustainable rural development*

### **INTRODUCTION**

The current trends in rural development, sustainable use of nature, provision of comfortable ecological, economic and social conditions for the life of the population determine the solution to the problem of inequality within the respective state and between the countries as a whole.

The international community has made significant strides in ridding people of poverty. However, inequalities have not disappeared and persist, in particular the widening of the income gap (property inequality), the provision of food, natural resources (land, forest, water, etc.), the quality of health care and the provision of educational services, especially in rural areas of residence. most of the poor, as noted by the FAO World Organization [5].

The question of inequality in the availability of natural resources, including land for forestry purposes is of particular relevance in scientific studies of various scientists. In particular, M. L. Ross [18], which deals with the problem of the negative impact of the economic structure on economic growth, is surprised at how little is known about the definition of forest resources and inequality. The scientist says, that the study of the relationship among natural (forest) resources and property inequality is outlined only in a narrow circle of researchers.

Th. Gylfason and G. Zoega believe that there is a direct link between the level of property inequality and natural resources. Excess of natural resources can cause the outflow of employed workers from the manufacturing industry and services to the resource sector. At the same time, wage distribution in the manufacturing sector is fairly uniform (since

human capital is more or less equally distributed among the population), whereas in the sector related to the use of natural resources, income is unevenly attributed to the dependence of production on natural conditions and uneven distribution of natural resources. population [10].

Scientist F. van der Pluh emphasizes that high levels of property inequality are inherent in countries with a high share of natural resource exports in GDP, especially in cases of high levels of corruption [7].

Thus, the heterogeneity of the economic space affects the inequality of development of socio-economic urban systems, which in turn leads to the need to develop mechanisms to transform the socio-economic and environmental direction of the country's development and to carry out appropriate institutional transformations [8, 9].

Scientific studies directly addressing the issues of rational use and protection of forest land, uniform distribution between communities of forest land uses with the use of GINI index are outlined in the publications Anuja Raj Sharma [1], Sareth Nhem, Young Jin Lee, Sopheap Phin [13], Oliver T. Coomes, Yoshito Takasaki ta Jeanine M. Rhemtulla [3], Tsegaye Tadesse Gatisoa, Tesfamicheal Wossen [6], Ouedraogo Boukary, Ferrari Sylvie [16], Bir Bahadur Khanal Chhetri, Patrick Asante, Atsushi Yoshimoto [2] and others [11, 12, 14, 15].

However, the direct analysis of problems of the organization structure of the land based on Gini Coefficient (GC), engaged Xinqi Zheng, Tian Xia, Xin Yang, Tao Yuan, Yecui Hu in China [21]. During the study, scientists were asked to use Gini Coefficient not only in its classical interpretation (in quantifying differences in income) but also in assessing the rational land use structure, the so-called Land Gini Coefficient (LGC). Using this coefficient, scientists were able to find out that over the 13 years (1996 - 2008), agricultural land and unused land were evenly distributed across China. However, the land under construction was relatively or completely unequally located, which

contributed to the rapid development of urbanization processes in China.

Whereas, L. Erickson and D. Vollrath, in their scholarly work, emphasize the need to study the equitable distribution of land use among rural communities, as one of the main factors of economic and social development [4].

In addition, Sareth Nhem, Young Jin Lee, Sopheap Phin investigated and identified the distribution of forest land revenue and other variable income sources in rural communities in the Kingdom of Cambodia (Southeast Asia). participation in reducing income inequality and increasing rural poverty by using GI indicate that 'forest income' is an important part of the livelihoods in united territorial community (UTC) [13].

The purpose of our research was to definition the inequality of forest resources within the natural and climatic regions of Ukraine on the basis of the GINI index.

## MATERIALS AND METHODS

The problem of inequality of socio-economic development of regions and increasing of environmental burden on the environment requires conceptual directions of transformation of ecological and economic mechanisms of forest land use [8, 9].

Thus, the next stage of our study was to study the dynamics of inequality of regions in our country on the basis of environmental indicators – “... a summary (generalizing) indicator of the quality of socio-economic development of the territories, reflecting in general the level and degree of anthropogenic impact on the environment” [8, 19], in the conditions of decentralization of power, using the most common indicator – the Gini index.

The idea of the study is based on the definition of the Gini index between the indicators that characterize the socio-economic development of the state and its regions, in particular:

I – indicator – gross income from forestry production, thousand UAH/area of forest land, thousand hectares - establishment of inequality between income from forestry production and area of forest land in terms of

regions and natural and climatic zones will allow to form an idea about the efficiency of forest resources use;

II – indicator – gross income from forestry production, thousand UAH. / united territorial communities population, individuals - determination of the Gini index between these indicators allows to calculate the even distribution of forestry production among the population in the united territorial communities in the conditions of decentralization of power;

III – indicator – area of forest land, thousand hectares / united territorial communities, units - calculation of the Gini index between outlined indicators, in our view, will allow in the future to reorient the economic direction of production in the respective communities in terms of decentralization of power, to form preconditions for the intensification of effective use of land forestry purposes;

IV – indicator – area of forest land, thousand hectares / population, persons - this ratio will allow to determine the degree of concentration of forest land among the population, which is a very important environmental and economic factor for the population;

V – indicator – area of forest land, thousand hectares/population of UTC, persons - this indicator will allow to measure the level of forest concentration in the UTC power. In this case, the Gini Index will be the main criterion for developing conceptual solutions in providing an environmentally friendly environment for rural livelihoods.

Gini Coefficient (GC) – a statistical indicator of the degree of stratification of society in a given country or region in relation to any studied trait. Used to estimate economic inequality ("economic inequality is the difference in economic well-being between individuals within a group, between population groups, or between countries") [17]. In absolute terms, this coefficient varies from 0 to 1. The greater its value deviates from 0 and approaches one, the greater the income is concentrated in the hands of individual populations. Sometimes this

percentage coefficient is used - the Gini index (GI) [20].

The Gini coefficient is calculated by the formulas 1, 2 [21].

$$G = \frac{1}{n}(n+1) - 2 \left( \frac{\sum_{i=1}^n (n+1-i)y_i}{\sum_{i=1}^n y_i} \right) \quad (1)$$

or

$$G = \frac{2 \sum_{i=1}^n (i)y_i}{n \sum_{i=1}^n y_i} - \frac{n+1}{n} \quad (2)$$

where:  $y_i$  = quantities for some general set of elements  $i = 1$  to  $n$ .

## RESULTS AND DISCUSSIONS

The calculation of the Gini index between the outlined indicators in Ukraine was carried out by the array of data by region  $x_i$  and  $y_i$ , pre-ranked in ascending order  $y_i / x_i$ . A positive aspect of the application of this coefficient is its applied nature and flexibility in interpretation, which allows us to assess interregional inequalities in the use of forest land [7].

Found in the Forest-steppe (GINI = 0.28), Polissya climatic zone and the Carpathians (GINI = 0.24) gross income from forestry production is evenly generated from the area of forest land, unlike in the Steppe zone (GINI = 0.53) where forest land use is inefficient.

The largest inequality by II indicator is similarly observed in the Steppe (GINI = 0.42) natural and climatic zone, which indicates the uneven distribution of income from forestry production among the population of the united territorial communities under decentralization.

The inequality in III – indicator in all natural and climatic zones of Ukraine is moderate, that is, the lands of forestry destination are evenly concentrated between UTC.

According to IV – indicator in all natural and climatic zones of Ukraine, low level of inequality between the population in the provision of forest lands is caused.

Similar is the differentiation of forest lands between the UTC population under decentralization, as evidenced by the low Gini

index by V – indicator in all natural and climatic zones of Ukraine.

According to the results of the study of equality of supply with natural resources, in particular, forest land we have found that the greatest imbalance in the generation of gross income from the use of forest land is

determined in the Steppe natural and climatic zone (GINI = 0.53) and the Kyiv and Sumy regions, the northern part of which is located in the Polissya zone, and the southern part of the administrative unit is located in the Forest-steppe zone (GINI = 0.92) (Table 1).

Table 1. Generalized values of the Gini index by specific indicators in terms of natural and climatic zones of Ukraine

Name of the climate zone	Indicators				
	I	II	III	IV	V
	Gross income from forestry production, thousand UAH/Area of forest land, thousand ha	Gross income from forestry production, thousand UAH. / Population of UTC, persons	Area of forest land, thousand hectares / Amount of UTC, units.	Area of forest land, thousand hectares / Population, persons	Area of forest land, thousand hectares / population of UTC, persons
GINI index					
Polissya and Carpathians	0.24	0.29	0.14	0.10	0.18
North part of Polissya, South part of Forest-steppe (Kyiv, Sumy region)	0.92	0.87	0.13	0.20	0.13
Forest-steppe	0.28	0.26	0.12	0.18	0.15
Steppe	0.53	0.42	0.17	0.21	0.17

Source: own calculations.

Similar is the situation in the inequality in the distribution of gross forestry production among the population of the UTC in the conditions of decentralization of power - in the Steppe natural and climatic zone (GINI =

0.42) and the Kyiv and Sumy regions, the northern part of which is in the Polissya zone, and the southern part of the administrative unit is located in the Forest-steppe zone (GINI = 0.87).

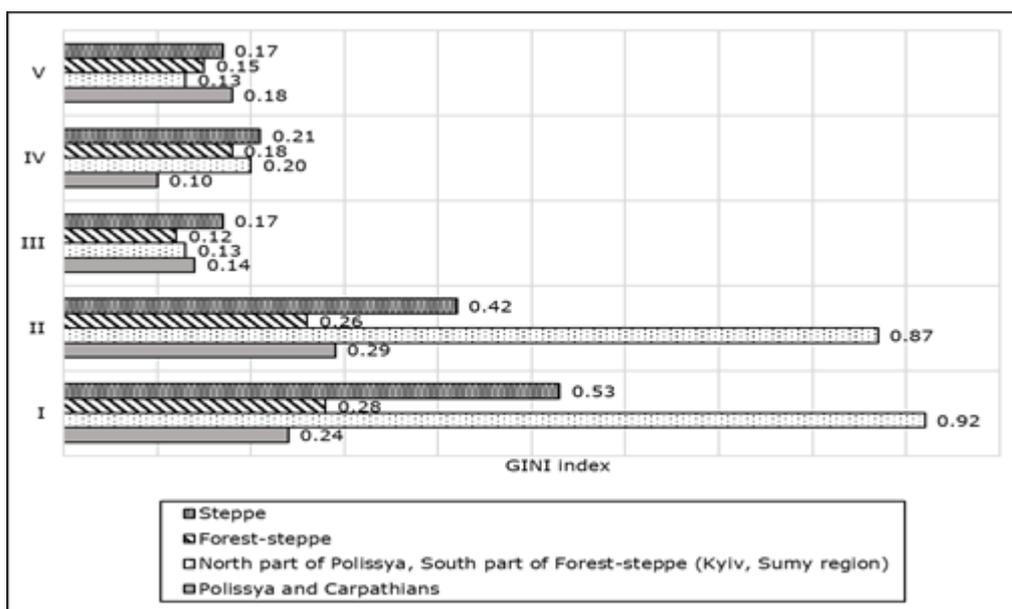


Fig. 1. Gini index chart by specific indicators in terms of natural and climatic zones of Ukraine

Source: author's calculations.

In the areas of Polissya, Carpathian, and Forest-steppe moderate equality is observed (Fig. 1).

## CONCLUSIONS

It should be noted that on all other indicators the calculated Gini index indicates a low inequality in the provision of natural resources to the population, in particular, forestry lands in the context of all natural and climatic zones of Ukraine, which is a favorable factor for rural development, the formation of environmentally-safe conditions people living and decentralization.

With the help of Gini index (inequality), it is possible to formulate a conceptual direction of transformation of ecological and economic mechanisms of forest land use, the mainstream of which should approach absolute equality in providing the population with natural resources, in particular, forestry, distribution of economic income from the implementation of forestry production. safe environment and social living conditions of people in newly created UTC.

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## REFERENCES

- [1]Anuja, R. S., 2010, Using GINI coefficient for analysing distribution of community forests in Nepal by development and ecological regions. *International Journal of Social Forestry (IJSF)*, Vol. 3(1): 17 – 27.
- [2]Chhetri, K. B. B., Asante, P., Yoshimoto, A., 2016, Forest Dependence and Inequality: An Empirical Study from Community Forests in Kaski, Nepal. *FORMATH*, Vol. 15, pp. 33 – 43.
- [3]Coomes, O. T., Takasaki, Y., Rhemtulla, J. M., 2016, Forests as landscapes of social inequality: tropical forest cover and land distribution among shifting cultivators. *Ecology and Society*, Vol. 21(3): 20.
- [4]Erickson, L., Vollrath, D., 2004, Dimensions of Land Inequality and Economic Development. *International Monetary Fund*, p. 23. <https://www.imf.org/external/pubs/ft/wp/2004/wp04158.pdf>, Accessed 23.01.2020.
- [5]FAO, 2015, Sustainable Development Goals. Reduce inequality within and among countries. <http://www.fao.org/sustainable-development-goals/goals/goal-10/en/>, Accessed 20.11.2019.
- [6]Gatiso, T. T., Wossen, T., 2015, Forest dependence and income inequality in rural Ethiopia: evidence from Chilimo-Gaji community forest users. *International Journal of Sustainable Development & World Ecology*, Vol. 22(1):14 – 24.
- [7]Gonotskaya, Zh. A., 2013, Property inequality and the resource curse: points of view and empirical evidence. Moscow: Vysshey shkoly ekonomiki, 32 p. (in Russian).
- [8]Gorsky, A. M., 2013, Research of inequalities of sustainable development of regions of Ukraine in the discourse of ecological safety. *Efektivna ekonomika (electronic journal)*, Vol. 11. <http://www.economy.nayka.com.ua/?op=1&z=2511>, Accessed on 20.11.2019).
- [9]Granberga, A. G., 2000, Regional development: the experience of Russia and the European Union. Moscow: Ekonomika. (in Russian).
- [10]Gylfason, Th., Zoega, G., 2002, Inequality and Economic Growth: Do Natural Resources Matter? <https://www.semanticscholar.org/paper/Inequality-and-Economic-Growth%3A-Do-Natural-Matter-Gylfason-Zoega/bbf5aedf39dd25da5222f7173581f9f55618a0a#paper-header>, Accessed on 20.11.2019).
- [11]Ievsiukov, T., Openko, I., 2014, An Inventory Database, Evaluation and Monitoring of Especially Valuable Lands at Regional Level in Ukraine. Abstracts. 3rd International Geography Symposium, Geomed 2013. Vol: 120, 513-523.
- [12]Martyn, A., Openko, I., Ievsiukov, T., Shevchenko, O., Ripenko, A., 2019, Accuracy of geodetic surveys in cadastral registration of real estate: value of land as determining factor. 18th International Scientific Conference. Engineering for Rural Development, 22-24.05.2019 Jelgava, Latvia. pp. 1818 – 1825
- [13]Nhem, S., Lee, Y. Jin, Phin, S., 2018, Forest income and inequality in Kampong Thom province, Cambodia: Gini decomposition analysis, *Forest Science and Technology*, Vol. 14(4):192 – 203.
- [14]Openko, I., Shevchenko, O., Zhuk, O., Kryvoviaz, Ye., Tykhenko, R., 2017, Geoinformation modelling of forest shelterbelts effect on pecuniary valuation of adjacent farmlands. *International Journal of Green Economics*, Vol. 11(2):139 – 153.
- [15]Openko, I., Shevchenko, O., Tykhenko, R., Tsvyakh, O., Stepchuk, Ya., 2019, Economic analysis of deforestation impact on the yield of agricultural cultures in Ukraine. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*. Vol. 19(4):233 – 237.

[16]Ouedraogo, B., Ferrari, S., 2012, Incidence of forest income in reducing poverty and inequalities: Evidence from forest dependant households in managed forest' areas in Burkina Faso, Cahiers du GREThA, Vol. 2012-28. <http://ideas.repec.org/p/grt/wpegrt/2012-28.html>, Accessed on 20.11.2019.

[17]Piketty, T., Goldhammer, A., 1971, Capital in the twenty-first century. Cambridge Massachusetts, VIII, 685 p., <http://www.worldcat.org/title/capital-in-the-twenty-first-century/oclc/858914389>, Accessed on 20.11.2019.

[18]Ross, M. L., 2007, How Mineral Rich States Can Reduce Inequality. Escaping the Resource Curse. N.Y.: Columbia University Press, 237 – 255.

[19]Sadykova, E. Ts., 2009, Otsenka prirodoyemkosti kak indikatora kachestva sotsial'no-ekonomicheskogo razvitiya regiona (Assessment of nature intensity as an indicator of the quality of the socio-economic development of the region). Ekonomika prirodopol'zovaniya, Vol. 2, 11 – 22. (in Russian).

[20]Toma, E., Vlad, I. M., 2018, Land concentration changes in Romania during 2002-2016 period. University of Agronomic Sciences and Veterinary Medicine of Bucharest. Agrolife Scientific Journal, Vol. 7(1):137 – 142.

[21]Zheng, X., Xia, T., Yang, X., Yuan, T., Hu, Y., 2013, The land Gini coefficient and its application for land use structure analysis in China. PLoS ONE. 8(10):e76165. DOI:10.1371/journal.pone.0076165.