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Measuring Well-Being Index with Environmental in Mind: Evidence Forest Land Use in Indonesia

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ABSTRACT
This project aims to create an objective composite well-being index from the point of view of the whole by using a complete welfare methodology and suggested weightings to take into account the differences between the components. Forestry total productivity (TFP) was also compared because of the importance of the environmental component in preparing the well-being index. This study examined 64 social, economic, environmental, and institutional indicators from the BPS-Statistics Indonesia, the Ministry of Environment and Forestry, and the National Disaster Management Agency. Three primary analysis elements were highlighted in this investigation. First, PCA created a weighted index of eleven essential domains. Second, it creates a well-being index model for Indonesia's environmental sustainability. Third, comparing forestry's environmental dimension to its TFP. This study found that the Indonesian well-being model under construction weighs environmental quality living conditions, including housing and happiness. Indonesia's disaster-prone locations make environmental quality necessary, unlike other well-being indices. Forest degradation has decreased the composite wellbeing index, notwithstanding other socio-economic improvements. This study stands out from past research by being the first to compare the environmental dimension with forestry total factor productivity (TFP). Deforestation significantly affects the well-being index in Indonesia.

Keywords: Indonesian Index of Well-Being, SDGs; Environment; Welfare Sustainability; Forest Degradation

INTRODUCTION

The measurement of well-being is often categorized into two distinct approaches, including objective and subjective (Bleys, 2012). The objective approach is often carried out by observing tangible observable facts comprising economic, social, and economic conditions. According to previous studies, Gross Domestic Product (GDP) is a one-dimensional measure often used to measure well-being objectively. Meanwhile, the subjective approach assesses personal feelings or experiences (Romina Conceicao, 2008).

International interest in well-being studies has experienced a significant increase in recent years due to the "Beyond GDP" initiative (Boarini et al., 2014; Durand, 2015; Stiglitz & Sen, 2009). This increased interest has spurred investigative endeavors to measure well-being and progress across various countries at different stages of development. GDP has been reported to have limitations in measuring well-being. This is because GDP growth does not necessarily equate to an increase in household income, and it often fails to account for disparities in economic resources and opportunities among people and households with different characteristics. Furthermore, this measure exhibits a negative correlation with leading indicators of environmental performance, such as environmental pollution.

The well-being of society can be comprehended from both an objective and environmental perspective, stemming from actual life experiences (Ivković et al., 2014). Furthermore, it is a metric for assessing human well-being within a given area (Summers et al., 2014). According to Helliwell (2003), its direct benefits are intricately linked to economic and government affairs affecting people. Several studies have been carried out on the development of a national well-being index using variables related to human capital, social capital, and environment to assess life satisfaction at the country level (Vemuri & Costanza, 2006). These efforts have also led to the creation of an economic well-being index from 4 dimensions, namely the flow of consumption, wealth, equality, and economic resilience (Osberg & Sharpe, 2002, 2005). Other reports assessed the standard of living and quality of life using multidimensional analysis (Bérenger & Verdier-Chouchane, 2007), and also investigated happiness (Blanchflower & Oswald, 2004); polarization in well-being (Peiró-Palomino & Picazo-Tadeo, 2017), and complex dimension (Balestra et al., 2018; Chaaban et al., 2016; D'Acci, 2011; D'Ambrosio et al., 2020; Peiró-Palomino & Picazo-Tadeo, 2017).

Indonesia currently lacks a comprehensive measurement framework for evaluating "Beyond GDP" factors. The country also continues to rely on GDP as its measure of economic prosperity. Apart from GDP, the Human Development Index is often utilized to assess development progress. The happiness index, which takes into account various factors, including personal income satisfaction and perceptions of educational opportunities, is also used as a measure of compassion and meaning (Bleys, 2012). However, these various indices are often computed and considered in isolation. Reflecting on several OECD member countries, well-being index has been calculated, making it a benchmark for a country well-being. This complexity is necessary to provide a comprehensive view.

The measurement of well-being index in several countries often refers to the OECD conceptual framework, which comprises three crucial domains (OECD, 2021). First, material living conditions consist of consumption and available resources. Although this is typically reflected in GDP, it extends to non-market activities that enhance people overall consumption. This domain consists of key indicators, such as income, wealth, jobs, earnings, and housing. Second, the quality of life is defined by a spectrum of non-monetary attributes that shape individuals' life opportunities and experiences, holding intrinsic value across various cultures and contexts. This domain consists of health status, work-life balance, education, skills, engagement, governance, social connections, environmental quality, personal security, and subjective well-being. Third, the sustainability of the socio-economic and natural systems in which people live and work plays a crucial role in ensuring sustainable well-being. The sustainability factor depends on how current human activities impact the stocks of various types of capital (natural, economic, human, and social). However, suitable indicators to describe the evolution of stocks are still lacking in many areas. Using various indicators in the preparation of well-being index, Alkire (2015) stated that a consensus on weights for each dimension or indicator was needed. The use of uniform weights runs the risk of introducing inaccuracies and inequities into the measurement. According to previous studies, several indicators are typically used to show the relationship with well-being (Papers, 2006).

One of the key factors influencing well-being on a global scale is the environment. The sustainability of the natural environment can be determined by assessing the carrying capacity of the forest as a balancer for natural ecosystems.

Deforestation as the conversion of forestry land into new agricultural land is positively correlated with household well-being (Hong et al., 2018). Although this can appear ecologically sound, deforestation causes vulnerability, leading to natural disasters (Kurniawan et al., 2022) and a quandary for the government when making related policies (Astuti et al., 2022). The economic productivity of forest and agricultural/plantation products is quite promising (Yuliani et al., 2020), and has the potential to stabilize of well-being.

This presents a unique opportunity to construct a comprehensive well-being index, with particular emphasis on the environmental aspect. Based on the diversity of Indonesian topographic conditions, it becomes imperative to measure the productivity of terrestrial ecosystems in terms of forest use as the 15th SDGs goal. Therefore, this study aims to establish Indonesian Index of Well-Being (IIW) to determine people well-being from the various dimensions of the formation. The environmental dimension is specifically examined by adding the relationship between forestry output and its determinants to produce forestry total factor productivity (TFP). The primary aim is to provide the government with valuable insight for setting forest policy priorities in line with the characteristics of the Indonesian people. Measurement of well-being is at the core of public policy, which is useful for monitoring progress, informing policy design, and policy assessment (Dolan et al., 2011). The formation of the index in this study began with the identification of the appropriate weighting using factor analysis and the formation of dimensions/domains and indicators adjusted to the data available in Indonesia.

METHOD

1. Data source

This study used various data sources to build IIW and calculate forestry Total Factor Productivity (TFP). Furthermore, the primary data sources were from the BPS-Statistics Indonesia, and the supporting data were obtained from the Ministry of Environment and Forestry (MoEF) and the Disaster Management Capacity of the National Agency for Disaster Management. The panel dataset consisted of 34 provinces in Indonesia and 12 years as a cross-section and time series, respectively.

The study procedures began with the development of IIW through the empirical collection of data in the context of compiling the macro well-being index. A total of 64 types of indicators were collected across various dimensions. The year 2010 was selected based on its historical usage as a reference time for formulating GDP, a measure of macro well-being in Indonesia. Furthermore, it was used as a base year to determine the development of well-being during the study period. The limitation of data that was not available in the corresponding year used data available in the nearest year.

The procedures continued with the calculation of TFP within the forestry sector. TFP was a valuable metric used to assess the productivity of several inputs in the production of specific sectors. Furthermore, it was often calculated as the ratio of the aggregate output to the aggregate input used (Coelli et al., 2005). Based on the assumption of the production of the forestry sector in the form of a Cobb-Douglas production function, an equation was constructed. The dependent variable was forestry output and the independent variables were forestry labor, capital in the form of forest and non-forest land area, and land quality index. The panel data regression model considered GDP as a proxy for economic growth (Zhang et al., 2022), with 34 provincial observation units in Indonesia and 12 years from 2010 to 2021. TFP was calculated as the difference in the provincial GRDP minus the predicted Y, which was

the sum of the multiplication of the regression coefficients and each independent variable used in the model (Beveren, 2012).

2. Factor Analysis and Principal Component Analysis (PCA)

This study compiled a composite index or a single index that summarized various well-being indicators using Principal Components Analysis (PCA) as a part of factor analysis (Vermunt & Magidson, 2004). This analysis was a statistical method used to study the dimensions of a set of variables (Asis Kumar Chattopadhyay, 2014). Alkarkhi & Alqaraghuli (2018) explained that in conducting factor analysis, the contribution of each factor to the original variable was determined by measuring the coefficients associated with each formed factor directly. This was performed to help policymakers intervene in improving people well-being. Weights that were generated by PCA were clear from a mathematical point of view (Mazziotta & Pareto, 2019). The index obtained from the first-factor principal component contributed the largest amount of the total variance of the individual indicators. PCA-based indexes had a strong tendency to represent highly interrelated indicators and ignore others. PCA was an empirical method based on observed correlations but ignored the polarity of individual indicators (Mazziotta & Pareto, 2019). In this study, it was used to calculate the weighting of the contribution of each domain.

PCA was used to calculate the domains weighted from the contribution for each variable. Furthermore, the contribution value was used as a weight/weight for each variable to produce IIW value, as shown in Table 1. The steps were taken to obtain the factors in producing the weights that was to be used in the next stage (index calculation):

a. Normalizing the data because the indicators used had different units. The unit of observation was the 34 provinces in Indonesia.
b. Testing the correlation matrix to determine the feasibility of the data using three measures, namely Barlett's test, the Kaiser-Meyer-Olkin (KMO), and the value of Measures of Sampling Adequacy (MSA).
c. Determine the number of factors generated based on the Kaiser Criterion. The number of factors generated could also be seen by using a scree plot.
d. When the resulting factor was more than one, the factor rotation was performed using varimax.
e. The percentage generated from the Rotation Sums of Squared Loadings was used as a consideration in selecting factors in a certain year and certain dimensions, and was employed as a weight for the selected factors.
f. The measure is carried out annually and on the four dimensions independently.

A particular year was selected in each dimension based on the value of the largest variation that could be explained by the factors in the dimension. It was then adjusted to the literature review to assess the composition of the indicators included in the factor. Furthermore, the dimensions in this study were used to facilitate data processing and consider the representation of the number of indicators. The preparation of IIW did not use dimensional weights but directly used domain weights.

The factors resulting from PCA processing were 11 factors, which were referred to as the domains. The domains obtained in data processing were 11, and they were built from 36 indicators that had been selected based on PCA reduction. According to the domains formed, they were further grouped into 4 dimensions, as shown in Table 1.

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Table 1. The number of indicators in the domains and the number of domains in the dimensions and the contribution to building IIW

No. Dimension	Dimension	Number of Domains in Dimension	Dimension Variation	Dimension Weighting	No. Domain	Domain Name	Number of Indicators in Domain	Domain Variations	Domain Weighting (%)
1	Environment	2	70,01	0,2409	1	Environment Quality	2	44,90	15,45
				0,2409	2	Forestry	2	25,11	8,64
2	Economy	2	67,82	0,2333	3	Living Standard and Housing	6	40,04	13,77
				0,2333	4	Labour	2	27,79	9,56
3	Social	3	77,63	0,2671	5	Health	5	28,27	9,72
				0,2671	6	Education	4	26,15	9,00
				0,2671	7	Social Security	4	23,21	7,99
4	Security, Recreation and Institutions	4	75,19	0,2587	8	Happiness	4	30,36	10,45
				0,2587	9	Disaster	3	23,42	8,06
				0,2587	10	Democracy	2	10,82	3,72
				0,2587	11	Law	2	10,58	3,64
Total		11	290,65				36	290,65	100,00

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3. The Indonesian Index of Well-Being (IIW) Framework

The conceptual framework developed in this study referred to (OECD, 2021) with adjustments to the indicators used. Compared to Sen's capability approach (Bérenger & Verdier-Chouchane, 2007), this this study focused on the standard of living and quality of life as components of well-being. This conceptual framework included both current and future well-being. Future well-being in this study was carried out by looking at natural resources with an impact on current well-being, namely environment quality and forestry. This framework was not rigid, adapted to reality, and could adapt to various conditions in developing countries (Durand, 2015).This study proposed four dimensions, namely 1) environmental, 2) economic and housing, 3) social, and 4) security, recreation, and institutional. Furthermore, the indicators in this conceptual framework were derived from empirical data. The calculation of IIW modified the method of calculating the Canadian Index of Well-Being (CIW) by using a weight and presenting it with various possibilities when the weight was either used or not (A. Michalos et al., 2011). This was intended to provide an overview of the effect of weighing in the preparation of the composite index, as shown in Figure 1.

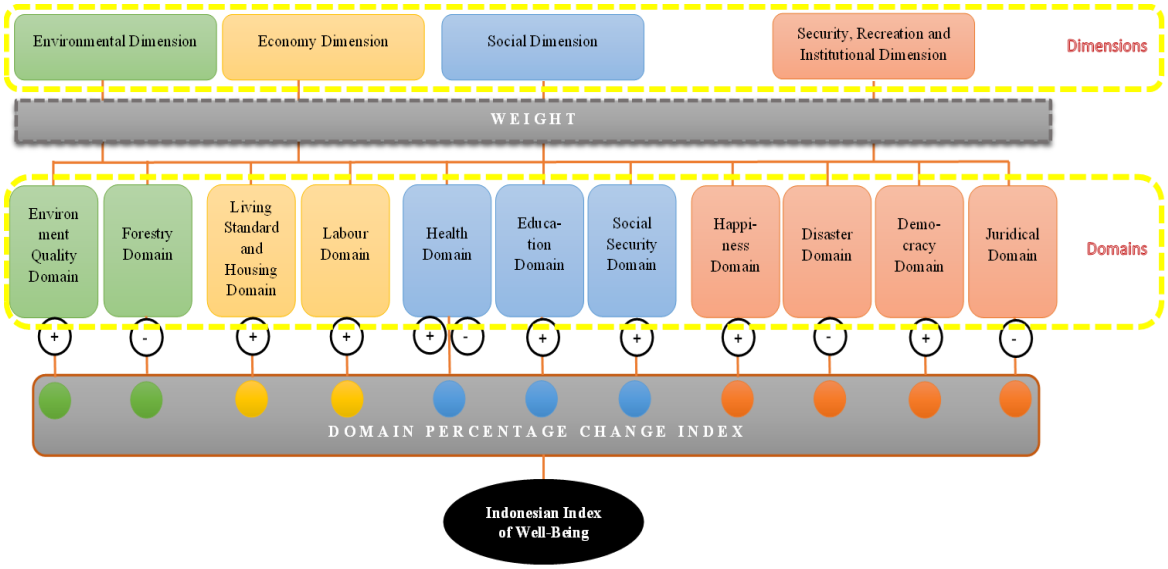

Figure 1. IIW Framework

Based on Figure 1, a positive sign (+) indicated that the indicators in the domains had a positive effect on the index. Meanwhile, a negative sign (-) showed that the indicators in the domains had a negative effect on the index. The steps taken in calculating IIW using the weights generated in the previous stages were as follows:

a. Using indicators that had been selected based on PCA (a total of 36 indicators in Table 2).
b. Classifying indicators into 2 types of characteristics, namely positive indicators, and negative indicators. A positive indicator showed the presence of an increase in the numerical value, reflecting an improvement in well-being. Meanwhile, a negative indicator showed a decrease in the numerical value, reflecting a decline in well-being. The majority of indicators used were positive. In this study, there were 8 negative indicators in 4 domains, namely:
    a) The forestry domain had 2 negative indicators, namely the net deforestation rate inside the forest area and the net deforestation rate outside the forest area.

b) The health domain had 1 negative indicator: the percentage of health complaints.
c) The disaster domain had 3 negative indicators, namely the number of the disaster, the number of victims, and the amount of damage caused by the disaster.
d) The legal domain had 2 negative indicators, namely the risk of the population being punished and the number of criminal acts.

c. Determine the base year to be used, namely 2010, which was the base year for calculating GDP as the basis for determining well-being. This indicator was also used in the living standard domain, which had the largest number of indicators and a high contribution to the composite index.
d. Using the base year as a reference for indicators in the following year to produce a domain percentage change index called I (Michalos et al., 2011). If Ipct was the percentage change index indicator in year t, i_t was the indicator value in year t, and i_b was the indicator value in the base year, then the formula used for positive indicators was:

$$I_{ipct} = \frac{i_t}{i_b} \times 100 \quad (1)$$

the formula used for negative indicators was:

$$I_{ipct} = \frac{1}{i_t/i_b} \times 100 \quad (2)$$

Using this formula, a total of 432 indices of percentage change was obtained by multiplying 36 by 12, providing a comprehensive description of the index development based on year-to-year indicators.
e. Calculating the domains percentage change index by performing an arithmetic average of the indicators in the domains. A total of 132 indexes were obtained by multiplying 11 (a total of domains) by 12 (a total of years), and they described the development of the index by domain from year to year.
f. Calculating IIW by adding up the multiplication of the domains percentage change index and the weight.

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Table 2. Indicators (variables) in Calculation of Indonesia's Wellbeing Index

No	Dimension	Domain	Indicators (Variable)	Description	Source	Reference (Year)
1	Environment	Environment Quality	1. Air Quality Index (IKU) 2. Water Quality Index (IKA)	1. Air Quality Index is a number used to assess air pollution in an area. 2. Water Quality Index is a measure used in assessing water pollution in an area.	Ministry of Environment and Forestry (MoEF)	2010-2019
	Environment	Forestry	1. Indonesia's Net Deforestation Rate Within Forest Areas (Ha/Th) 2. Indonesia's Net Deforestation Rate Outside Forest Areas (Ha/Th)	1. Change/reduction of land cover area with forested category in a certain period of time obtained from the calculation of gross deforestation area minus the area of reforestation in forest areas. 2. Change/reduction of land cover area with forested category in a certain period of time obtained from the calculation of gross deforestation area minus the area of reforestation outside forest areas.	Statistics Indonesia	2014-2020
2	Economy and Housing	Living Standard and Housing	1. GDRP per capita (Thousand Rupiah) 2. Gross Fixed Capital Formation (GFCF) Current Price (Thousand Rupiah) 3. Percentage of households with access to proper sanitation (percent) 4. Percentage of households that have access to safe drinking water (percent) 5. Percentage of households using electricity as an energy source (PLN) (percent) 6. Percentage of Households by Province, Type of Region and Status of	1. Gross Regional Domestic Product (GDRP) per capita is the amount of the average income of the population in an area. 2. GFCF is defined as the addition and subtraction of fixed assets in a production unit 3. Proportion of households having defecation facilities that are used alone or with certain (limited) households or in communal toilets, using goose-neck toilets, and final disposal of feces in septic tanks 4. The proportion of households with sustainable access to safe drinking water is the ratio between households with access to quality (decent) drinking water sources and all households, expressed as a percentage. 5. Percentage of households that use electricity (PLN) as the main source of lighting 6. Percentage of households that have contracted or rented house ownership status	Statistics Indonesia	2010-2021, except Indicator (6) from 2010-2015 and 2019-2021

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No	Dimension	Domain	Indicators (Variable)	Description	Source	Reference (Year)
			Ownership of Contracted/Leased Houses (Percent)			
	Economy and Housing	Labor	1. Employment Opportunity Rate (% Employed/AK) 2. Labor Force Participation Rate	1. Percentage of population aged 15 years and over who work in the labor force. 2. Residents who are not included in the labor force are people of working age (15 years and over) who are still in school, taking care of the household or carrying out other activities other than personal activities.	Statistics Indonesia	2010-2021
3	Social	Health	1. Percentage of Deliveries in Health Care Facilities 2. Percentage of Population with Health Complaints During the Last Month 3. Percentage of Toddlers Who Ever Received Measles Immunization (Percent) 4. Presentation of Toddlers who received complete Immunizations (Percent)	1. Percentage of ever-married women aged 15-49 years whose last delivery was in a health facility 2. Percentage of population who have complaints. A health complaint is a condition of a person experiencing a health or mental disorder, either due to an acute illness, a chronic illness (even though he has not had any complaints for the past month), an accident, a crime or other things. 3. Percentage of children under five who have received measles immunization 4. Percentage of children under five who have received complete immunization in the form of immunization. Complete basic immunization itself consists of 1 dose of Hepatitis B, 1 dose of BCG, 2 doses of DPT-Hepatitis B, 4 doses of polio, and 1 dose of measles.	Statistics Indonesia	2010-2021, except indicator (4) only from 2015-2018
	Social	Education	1. Percentage of early childhood (5-6 years) who have attended/are currently attending early childhood education 2. Average Years of Schooling 3. Gross Enrollment Rate (GER) for Elementary School 4. Middle School Gross Enrollment Rate (GER)	1. Percentage of children aged 5-6 years who attend non-formal education at the level of Early Childhood Education (PAUD) 2. The average number of years spent by residents aged 15 years and over to take all types of education that have been undertaken. For those who finished elementary school, the length of schooling was calculated for 6 years, graduating from junior high school was calculated for 9 years of schooling, graduating from high school was calculated for 12 years of schooling without taking into account whether they had stayed in class or not. 3. Comparison between the number of people who are still in school at the elementary education level/equivalent to the	Statistics Indonesia	2010-2021

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No	Dimension	Domain	Indicators (Variable)	Description	Source	Reference (Year)
			5. High School Gross Enrollment Rate (GER)	number of people who meet the official requirements for the population of school age at the same level of education, namely 7-12 years. 4. Comparison between the number of people who are still in school at the junior high school education level/equivalent to the number of people who meet the official requirements for the population of school age at the same level of education, namely 13-15 years. 5. Comparison between the number of people who are still in school at the junior high school education level/equivalent to the number of people who meet the official requirements for the population of school age at the same level of education, i.e. 16-18 years.		
	Social	Social Protection	1. Life Expectancy (AHH) 2. Percentage of Population Having Health Insurance by Type of Insurance - BPJS Kesehatan Non-Recipient of Contribution Assistance (Non-PBI) 3. Percentage of Population with Health Insurance by Type of Insurance - Private Insurance 4. Percentage of Population with Health Insurance by Type of Insurance - Company/Office	1. The average years of life that will still be lived by a person who has succeeded in reaching age x, in a given year, in a mortality situation prevailing in his community. 2. Percentage of population who have BPJS Non-PBI health insurance or insurance 3. Percentage of population with private health insurance or insurance 4. Percentage of population who have insurance or health insurance provided independently by the company or office	Statistics Indonesia	2017-2021
4	Safety, Recreation, and Institution	Happiness	1. Life Satisfaction Index 3. Feeling Index	1. Number that showing personal life satisfaction and social life satisfaction covering 10 (ten) domains related to essential aspects of human life, namely: education, work, household income, physical and mental health (loneliness), family harmony, availability of free time, social relations, environmental conditions, and security conditions, as well	Statistics Indonesia	2014, 2017 dan 2021

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No	Dimension	Domain	Indicators (Variable)	Description	Source	Reference (Year)
				as housing conditions and home facilities. This index is one of the dimensions in the Indonesian happiness index. 2. Number that shows the feeling (affect) which is divided into 3 (three) indicators, namely feeling happy, not worried/anxious, and not depressed. This index is one of the dimensions in the Indonesian happiness index.		
	Safety, Recreation, and Institution	Natural Disaster	1. Number of Disasters 2. Number of Disaster Victims 3. Amount of Disaster Damage	1. The number of disaster events is the number of disaster events that occur in an area during a certain year according to the type of disaster and the location of the disaster. 2. The number of victims of a disaster is the number of victims of a disaster that occurred in an area and within a certain period of time 3. The amount of disaster damage is the amount of damage caused by a disaster occurring in an area and within a certain period of time.	The Disaster Management Capacity of National Agency for Disaster Management	2010-2021
	Safety, Recreation, and Institution	Democracy	1. Indonesian Democracy Index-Civil Liberties Aspects 2. Indonesian Democracy Index-Aspects of Political Rights	1. Numbers that referring to freedom of assembly and association, freedom of opinion, freedom of belief, and freedom from discrimination. 2. Numbers that refer to the right to vote and be elected as well as Political participation in Decision Making and Monitoring	Statistics Indonesia	2010-2020
	Safety, Recreation, and Institution	Juridical	1. Criminal Risk 2. Number of Criminals	1. Numbers that show the risk of the Population Affected by Crime (Per 100,000 Population) 2. Numbers that show the number of criminal acts according to the regional police	Statistics Indonesia	2010-2020

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RESULTS AND DISCUSSION

As a first step, constructing well-being index required a weight for each domain. This study produced 11 domains from 64 indicators, which were generated from PCA. Furthermore, this analysis provided insights into the contribution of each domain. The largest domain weighting was the Environment Quality Domain, as shown in Table 1. This indicated that the role of the natural environment in Indonesia was a determinant of well-being. Water quality, air quality, and forest degradation had the highest contribution to well-being with an objective approach. This domain had a contribution that exceeded the Living Standard and Housing, with the Happiness aspect coming third. The other eight domains could not be ignored as they were a reflection of several indicators that were selected as important contributors to well-being index (Figure 2).

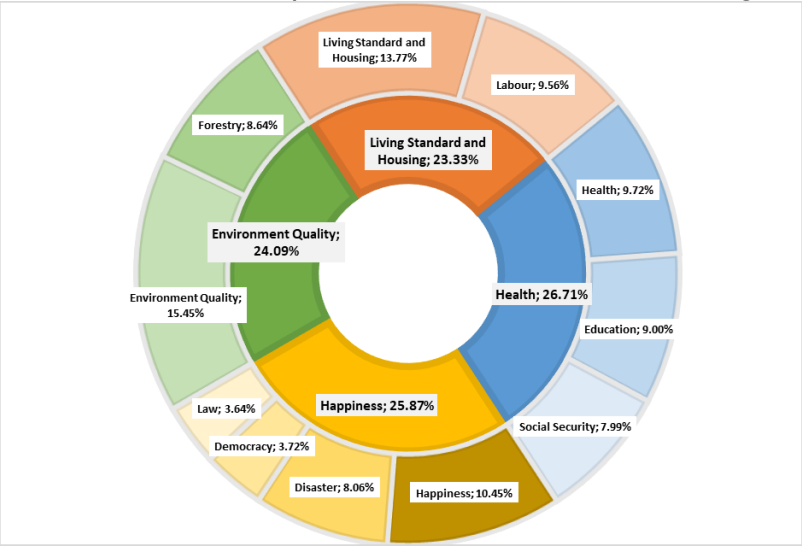

Figure 2. The Contribution of Indicators to Domains and Domains to Dimensions

Well-being index proposed in this study used domain weights, which were described in the index formula in a particular year as follows:

$$IIW_t = \sum_{i=1}^{11} \left[W_i \times \left\{ \frac{\sum_{j=1}^{m} I_{ipct}}{j} \right\} \right] \quad (3)$$

IIW is the Indonesian Index of Well-Being, t is the period (year), i is the domain, Wi is the weight in the i-th domain, j is the indicator in the domain, m is the number of indicators in the domain, and Iipct is the domain percentage change index. IIW in a particular year was calculated by summing the multiplication of the domain weight with the average domain percentage change index.

The results showed that IIW fluctuated from year to year, as shown in Figure 3. Although it had an increasing trend in the last decade, IIW had decreased in some years. Furthermore, the decline against the previous years occurred in 2011, 2012, 2016, and 2020. Based on the pattern of the constituent domain numbers, this condition was due to the Natural Disaster Domain in those years and also the Health Domain caused by COVID-19 in 2020.

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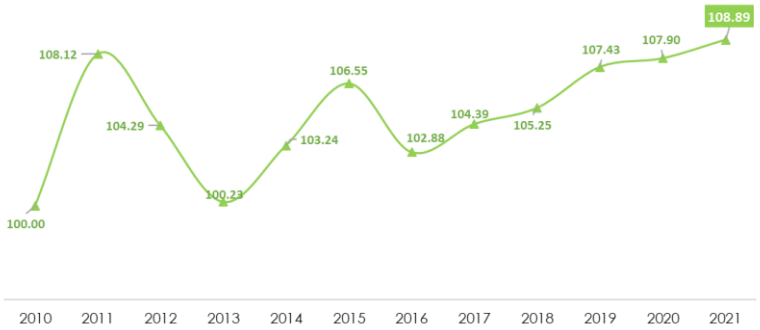

Figure 3. IIW in 2010-2021

This study did not include provincial figures (only national level) because some indicators in the Forestry Domain and Disaster Domain were zero. Assuming that there was no disaster in a certain province in a particular year, then the index value in the domains was likely to be zero. This indicated that when multiplied by the weights, it was also meaningless. Therefore, the distribution at the provincial level had no meaning, serving as a limitation in this study.

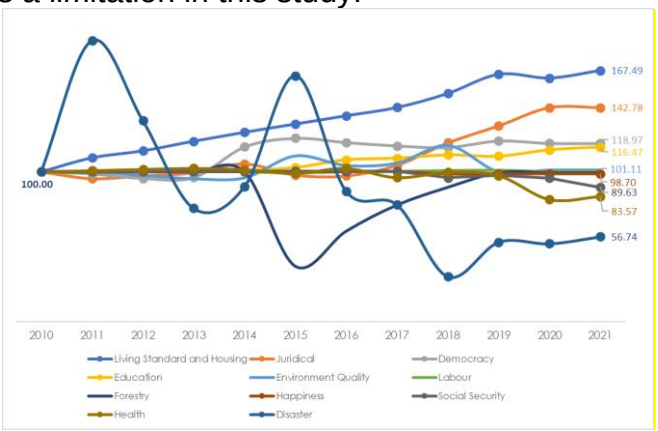

Figure 4. IIW by Domains, 2010-2021

Based on Figure 4, the domain that had persistently increased was the Living Standards and Housing. This was an important component of the stability of well-being in Indonesia. Furthermore, domains in the Social Dimension generally increased slowly, and a similar trend was observed in the Security, Recreation, and Institutional Dimensions except for the Disaster Domain. The Democracy and the Juridical Domain experienced high increases for several years at the end of the study period. The Environment Quality Domain with the largest contribution to IIW tended to be stable. This was inconsistent with the Forestry Domain, which was still in the same dimension of environment. Forest degradation occurring in Indonesia caused sharp fluctuations in the index. The influence of nature also caused the Desaster Domain to be poorly controlled, thereby leading to fluctuations in IIW.

Forest degradation was an interesting topic for forest-rich Indonesia. This study calculated forest productivity using TFP and compared the pattern with the index in the Forestry Domain. Fluctuations in the Forestry Domain Index did not occur in forest productivity. Despite considerable land degradation in Indonesia, the value-added generated from the forestry sector of the economy was still increasing.

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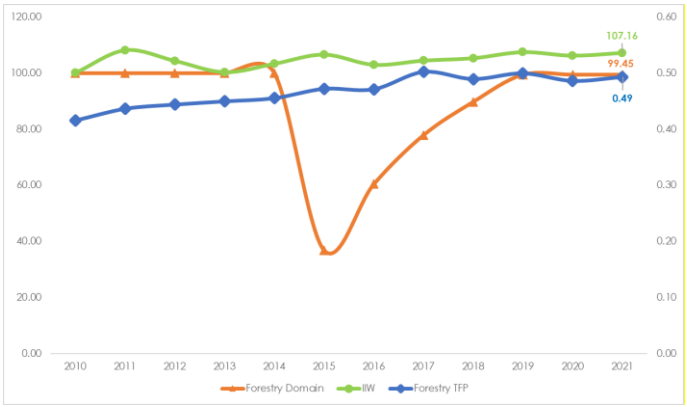

Figure 5. Forestry TFP, Forestry Domain Index and IIW

Forestry TFP as a proxy of productivity in the forestry sector was closely associated with the value added generated in the forestry sector (Forestry GRDP) (Table 3). The correlation of Forestry TFP with IIW also had the same direction as GDP but was weaker. However, this was not the case with the correlation of TFP with the Domain Index. Forestry productivity was inversely but weakly correlated with the Domain Index, which was composed of deforestation indicators.

Table 3. Pearson Correlation Forestry GDP, Forestry TFP, Forestry Domain Index and IIW

Description	Forestry GDP	Forestry TFP	Forestry Domain Index	IIW
Forestry GDP	1.0000			
Forestry TFP	0.9118	1.0000		
Forestry Domain Index	-0.0307	-0.2265	1.0000	
IIW	0.5653	0.5229	-0.0915	1.0000

The measure that had been used in measuring the value added of a sector could have a different pattern from the measurement using the concept built by well-being index. This could also be seen when the trend index of IIW was compared with the trend index of GDP and HDI. Values above 100 indicated improvements and values below 100 showed deterioration. The results showed that GDP had increased significantly over the past 12 years (+61.99). However, this was not the case with IIW, which increased slightly (+8.89), and improvements in well-being were only approximately 8.99 for 12 years. The trend index of GDP as a measure that was often used today had a very different pattern from IIW. Based on the results, the trend index of HDI tended to be more stable because it only consisted of some of the components in the preparation of IIW. Compared to the calculation method, IIW and the weights generated in this study (weights from PCA) had the advantage of avoiding upward bias when calculated using the same weights on all indicators (64 indicators). At the same time, it could avoid downward bias when calculated using the same weights on 11 domains, as shown in Figure 6.

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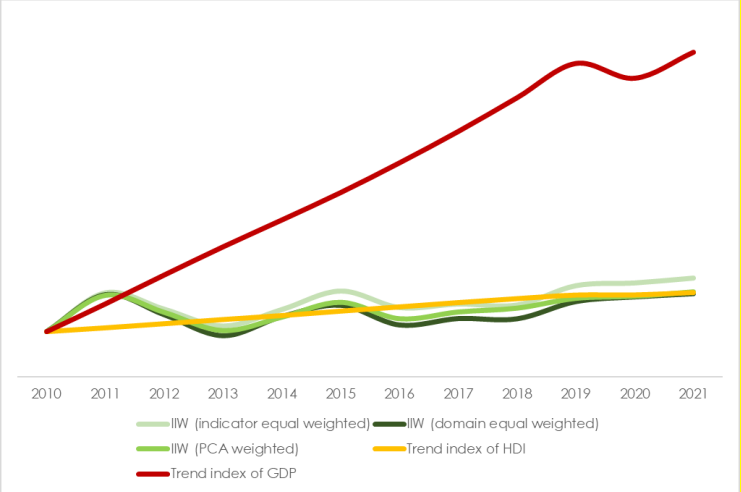

Figure 6. Forestry TFP, Forestry Domain Index and IIW

Discussion

Indonesia often used GDP as a measure of well-being, and it had been identified as a measure of social well-being (England W., 1998). This is still needed even though GDP could not measure sustainability in terms of both well-being and income (Khanfer et al., 2013). IIW in this study was not proposed to replace GDP, but to serve as a comprehensive measure of well-being that used one number. The single use of GDP measure to describe well-being could be misleading for policymakers. This indicated that IIW must be compiled annually to describe people well-being from the economic and non-economic aspects. The results of this study showed that IIW was more appropriate compared to GDP.

The index distribution at the provincial level could not be illustrated due to its less meaningful value. This was because when certain indicators at the provincial level were zero, the index obtained remained zero when it was multiplied by the weights. However, when the index was aggregated nationally, this weakness was expected to be reduced. IIW obtained was better compared to other frequently used measures, including GDP, HDI, and their constituent indicators.

GDP growth was a measure that had the highest upward trend compared to HDI and IIW. Similar results were obtained in the United States, Britain, Canada, Australia, Norway, and Sweden well-being index studies from 1980 to 1999 (Osberg & Sharpe, 2002). Osberg & Sharpe (2005) compared well-being index compiled with HDI in this study. The results showed that HDI was closer to IIW result compared to GDP growth. As a composite indicator for human development, HDI was more stable because it did not consider environmental damage and disasters that could threaten human life. IIW tends to decrease when disaster occurs. Therefore, IIW was often recommended in the context of achieving the SDGs because it includes all components that may ensure human welfare.

The index movement in the economic dimension experienced a steadily increasing trend except during the COVID-19 pandemic. Economic contraction occurred in several economic indicators, such as GRDP per capita and labor in 2020, and these economic indicators rebounded in 2021. Meanwhile, the index for dimensions other than the economy fluctuated. The strength of the increase in IIW was in the economic dimension, with indicators that had an increasing trend. The divergent pattern of this economic dimension was due to a fairly high increase in most of the indicators in this

dimension. The social dimension had a divergent pattern due to a decrease in its constituent indicators compared to the base year, specifically social security in terms of private insurance, insurance from companies/offices, as well as immunization for children under five. The dimensions of security, recreation, and institutions had the opposite pattern to the economic dimension with the curve pattern being divergent due to disasters.

This decrease also occurred in the indicators of happiness related to life satisfaction both personally and socially. Meanwhile, indicators of happiness related to affection and the meaning of life as well as those in the legal domain experienced an increasing trend. However, the increase in these indicators was smaller compared to the decline in those in the disaster domain. Disaster indicators also had a fluctuating pattern, indicating that disaster mitigation in Indonesia had not succeeded in maintaining well-being of the victims. According to previous studies, the forestry domain appeared real and had a fluctuating pattern. Deforestation was also associated with catastrophic forest fires. This domain caused the lack of better development in the environmental dimension. Environment quality was reported to play an important role in increasing the index in the environmental dimension and it had the largest contribution to the diversity of IIW.

When broken down by domain, the Living Standards and Housing Index was a consistent and stable index with a positive trend except in 2020 due to the impact of the COVID-19 pandemic. Based on previous studies, the continuous increase in IIW during the pandemic could be attributed to environmental quality. Several economic activities were halted due to large-scale social restrictions. This led to improvement in environmental conditions, as indicated by indicators of air and water quality. The constituent domains with irregular and fluctuating patterns were disaster and forestry. Furthermore, disaster mitigation was important in maintaining IIW. The deep decline in the index in 2012 and 2013 could best be explained by the large number of disasters, while the decrease in 2015 was caused by forest degradation, both inside and outside the forest area.

The results showed that the living standards and housing domain had the highest number of indicators. This indicated that the domain comprised the dominant determinants of well-being in terms of the characteristics of its constituent indicators, followed by the health domain. Well-being was largely determined by health, which supported life. Other domains with a high number of indicators included education, social security, and happiness, which were components of the social dimension.

Based on the resulting variations in the domains, the biggest factor contributing to the preparation of IIW was environmental quality. Indonesia was rich in natural resources, indicating that the presence of a good and quality environment had an influence on general well-being. This served as a significant impetus for the country to remain steadfast and unwavering in its pursuit of achieving the Sustainable Development Goals (SDGs). With this supportive environment, the continuity of life was guaranteed. Kurniasih et al., (2021) stated that local institutions were the major factors contributing to the success and sustainability of forest improvement and natural resource management.

As part of the environmental dimension, forestry was an integral part of environmental quality in Indonesia, leading to sharp fluctuations in some periods. This study also correlated the productivity of the forestry sector proxied by TFP with the

Forestry Domain Index and IIW. Several studies reported that deforestation had a significant effect on the decline of the percentage change index in the forestry domain, although Indonesian forest productivity continued to increase in line with the general well-being index.

Indonesian forest degradation had attracted international attention due to high carbon emissions and conflicts over land used for plantations (Sahide et al., 2020). Various government efforts had also been made to reduce forest degradation through statutory policy instruments. For example, the government stipulated regulations regarding the supply and use of biofuels domestically in 2015. In the same year, the Indonesian government rearranged one-door integrated licensing in the forestry sector as a commitment to preserving forest resources. This regulation showed the strong political will to support broader visions and goals in the sector (Maryudi et al., 2022). Government support and interference for people were essential factors for obtaining win-win solutions in increasing forest conservation (Putraditama et al., 2021).

The domain with the highest number of constituent indicators ranked second based on its contribution/weight, namely living standard and housing. Living standards were usually used to measure economic activity. At present, macroeconomic indicators had been used to describe material prosperity and had become an objective measure to describe well-being. In this study, the economic aspect was proxied using housing. The results showed that the economic conditions of the Indonesian people had similar characteristics to their housing conditions. This was in line with the decision of the Ministry of Social Affairs in Indonesia. stipulating that the first poverty criterion was shelter/daily living (housing). Examining the composition of indicators within this domain, it became evident that 'income' and 'investment' indicators were utilized to assess economic aspects. Meanwhile, in the realm of housing facilities, this domain included indicators, such as the percentage of households with access to proper sanitation, clean drinking water, and electricity as the primary energy source, and those with contracted or rented housing. Indicators related to the SDGs regarding clean water and proper sanitation were a challenge for local government governance due to potential obstacles in the implementation (Herrera, 2019).

In third place, the domain of happiness had the greatest weight in the preparation of IIW. The aspects measured included comprehensive, consisting of all the indicators in the Indonesian Happiness Index, namely personal and social life satisfaction, affection, and meaning in life. From the perspective of positive psychology, this domain had meaning and coverage of pleasant living conditions, a good life (being well or good life), and a meaningful life (conditions life). Furthermore, it could reflect the level of well-being that had been achieved by each individual (Blanchflower & Oswald, 2004). In a broader sense, the measure of individual happiness per individual was considered a measure that described the level of social development (Forgeard et al., 2011; Stiglitz & Sen, 2009). However, in this study, the role of this domain in the preparation of IIW was less dominant compared to living standards and housing.

The domains of environment quality, living standard, housing, and happiness accounted for approximately 40% of IIW. The other eight domains each contributed ≤10%. The next dominant domains were health, labor, and education, which became important measures in social and economic aspects, with the respective contributions of 9.72 % 9.56%, and 9%, respectively. The results showed that forestry, disaster, and

social security had contributions of 8.64%, 8.06%, and 7.99%. Meanwhile, democracy and law had the lowest values, namely 3.72% and 3.64%, respectively.

The results showed that environmental quality was the domain with the biggest influence. This condition needed serious attention from the government regarding policies that could be taken to improve the quality of the environment. Unstable increases in IIW could be attributed to various factors, including natural disasters, which were used in this measure. Policies regarding disaster mitigation in disaster-prone countries were important to maintain stable long-term prosperity. The results were consistent with recent reports that the management and protection of nature were beneficial to humans. Therefore, political and social policies must consider the important role of nature and species diversity in human well-being (Methorst et al., 2021), as well as during the pandemic (Möhring et al., 2021)

Social factors had an important role and were difficult to quantify as income (Helliwell & Barrington-Leigh, 2010). The use of these well-being measures provides a more objective figure to show the state of society and provides better public policy information (Hicks et al., 2013). This statement was confirmed in this study with the results that the biggest consideration after good environmental quality, as well as living standards and housing, was happiness. Therefore, in the context of achieving the SDGs, IIW was recommended.

Well-being was the goal of all the indicators targeted in the SDGs, and the assessment of indicators was reciprocal and complementary (Barbier & Burgess, 2019). Furthermore, there was an implicit hierarchy because the indicators in the SDGs formed an interlinkage network (Dawes, 2022). This could indicate that an important channel supporting food security was collective action in strong institutions or education (Biggeri et al., 2022). The results showed that efforts to fulfill food were always related to the environment and the achievement of this target must be accelerated because the COVID-19 pandemic disrupted the world food system and global economic shocks also reduced incomes in most countries in the world (Saccone & Vallino, 2022).

When the SDGs target was maintained, all elements of existing resources needed to be empowered. Demographic and people structures provided the basis for interactions that lead to satisfaction, subjective well-being, and quality of life (Ferriss, 2006). The quality of life or people well-being was a function of actual conditions and the activities performed. Well-being in the future was a function of what people think, feel, and do (A. C. Michalos, 2017)

CONCLUSION

In conclusion, this study proposed a new measure of well-being specifically for Indonesia using weights calculated by PCA. The calculation of the recommended weights was obtained from the indicators available for 12-years, namely from 2010 to 2021. Furthermore, processing was carried out using a 4-dimensional classification, namely the environmental, economic, social, as well as security, recreation, and safety dimensions. Weighing was obtained according to the domain originating from 11 factors, which was proven in this study to be an important domain in measuring well-being. IIW calculated using these weights was recommended because it avoided downward and upward bias.

The environmental quality domain, which was composed of air and water quality, had the highest weight. However, forest land use was a crucial issue in Indonesia with global impacts. Forest productivity in the country continued to increase despite deforestation in various regions. This indicated that natural wealth in the form of forests could still be relied upon with government support. The Indonesian government's efforts in implementing various policies had enabled it to maintain well-being index.

IIW using an objective approach was still relevant in the case of Indonesia, which still placed material well-being as an integral part of well-being. It was important to have comprehensive indicators in the preparation of IIW. This was to facilitate the reflection of actual well-being and keep up with the times. Based on the trend plot of IIW, which was not as smooth as the trend of other indices (GDP and HDI), IIW every year was an option to be considered. The results showed that there was a huge difference between the increase in GDP and the increase in well-being over 12 years. This could potentially mislead stakeholders to intervene in well-being improvement if they only use measures, such as GDP.

Future Study

As an index that combined some indicators and dimensions described in 11 domains, IIW should be continued with Sensitivity and Uncertainty Analysis. It could also focus on certain dimensions that were urgently investigated due to the strategic value in sustaining prosperity. Future studies should also conduct Working Groups/FGDs across data producers related to well-being indicators. Furthermore, all these stages were carried out to select indicators in compiling the well-being index, treatment of missing data, and the sustainability of indicators in the future. The sustainability of official statistics data was an inevitable requirement following the recommendations of the Data Gaps Initiative that must be prepared by the National Statistical Office.

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Methodology: Krismanti Tri Wahyuni, Robert Kurniawan, Yoga Dwi Nugroho
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Data Availability: The datasets utilized in this article are available upon reasonable request from the corresponding author.

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