

# Review of personal environmental indicators

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**Abstract.** Indicators are used in almost every scientific field to quantify and/or record and/or follow the evolution of a specific parameter. Environmental indicators are related to the environment quality and are specifically used to monitor the quality of the environment and to measure the environmental performance. They can be categorized into specific, composite and personal environmental indicators. A review of the personal environmental indicators used in the literature are presented here. Personal environmental indicators include indicators related to the attitudes and behaviours of citizens towards environmental issues. The main personal environmental indicators reported in the literature are: the New Environmental Paradigm Scale, the Environmental Attitude Inventory, the General Ecological Behavior Scale, the Motivation Toward the Environment Scale, the Connectedness to Nature Scale, the Ecocentric Scale and the Anthropocentric Scale.

## 1 Introduction

The general term "indicator" refers to anything that indicates something. It is a sign or a measure of something [1]. Indicators are used in almost every scientific field to quantify and/or record and/or follow the evolution of a specific parameter. The term indicator finds application in various scientific fields, such as the environment. Environmental indicators are related to the environment and are powerful tools to monitor the quality and status of the environmental and to measure the environmental performance [2].

Environmental indicators are categorized in various ways. Here, the categorization of the indicators is chosen based on the characteristic they examine. Specifically, the indicators are divided into specific, composite and personal environmental indicators. However, the limits separating indicators into specific, composite or personal are not always clear [2].

Specific environmental indicators include indicators related to the natural and to the anthropogenic environment. In particular, the specific environmental indicators for the natural environment refer to the atmosphere, water, soil and biodiversity [3]. On the other hand, the specific environmental indicators for the anthropogenic environment are mainly related to socio-economic activities. Socio-economic anthropogenic activities (e.g. waste production, energy activities, population, transport, etc.) are directly linked to the environment and the use of resources and ecosystems, as human activities have a direct impact on the environment and are in large degree the cause of change in the state of the natural environment [2]. These indicators are presented in another work [4].

The environment is considered as one of the three pillars of development, where it is directly linked to the other two pillars, the economic and the social ones. Therefore, there is a need for indicators that could capture the relationships between the environment and the other two pillars [2]. Composite environmental indicators either include all three of these pillars or are a combination of specific environmental indicators. The main composite environmental indicators reported in the literature, are: Sustainable Development Goals Index, Ecological Footprint, Environmental Performance Index, Environmental Sustainable Index, Air Quality Index, Policy Performance Index, Genuine Progress Indicator, Living Planet Index and Bhutan Gross National Happiness Index. These indicators are presented in another work [5].

This paper is the third one of a series of three papers dealing with environmental indicators. The first one deals with the specific indicators [4], while the second one is focused on the composite ones [5]. A review of the personal environmental indicators used in the literature are presented here.

Personal environmental indicators are indicators related to the attitudes and behaviors of citizens towards environmental issues., The behavior of citizens towards the environment is directly related to their opinion of nature and their relationship with it [2] and various works have studied the attitude and behavior of citizens on various environmental issues e.g. climate change [6], renewable energy sources [7], waste management [8], green growth [9], etc. The personal environmental indicators are created by the researchers themselves and the main of them are the New Environmental Paradigm Scale, the Environmental Attitude Inventory, the General Ecological Behavior Scale, the Motivation Toward the

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Environment Scale, the Connectedness to Nature Scale, the Ecocentric Scale and the Anthropocentric Scale.

## 2 Personal environmental indicators

Personal indicators are created by the researchers themselves in order to measure the attitude and behaviour of people towards the environment. The main personal environmental indicators reported in the literature are presented below.

### 2.1 The new environmental paradigm scale – NEP scale

#### 2.1.1 The beginning of the NEP scale

The environment has a long and important place in human history. Human beings have always looked to nature to satisfy their physical needs and spiritual desires [3]. Sociologists, economists, philosophers and psychologists have been studying human attitudes towards the environment for many years, as it seems that the environment is a point of common interest among a variety of scientists [3].

Today, there is an increased worldwide environmental concern. However, global environmental change caused by human activity has its roots in the industrial revolution and geographical discoveries of the European world that provided the world with “unlimited” natural resources (as it was considered that period of time) [10]. Human activity has constantly sought to benefit from natural resources, causing pollution, producing waste and introducing changes to the soil, water and atmosphere [11].

Environmentalism emerged as a political and social movement in the late 1960s and early 1970s. The first broad environmental debate was the growth debate that began in 1972 with the Club of Rome report "Limits to Growth" [12]. Environmental awareness was constantly increasing, forcing many individuals not only to think about environmental protection, but to demand more action from local and global authorities [13].

Given this situation, it has been important for scientists to better understand why citizens deal with the environment the way they do [14]. An important step for this was to measure citizens' environmental attitudes in a valid and reliable way [14]. Many different approaches to measuring these attitudes have been developed, mostly using self-report methods, such as interviews or questionnaires [2]. Developing valid and reliable measures of environmental worldview help scholars better understand the evolution of environmental change and its relationship to demographic, economic and behavioral changes in the population [15], and thus discover techniques that could be used to encourage citizens to live more sustainably [16].

Globally, researchers have investigated environmental attitudes from various theoretical perspectives [11]. Among the various efforts to measure environmental attitudes, Riley Dunlap and colleagues at the University of Washington developed an instrument

they called the New Environmental Paradigm Scale (sometimes called NEP) [15]. The NEP scale is an internationally used measure of environmental attitudes and a predictor of pro-environmental behaviors [17]. By using the NEP scale it is possible to investigate how citizens perceive the environment and what they think and feel about it, because the NEP scale is a measure of the cognitive aspects of environmental attitudes [11].

#### 2.1.2 Presentation of the NEP scale

The original NEP scale was published in 1978, consisted of 12 questions and used a 4-point Likert scale [18]. The original NEP scale consisted of three dimensions: balance of nature, anthropocentrism, and limits to growth [18]. The NEP scale aimed to capture “... beliefs about humanity's ability to disturb the balance of nature, the existence of limits to development for human societies and humanity's right to rule over the rest of nature” [17].

In the late 1980s, the increase in transboundary environmental issues, the increase in water pollution, the further desertification of the Earth, the need to protect endangered ecosystems and the increase in air pollution required the adjustment of the NEP scale to recognize and deal with environmental reality and global environmental change [19]. Furthermore, the original NEP was criticized for several shortcomings, including an absence of internal consistency between individual responses, a poor correlation between the scale and human behavior and the “outdated” language used in the questions [15].

Therefore, the NEP scale was revised in 2000 to include 15 questions, using a five-point Likert scale ranging from “strongly disagree” to “strongly agree” [17]. The revised scale uses less outdated language and is more precise, using 15 questions instead of the original 12. In the 15-question layout of the NEP scale there are 8 pro-NEP and 7 anti-NEP questions. Therefore, the scale is not measured by questions that are only in one, positively or negatively expressed, direction [20]. The revised NEP scale is based on five dimensions of people's environmental attitudes: beliefs about humanity, human's ability to subvert nature, existence of limits to human development, humanity's right to dominate the rest of nature, and rejection of anthropocentrism [17].

The questions are:

1. We are approaching the limit of the number of people the Earth can support,
2. Humans have the right to modify the natural environment to suit their needs,
3. When humans interfere with nature it often produces disastrous consequences,
4. Human ingenuity will insure that we do not make the Earth unlivable,
5. Humans are seriously abusing the environment,
6. The Earth has plenty of natural resources if we just learn how to develop them,
7. Plants and animals have as much right as humans to exist,

8. The balance of nature is strong enough to cope with the impacts of modern industrial nations,
9. Despite our special abilities, humans are still subject to the laws of nature,
10. The so-called "ecological crisis" facing humankind has been greatly exaggerated,
11. The Earth is like a spaceship with very limited room and resources,
12. Humans were meant to rule over the rest of nature,
13. The balance of nature is very delicate and easily upset,
14. Humans will eventually learn enough about how nature works to be able to control it,
15. If things continue on their present course, we will soon experience a major ecological catastrophe.

Rather than demonstrating human dominance over nature, the NEP scale projects the concept of a human-nature relationship in which neither side is dominant. This approach promotes equality between people and nature [11]. The main concern of this scale is the well-being of citizens. In the light of this way of thinking, citizens must maintain the balance of nature, admit the existence of limits to the development of human societies and adapt to these limits, consider the possibility of stable economies, adopt consultative and participatory policies that they emphasize foresight and careful planning in order to avoid risks to humans and nature and to seek to change society towards cooperation, openness and participation [21].

### 2.1.3 Application of the NEP scale

The NEP scale is widely used by various researchers to assess environmental attitudes in different groups of citizens in different parts of the world [19].

Specifically, the NEP scale has been used by social psychologists [23], political scientists [23], sociologists [24], geographers [25] and anthropologists [26].

It has also been used in different samples, such as: college students [27, 28, 29, 30] general population [32, 33], in a population with different religious beliefs [33] and, to a lesser extent, in specific groups of the population, such as, scientists or stakeholders [34].

In addition, the NEP scale has been used in conjunction with other scales to determine pro-environmental attitudes such as: in various populations [29, 35], in environmental education [36], in agro-industrial actions [37], in tourism [38], in student behavior [39, 40], in pro-environmental behaviors [15], in species conservation actions [41], in academic, national and international actions, etc.

The NEP scale is also used in studies before and after an intervention or activity, such as the impact of educational programs on environmental attitudes [15], to study the effects of this intervention or activity. Moreover, it is often correlated with different socio-demographic variables such as gender, age and educational level [30, 31, 42].

Finally, the NEP scale is used in various countries of the world, such as Brazil, Mexico [43], America [27],

Japan [44], China [45], Turkey [29], Bulgaria [46], Czech Republic [42], Poland [11], Greece [20, 47], etc.

## 2.2 Environmental Attitude Inventory (EAI)

The environmental attitude inventory assesses broad perceptions or beliefs about the natural environment, including factors that influence its quality [48].

Environmental behaviour is considered to have a multidimensional structure that can be organized in a hierarchical manner into two dimensions: a vertical dimension (conserving nature) and a horizontal dimension (using nature). This inventory was created to capture both the vertical and horizontal dimensions of environmental behaviour that define this two-dimensional structure of environmental behaviour: conservation and use [48].

A set of twelve scales related to the natural environment are identified as specific aspects/dimensions of environmental attitude. These twelve scales are:

1. Enjoyment of nature,
2. Conservation policies,
3. Environmental activism,
4. Anthropocentric concern,
5. Confidence in science,
6. Environmental fragility,
7. Altering nature,
8. Personal conservation,
9. Dominance over nature,
10. Utilization of nature,
11. Ecocentric concern,
12. Population growth.

Each one of these twelve scales includes 10 perceptions or beliefs. A total of 120 perceptions/beliefs are examined using a questionnaire. Often the questionnaire is used in its short form, where 6 perceptions/beliefs are used per scale (a total of 72 perceptions/beliefs). A 7-point Likert scale from "strongly disagree" to "strongly agree" is used to measure these perceptions/beliefs [48].

Descriptive analysis and factor analysis are used to investigate those scales, while the internal consistency of those scales (Cronbach's alpha) is also examined [48].

## 2.3 General Ecological Behaviour scale (GEB)

The General Ecological Behaviour scale measures the individual environmental attitudes and management behaviour of citizens. The General Environmental Behaviour scale was created by Kaiser in 1998 [49] to measure environmental attitudes by asking a set of pro-environmental questions. The number of pro-environmental questions in everyday tasks is a measure of general ecological attitude manifested through pro-environmental behaviour [49].

A well-designed questionnaire with appropriate items that match users' actual lifestyle habits is an essential condition for research success, as is ensuring that different cultural and geographic contexts are taken into account in the research [50].

Specifically, using a questionnaire, participants are asked to indicate how often they have engaged in each of the default behaviours on a 5-point Likert scale from “never” to “very often” [51].

If the pro-environmental behaviour measure is treated as a unidimensional measure, the scale is calculated either by summing the number of declared pro-environmental activities, or in a more complex way using Item Response Theory techniques [11]. When the scale is treated as a multidimensional measure, various subscales are used: energy saving, mobility transfer, waste avoidance, consumerism, recycling and representative social behaviours, followed by the statistical analysis of the data [52].

## 2.4 Motivation Toward the Environment scale (MTE)

Environmental motivation is central to environmental attitude assessment because it measures the individual's rationale for its engagement in environmentally friendly behaviours [53].

The evaluation of citizens' friendly attitudes towards the environment, using the Motivation Toward Environment scale, was developed by Pelletier et al. [53]. In this scale there are six subscales to measure the following motivations: intrinsic motivation, integration, identification, unconscious adoption of attitudes, external norms and motivation. A total of 60 questions are used, 10 questions per subscale [53].

The participants, using a questionnaire, rate on a 7-point Likert scale from “not at all” to “very much”, the extent to which various questions/statements indicate the reasons why they engage in environmentally friendly behaviours in each motivation: intrinsic motivation (e.g. “the pleasure I get from finding new ways to improve the quality of the environment”), integration (e.g. “because environmental consciousness has become a fundamental part of who I am”), identification (e.g. “because I think it's a good idea to do something about the environment”), unconsciously adopting attitudes (e.g. “because I would feel bad if I didn't do something”), external norms (e.g. “to avoid criticism”) and motivation (e.g. “honestly, I don't know. I feel like I'm wasting my time doing things for the environment”) [53].

To investigate the scale, a statistical analysis is used, such as correlation analysis and factor analysis; also, the internal consistency reliability of the scale (Cronbach's alpha) is examined [53].

## 2.5 Connectedness to Nature Scale (CNS)

The Connectedness to Nature Scale was designed by Mayer & Frantz [54] and measures the degree to which citizens feel emotionally connected to the natural environment.

The scale arises from the claim that citizens must feel that they are part of the wider natural world if they are to deal effectively with environmental issues [55]. For Leopold [55], this meant understanding the extent to which citizens empirically see themselves as equal

members of the larger natural community, feel a sense of kinship with it, see themselves as belonging to the natural world as much as the natural world belongs to them, and they see their well-being as tied to the well-being of the natural world.

Specifically, this scale assesses the continuity between human and nature. The connectedness to nature scale uses a scale of 14 questions/statements on a 5-point Likert scale from “strongly disagree” to “strongly agree” [54].

The 14 questions/statements are as follows:

1. I often feel a sense of oneness with the natural world around me,
2. I think of the natural world as a community to which I belong,
3. I recognize and appreciate the intelligence of the other living organisms,
4. I often feel disconnected from nature,
5. When I think of my life, I imagine myself to be part of a larger circular process of living,
6. I often feel a kinship with animals and plants,
7. I feel like I belong to the Earth as much as it belongs to me,
8. I have a deep understanding of how my actions affect the natural world,
9. I often feel part of the web of life,
10. I feel that all inhabitants of Earth, human and non-human, share a common “life force”,
11. Like a tree can be part of a forest, I feel embedded within the broader natural world,
12. When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature,
13. I often feel that I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees,
14. My personal welfare is independent of the welfare of the natural world.

To investigate the scale, the data are statistically analysed using factor analysis and the internal consistency reliability of the scale (Cronbach's alpha) is examined [54].

## 2.6 Ecocentric scale (ECO)

The Ecocentric scale measures the individual's motivation to protect nature because of its value, so that nature continues to exist without external disturbance. Ecocentric individuals value nature for its own value and therefore judge it to be worthy of protection for its own value. Ecocentric individuals will act to support the environment even if these actions involve discomfort, inconvenience and expense to themselves, which may reduce their material quality of life [56].

The ecocentrism scale uses a questionnaire of 12 questions/statements to assess citizens' levels of ecocentrism [56]. A 5-point Likert scale from “strongly disagree” to “strongly agree” is used for the following questions/statements:

1. One of the worst things about overpopulation is that natural areas are getting destroyed for development,

2. I can enjoy spending time in natural settings just for the sake of being out in nature,
3. Sometimes it makes me sad to see forests cleared for agricultural,
4. I prefer wildlife reserves to zoos,
5. I need time in nature to be happy,
6. Sometimes when I'm unhappy I find comfort in nature,
7. It makes me sad to see natural environments destroyed,
8. Nature is valuable for its own sake,
9. Being out in nature is a great stress reducer for me,
10. One of the most important reasons to conserve is to preserve wild areas,
11. Sometimes animals seem almost human to me,
12. Humans are as much a part of the ecosystem as other animals.

Statistical analysis, such as correlation analysis, is used to investigate the scale, while the internal consistency reliability of the scale (Cronbach's alpha) is also examined [56].

### 2.7 Anthropocentric scale (ATR)

The anthropocentric scale was designed to assess people's motivations that the environment should be protected for human well-being [56]. Anthropocentrism involves valuing nature because of the material or physical benefits it can provide to citizens [57].

Human-centered individuals believe that the environment should be protected because of its value in maintaining or improving people's quality of life. They support nature conservation because human comfort, quality of life and health may depend on the preservation of natural resources and a healthy ecosystem. Because the values underlying anthropocentric individuals' support of the environment are anthropocentric, they will be less likely to act to protect the environment if other anthropocentric values, such as material quality of life or wealth accumulation, interfere [56].

In anthropocentricity, a questionnaire of 12 questions/statements is used. A 5-point Likert scale from "strongly disagree" to "strongly agree" is used for the following questions/statements:

1. The worst thing about the loss of the rain forest is that it will restrict the development of new medicines,
2. The best thing about camping is that it is a cheap vacation,
3. It bothers me that people are running out of their supply of oil,
4. Science and technology will eventually solve our problems of pollution, overpopulation, and diminishing resource,
5. The thing that concerns me about deforestation is that there will not be enough lumber for future generations,
6. One of the most important reasons to keep lakes and rivers clean is so that people have a place to enjoy water sports,
7. The most important reason for conservation is human survival,

8. One of the best things about recycling is that it saves money,
9. Nature is important because of what it can contribute to the pleasure and welfare of humans,
10. We need to preserve natural resources to maintain a high quality of life,
11. One of the most important reasons for nature to conserve is to ensure a continued high standard of living,
12. Continued land development is a good idea as long as a high quality of life can be preserved.

To investigate the scale, statistical analysis is used, such as correlation analysis, and the internal consistency reliability of the scale (Cronbach's alpha) is examined [56].

### 3 Conclusions

Environmental indicators are indicators related to the environment. The personal environmental indicators are created by the researchers themselves and they are mainly related to the attitudes and behaviours of citizens towards environmental issues, as the behaviour of citizens towards the environment is directly related to their opinion of nature and their relationship with it. Several indicators are used in the literature; here, the the New Environmental Paradigm Scale, the Environmental Attitude Inventory, the General Ecological Behavior Scale, the Motivation Toward the Environment Scale, the Connectedness to Nature Scale, the Ecocentric Scale and the Anthropocentric Scale are presented.

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