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A Novel Environmental Awareness Index Measured Cross-Nationally For Fifty Seven Countries

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Abstract:

Today, a number of major challenges exist for measuring environmental awareness cross-nationally. These are 1) conceptualising environmental awareness and its relation to concrete behaviour is still under development; 2) the lack of a universally applicable methodology for country comparisons; and 3) the lack of an easy-to-use tool for data gathering for global studies. After overcoming these challenges, a new Environmental Awareness Index (EAI) was constructed. Six hypotheses were formulated on the EAI, relating to 1) national wealth; 2) state of the environment; 3) postmaterialist values; 4) self-transcendence values; 5) self-enhancement values; and 6) gender equality. EAI scores from 57 countries were measured for cross-national comparisons. The countries scoring highest on the EAI are Austria, Sweden, Finland, Germany and Denmark. All the countries with the highest EA are found in Europe. Of the non-European countries, the best performers are Japan, New Zealand and Canada. The weakest EAI scores were found in Southern Asia, Mexico and Africa. Additionally, the perceived current state and trend of the environment in 57 countries was compared. The results indicate that, globally, the perceived state of the environment is rather worrying and in most countries deteriorating. After calculating correlations of the six hypotheses and the measured indicators of the study, the results show support to all six hypotheses. This study strongly indicates that significantly better correlations with the other national-level indices are achieved by studying EA with our wider approach (EAI consisting of motivation, knowledge and skills) than by studying customarily only environmental concern.

Keywords: Environmental awareness, cross-national, measurement, environmental values, pro-environmental behavior

1. Introduction:

Environmental Awareness (EA) is defined here as a state of being aware, having knowledge about, and being conscious of the environment in which people live, which tends to influence people's development and proenvironmental behaviour (PEB). To study or improve the level of EA globally, a fundamental problem today is a lack of a universal method for measuring and comparing EA. This study aims to overcome this challenge, by constructing a solid theory and methodology for calculating a new environmental awareness index (EAI) for cross-national EA comparisons. Secondly, EAI is measured cross-nationally in 57 countries.

2. Theory
2.1 Earlier cross-cultural EA studies
Although plenty of research exists on EA or environmental concern (EC), rarely studies have had a cross-cultural measuring focus. From our literature study, we found 15 cross-cultural studies that analysed levels of EA or EC. Two very distinct groups can be distinguished from the existing studies, based on their geographical and measurement focus:

1.   Multinational studies (over 10 countries), but with a narrow focus on EC or attitudes. These are studies by Gelissen (2007), Marquart-Pyatt (2007), Mostafa (2011), Siemens (2012), Franzen and Vogl (2013) and GlobeScan (2013).
2.   Studies with a wide measurement focus (assessing several elements of EA or EC), but with a very limited cross-cultural coverage (maximum 10 countries). These are studies by Partanen-Hertell et al. (1999), Aoyagi-Usui et al. (2003), Lin et al. (2011), TERI (2013), Harju-Autti (2013) and European Commission (2014).

The first group generally measures EC of population samples. There are numerous international survey programmes such as Eurobarometer, the International Social Survey Program, the Gallup World Poll, the Voice of the People, and the Green City Index. This stream of research in environmental sociology seeks to explain national differences in public EC and public support for environmental protection (Gelissen, 2007). The second group consists of independent field studies in a small number of cities/states/countries. Their focus is not limited to only ECs or attitudes. Usually they also measure people's knowledge of environmental issues, as well as personal skills, or actual PEB.

There are two recent exceptions to this categorization. The Green City Index (Siemens, 2012) has a very wide geographical coverage, but does not measure public EC or motivational factors. The Eurobarometer (European Commission, 2014) special study on climate change has a broad multinational coverage – however, it has a thematic limitation to climate change issues. The current study has both a wide measurement focus and a multinational character (57 countries). Conceptually this study builds upon two studies, where a small number of countries or states were compared. Firstly, in Partanen-Hertell et al. (1999) a theory and methodology for comparing countries' levels of EA was tested in nine countries around the Baltic Sea. Secondly, in Harju-Autti (2013) the theory and methodology were refined and a completely new IT tool for data gathering and analysis was used in a case study with 19 states in India. In this study the research area is extended to cover all the countries. Moreover, we also intend to show that a wider definition of EA leads to certain benefits compared to a customary focusing to EC.

2.2 Definition of EA and its relation to PEB

Despite the growing research on environment, it remains challenging to clearly conceptualize EA or environmental consciousness. Within the existing research, the strongest conceptual challenges are:

1.   Poor definitions and inconsistent use of the terms EA, EC, or environmental consciousness (Price et al. 2014; Milfont et al. 2010; H'mida & Lakhal 2010; Takács-Santa 2007; De LaVega 2004).
2.   Lack of commonly agreed framework on how they affect to PEB (Steg 2014; H'mida & Lakhal 2010; Bamberg & Möser 2007; Valle 2005)
3.   Conceptual complexity of EC, with many conceptualization schemes. Weak distinction between EC in general and that for more specific environmental problems (Xiao 2013, Dunlap & Jones, 2002)
4.   Tripartite theory of attitudes (affect, cognition and/or beliefs and behaviour) is questionable, and its components are often seen indistinguishable from each other. (H'mida & Lakhal 2010).
5.   Most of the relevant research has only been carried out in advanced industrialized societies (Chiu 2009). Therefore, empirical studies on EA should be carried out also in developing countries to collect basic information, to justify the validity of method, and to incorporate the outcome into the environmental policy making process (Iizuka 2000).

We aim to overcome the abovementioned conceptual challenges by defining here a clear, easy-to-apply conceptualisation of EA. Secondly, we define of how EA affects to PEB. These definitions have significantly fewer conceptual complexities than presently with EC and attitudes.

2.2.1 Definition of EA

Stapp (1969) defined environmental education is "aimed at producing citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work towards their solution". Accordingly, EA is defined here as a combination of motivation, knowledge and skills (Fig. 1).
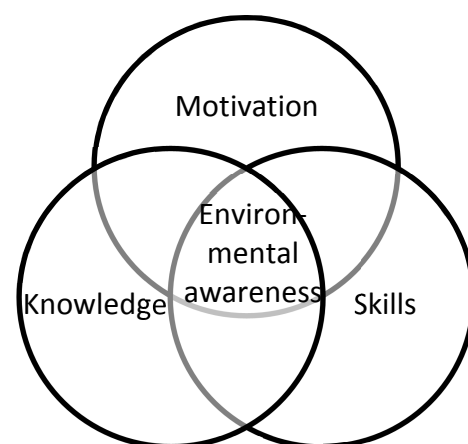

Fig. 1. Elements of Environmental Awareness (EA) (Partanen-Hertell et al., 1999).

Motivation to try to improve the environment is based on values and attitudes. In social psychology values are the criteria 'for guiding action for developing and maintaining attitudes toward relevant objects and situations' (Rokeach, 1968).

Besides values and attitudes, EC is an essential attribute of motivation. According to Dietz (2005) the word 'concern' reflects both a sense that something is important and a belief that it may be at risk. Dunlap and Jones (2002) define EC as 'the degree to which people are aware of problems regarding the environment and support efforts to solve them and/or indicate the willingness to contribute personally to their solution'. In earlier studies, Franzen and Meyer (2010) found that the level of EC of a society influences its environmental behaviour.

Knowledge could be defined simply as acquaintance with facts, truths, or principles. The knowledge people have about their environment is central to the development of their EA. Understanding the cause-effect relationships within our environment is especially important. However, knowledge is not enough: often modern people hold abstracted, intellectualized knowledge of natural destruction, and such knowledge does not sufficiently inhibit harmful actions (Worthy 2008).

Skills to act in ways that improve the environment are also needed. Learning suitable practical skills, like recycling, requires time and effort, both from individuals and societies. In view of raising EA, PEB should be made easy, since it is known that old habits die hard (Biel, 1999).

2.2.2 EA and its relation to PEB

EA is leading to practical action as shown in Fig 2, named here as EAPEB model. When environmentally aware individuals encounter an external physical stimulus, they may realise that there is potential for some action. If their world view and values support pro-environmental actions, they are motivated to make environmentally friendly choices. Based on an individual's knowledge and skills, and according to the existing opportunities to act, this motivation may manifest in pro-environmental actions. This, in turn, leads to an improved state of the environment (Partanen-Hertell et al., 1999).

For example, let's say a man is walking in a street. Because of his EA (Fig. 2, Box 1), when seeing a piece of litter in the street (Box 2), an idea occurs to him to consider picking the litter up (Box 3). The idea of picking the litter up to make the street look cleaner is fully compatible with his world view and values (Box 4), so he really wants to pick it up (Box 5). However, there should also be a litter bin nearby (Box 6) to support making his willingness to act become a concrete PEB (Box 7). This, in turn, will contribute to the state of the environment, strengthen his EA, and will often give him a satisfying feeling of empowerment (Box 8) (Harju-Autti 2013).
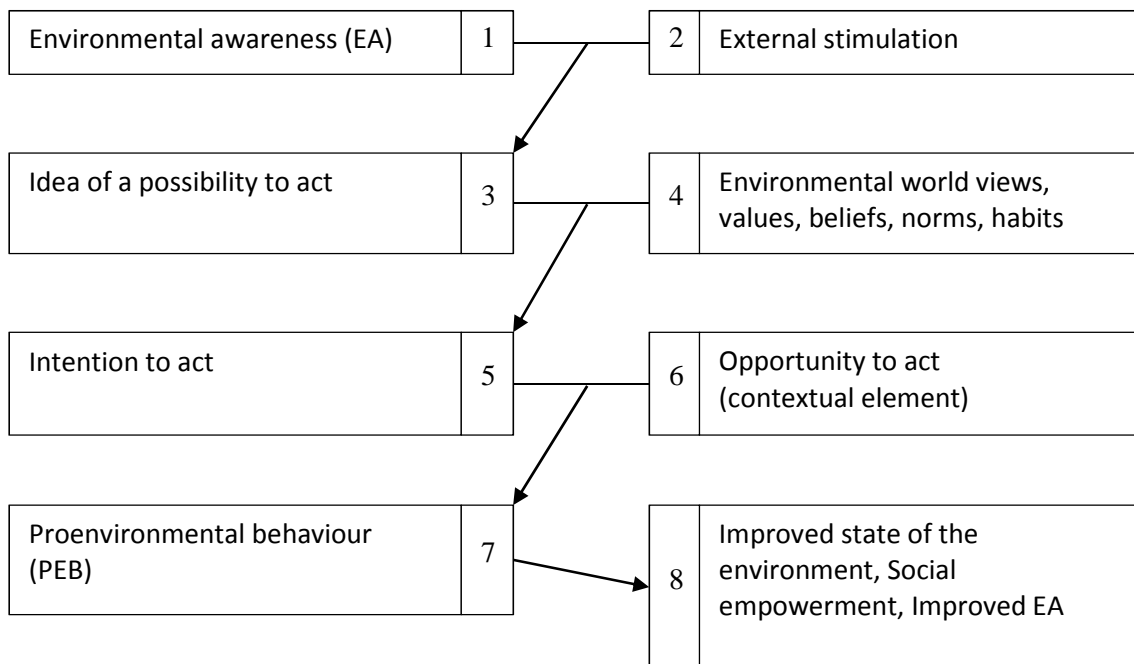
Fig. 2. General model on Environmental Awareness (EA) leading to proenvironmental behaviour (PEB), abbreviated here as EAPEB model (Harju-Autti, 2013).

2.2.3 Comparison with earlier definitions

The EAPEB model (Fig. 2) is similar to the integrative model proposed by Bamberg & Möser (2007). In their meta-analysis based on 57 studies on PEB, they calculated mean correlations between psycho-social variables and pro-environmental behaviour. They found that PEB intention (Fig. 2, Box 5) mediates well the impact of all other psycho-social variables on pro-environmental behaviour. Their results also confirmed that that problem awareness (Fig. 2, Boxes 1 and 2 combined) is an important but indirect determinant of intention for PEB.

Growing body of scientific evidence indicates that pro-environmental self-identity (similar to Fig. 2, Box 1) and past behaviour (Fig. 2, Box 4: habits) are important influences on PEB intention (Fig. 2, Box 5) (Van der Werff 2013; Whitmarsh 2010). Earlier, many studies have conceptualized environmental consciousness as knowledge/values, attitudes and behaviour. As an example, Sánchez and Lafuente (2010) established a multidimensional definition of environmental consciousness. In their model, they integrate the most widespread theories of EC from the sociological perspective with theories of environmental behaviour found in environmental psychology. As a result, their operationalization of environmental consciousness covers four dimensions: affective, cognitive, dispositional and active (Fig. 3). This is very different from our definition of EA, since in our view, PEB should not at all be included in the definition of EA. These two — awareness and action — surely are related to each other (as seen in the EAPEB model), but they are two fundamentally different things. Thus, one is not part of the other. In Fig. 3 PEB is added ambiguously to environmental consciousness, while stating that "environmental consciousness is characterized by the extent to which a person engages in PEB of diverse kinds". However, Fig 3 shows that the active dimension does not have an equal status among the four dimensions, but is set apart as something that depends on the other three. This indicates that the active dimension is some sort of out-put product of environmental consciousness, though it has a feedback function as well. To us, including PEB within the concept of EA is not correct, since action should not be treated as an element of awareness.
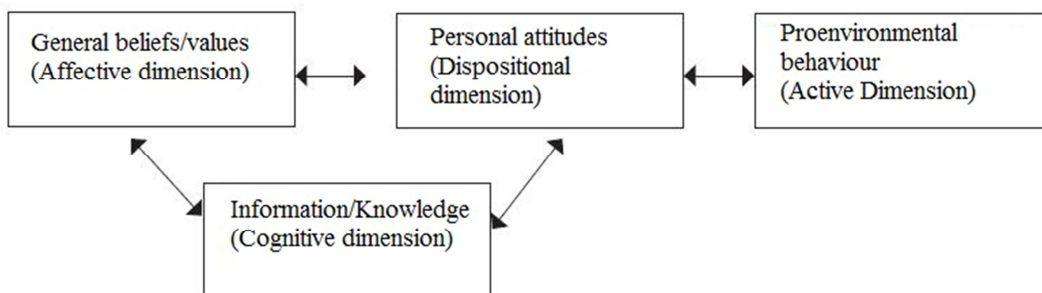

Fig. 3. Dimensions of environmental consciousness (Sánchez & Lafuente, 2010).

The EAPEB model shares several aspects with some theories of planned human behaviour, like the values-beliefs-norms (VBN) theory (Stern et al., 1999; Stern, 2000). According to Hansla et al. (2008) in the VBN theory, 'the determinants of intentions to PEBs include awareness of consequences – understood as individuals' beliefs about the adverse consequences of environmental problems.' Kenter et al. (2011) describe the VBN theory as a process where values shape an ecological world view (Fig. 4).
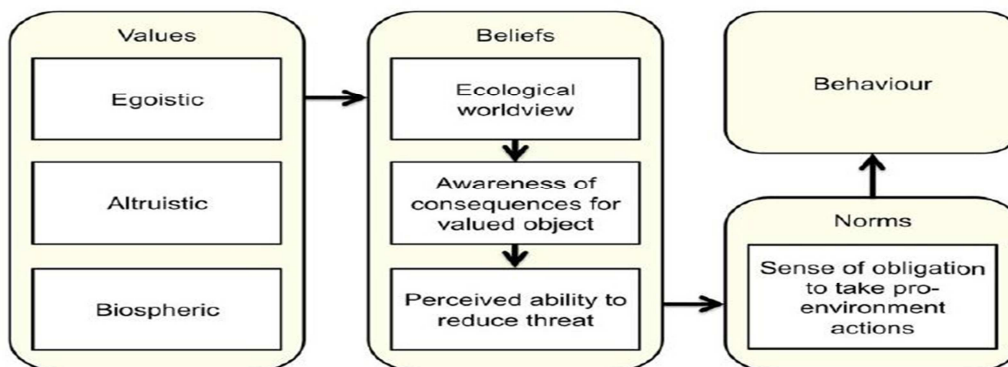

Fig. 4. Representation of the values-beliefs-norms theory of environmental behaviour (Kenter et al., 2011; adapted from Dietz et al., 2005; Stern, 2000).

The VBN and EAPEB models 4 contain similar elements. However, the relationships between the elements are set differently. There is a rather close resemblance between the values, beliefs and norms steps of the VBN theory and the Box 4 of the EAPEB model. Klöckner's (2013) proposition for a comprehensive model of the determinants behind PEB also includes a set of similar elements. According to this model, the key elements are attitudes, personal norms, perceived behavioural control, and social norms, which together form the intention to act. Again, these elements are positioned in Box 4 in Fig. 2. Recently Steg (2014) presented an Integrated Framework for Encouraging PEB (IFEP), offering a promising method to grasp the elements positioned in Box 4 in Fig 2, as well as the situational factors (Box 6).

We must bear in mind that often the intention to act (Fig. 2: Box 5) is not enough for PEB. For example, many studies have showed that littering intentions can be hampered by the lack of litter bins, and that distance to a litter bin is a strong predictor of littering behaviour (Schultz, 2011). Also Steg (2011) emphasises that the situational factors are generally overlooked in environmental behaviour research. Therefore, the EAPEB model includes the 'Opportunity to act' (Fig. 2: Box 6), taking into account this contextual element. The contextual element is not present in the VBN theory, nor in Klöckner's model or in Bamberg & Möser's model.

Generally, when measuring EA, we must acknowledge that because of the abstract nature of the term, it is not feasible to go and ask a person 'what is the level of EA in your country'. However, we see that the abovementioned elements of EA — motivation, knowledge and skills — are rather easy terms to understand. Therefore, it makes sense to ask a person for an opinion on these three very concrete elements and then define the EA as a combination of these elements. In this way, we will completely transcend the endless scientific debate on the roles of attitudes, personal norms, perceived behavioural control, social norms, as well as EC, thus moving the focus to easy-to-understand, concrete terminology that can be well applied in a universal survey.

3. Research questions and hypotheses
The relationship between a nation's wealth and its citizens' EC or an individual's prosperity and EC has been studied by many researchers. Previous research presents two theoretical perspectives that link economic development, or affluence, with EC: the theory of postmaterialism by Inglehart, and the affluence hypothesis by Diekmann, Franzen and Meyer (Knight & Messer, 2012). According to the postmaterialism theory, EC grows alongside a rise in affluence and a generational shift in cultural values (Inglehart, 1995, see e.g. Franzen & Meyer, 2010). In other words, as societies grow more prosperous, the population's values undergo a Maslowian shift from predominantly materialist values (values concerning survival and physical security) to predominantly postmaterialist values (values concerning identity, rights, and quality of life, e.g. environmental quality) (Knight & Messer, 2012).

The affluence hypothesis assumes a more direct link between affluence and EC, and claims that a rise in affluence has the most impact on the development of EC. If regarded from the perspective of the affluence hypothesis, the protection of the environment is not only a public good, but also a normal good, whose demand increases with income (Diekmann & Franzen, 1999; Kemmelmeier et al., 2002; Franzen, 2003; Franzen & Meyer, 2010, see e.g. Knight & Messer, 2012). In his theory, Franzen (2003) also includes the notion of a Maslowian value shift according to which people in wealthier nations 'have less pressing economic problems and are therefore more willing and able to reduce their standard of living in order to devote more resources to global environmental protection'.

However, it is still unresolved how a nation's wealth is related to its EC (Franzen & Meyer, 2010). There are also studies that have found negative associations. For example, Dunlap and Mertig (1995, see Dunlap & Mertig, 1997) found that national wealth is more likely to be negatively than positively related to citizens' EC. Also Knight and Messer (2012) concluded that affluence is either negatively or not associated with EC. However, for example, Givens (2011) and Kemmelmeier et al. (2002) found that a society's affluence predicted greater EC.

To sum up, the scientific community does not yet have a clear view on this matter, but we are inclined to hypothesize along the lines of the postmaterialism theory and the affluence hypothesis:

HP1:   There is a positive correlation between a country's wealth and EAI

Inglehart's postmaterialism theory suggests that EC is inherently higher in wealthier countries. When this assumption was questioned by the results of several surveys, Inglehart (1995) proposed an explanation in the form of the objective problems subjective values (OPSV) theory. The OPSV theory attributes the unexpectedly high EC of poor countries to objective environmental problems on the local level. Contrary to that, higher EC in wealthier countries was theorized to be due to economic development and consecutive dissemination of postmaterialist values. Brechin (1999, see Dunlap and York, 2008, 537) argued that the 'OPSV implies that residents of poor nations should rate local environmental problems as more serious than do their counterparts in rich nations (since the former presumably experience higher levels of community pollution), but the latter should rate global problems—the perception of which is dependent upon information presumably more accessible in wealthy nations—as more serious'. Brechin tested this assumption with Health of Planet data, and found out that citizens of poor nations do rate local problems as more serious than citizens in wealthy nations. However, he found no significant difference between their ratings of the seriousness of global problems. Along the lines of Brechin's study, we hypothesize that:

HP2   : There is a positive correlation between a country's good state of the environment and EAI

The next hypotheses deal with motivation and values. Some value orientations have been found to be positively or negatively related to pro-environmental attitudes and self-reported PEB (e.g. Hansla et al., 2008; Dietz et al., 2005). Especially interesting are altruistic and egocentric values (Stern et al., 1999). For example, Schultz and Zelezny (1998, see Dietz et al., 2005) found a negative relationship between Schwartz's self-enhancement values and PEB. On the other hand, values from Schwartz's self-transcendent value cluster have been shown to be positively related to PEB and attitudes (Hansla et al., 2008; Dietz et al., 2005). Accordingly, we hypothesize that:

HP3:   Since altruistic values are related to EA, there is a positive correlation between a country's self-transcendent values and EAI

HP4:   Since egocentricity is related to EA, there is a negative correlation between a country's self-enhancement values and the EAI

Several researchers have studied cross-nationally the relationship between postmaterialist values and the level of EC (Dunlap and Mertig, 1997). For example, Inglehart (1995, see Dietz et al., 2005) found that countries that hold postmaterialist values tend to give greater support for environmental protection. Therefore, we hypothesize that:

HP5   : There is a positive correlation between a country's postmaterialist values and EAI

Several studies have found that gender is a relevant predictor of environmentalism (e.g. Zelezny et al. 2000; Milfont 2013). Accordingly, we hypothesize that:

HP6:   There is a positive correlation between a country's gender equality and EAI.

4. Methods and implementation

4.1 Challenges and how to overcome them

Earlier, conventional studies have carried out comparisons between some aspects of EA between individuals, groups and nations. Traditionally, there are two main approaches to the measurements: One is based on investigating some particular aspects of EA by interviews, questionnaires and tests among individuals, organizations' staff or the public. Questions like 'Do you usually recycle newspapers?' and 'Would you be willing to sign a petition in favour of stricter environmental protection?' are often used (Dietz et al., 2005). The other approach concentrates on measuring concrete PEB - for example, recycling rates or belonging to environmental organisations.

Dietz et al. (2005) have pointed out some drawbacks in both approaches. In the first case, self-reporting questionnaires and interviews might be misleading: what people think or say they do is not necessarily what they actually think or do. Furthermore, they might not even do what they think they do. Therefore, the link between self-reported behaviour or behavioural intentions and actual behaviour is far from perfect. In the second case, measuring PEB is far more difficult and expensive to measure. Another important factor is that people may act differently, even inconsistently, in the different spheres of their life: home, work, leisure and hobbies (Partanen-Hertell et al., 1999).

Furthermore, there are major methodological challenges in the existing international survey mechanisms for cross-national comparison of EA. They typically use massive surveys for laymen, based on questions such as "how do you feel about the state of the environment in your home place?", answered on a Likert scale of 1 to 5, where one is "very bad" and five is "very good".

After getting huge amount of data from each country, the country comparisons can be made statistically. This is generally considered to be the best possible method, but it has significant limitations. Existing international surveys need large amount of respondents, because they are generally prone to certain challenges as 1) people use different scales; 2) people may provide answers they think the researchers want to hear; 3) people may be culturally driven to either select extremes or avoid extremes; 4) people may answer in a way that does not reflect to the actual reality; 5) extraordinary cultural variations within the context of the questions asked; 6) challenging data processing with room for researchers' own interpretation. As a result, existing international surveys are very time-consuming, data-intensive and expensive practices. Even with huge amount of collected data not all of the abovementioned challenges would necessarily be overcome (Harju-Autti, 2013).

Because of the abovementioned challenges, with the existing approaches it would be practically impossible to create a trustworthy global comparison of EA. Therefore, not surprisingly, global cross-national comparisons on EA have not yet been performed.

To overcome the abovementioned theoretical and methodological challenges, the approach in this study is based on five principles:
1.   Using terms that are easier to understand. Therefore, ask a person for an opinion on the three elements (motivation, knowledge and skills) of EA and then calculate the EAI as a combination of these elements.
2.   Keeping the survey questions as general as possible, without going to particular environmental problems, This will allow comparisons with later uses of the survey in the next decades. We cannot know the future of environmental problems, but we can well assume that the concept of EA (motivation, knowledge and skills) will continue to be suitable for use in the future.
3.   Using direct cross-national comparisons. EA would be virtually impossible to compare globally with just one fixed survey mechanism. However, a relative comparison between countries can be performed. For example, a Frenchman has an idea of the level of EA in his country as compared to the situation in Spain, Belgium, Italy and Germany.
4.   Asking for expert evaluations in each country. Experts are individuals who, by their

profession or some other activity, are expected to have relatively high EA and an understanding of environmental matters in their own country and worldwide.
5.   Instead of using Likert scales (typically from 1 to 5), allowing more nuanced country comparisons in a continuous scale from 0 to 100 with a sophisticated online survey methodology

In practice, the experts were asked to compare the three elements of EA (motivation, knowledge and skills) in a scale 0-100 in relation to other countries. This method gives us the relative level of EA in countries on a numerical scale so that in principle all 194 countries can be compared with each other. As a result, the EAI (EAI) will be created. After the validity check, we aim to prove that with this methodology the abovementioned five challenges of the existing international surveys can be overcome.

4.2 Content of the survey
For our study we used a previously developed online survey (Harju-Autti, 2012). To avoid the intercultural problem mentioned by Hofstede et al. (2010), the survey was kept as general as possible. The survey was done in English, containing five questions (Harju-Autti, 2012):
1.   Background question: Your country
2.   To your mind, how good is the state of the environment in… [each assigned country, separately]?
a) Current State of the environment (STATE) b) Trend of the environment (TREND)
3.   How good is the level of general education and environmental knowledge in…?
a) General education (EDUC)
b) Environmental knowledge (EKNOW)
4.   Motivation to try to improve the environment by their own behaviour and personal skills to do it (i.e. recycling, energy decisions etc.)…?
a) Motivation to act (MOTIV)
b) Personal skills (SKILLS)

5.   Possibilities to act environmentally friendly and availability of environmental information in…?
a) Possibilities to act (POSSIB)
b) Availability of environmental information (AVAIL)
After selecting the appropriate country, the questions from 2 to 5 were answered by indicating a point on a two-dimensional space. Part A of the question was answered on the x-axis and part B on the y-axis. The scale for both axes went from 0 to 100, where 0 indicated 'Poor' or 'Not at all', and 100 indicated 'Good' or 'Very much'.

4.3 Methodology for country comparisons
Every respondent evaluated the situation in his or her own country and in two neighbouring countries and two control countries, namely Germany and India. The two neighbouring countries determined for each country are illustrated in Fig. 5.

Fig. 5. Country evaluations for all 194 countries. Countries of the Club of Rome are marked with green star.

Hence, the respondents of each country had four other countries to assess. For example, a respondent from Switzerland would evaluate first the situation in Switzerland, and then in France and Italy, and finally in Germany and India. After typing in the respondents' country, the IT tool used determined automatically the two neighbouring countries to be evaluated (Fig. 6).
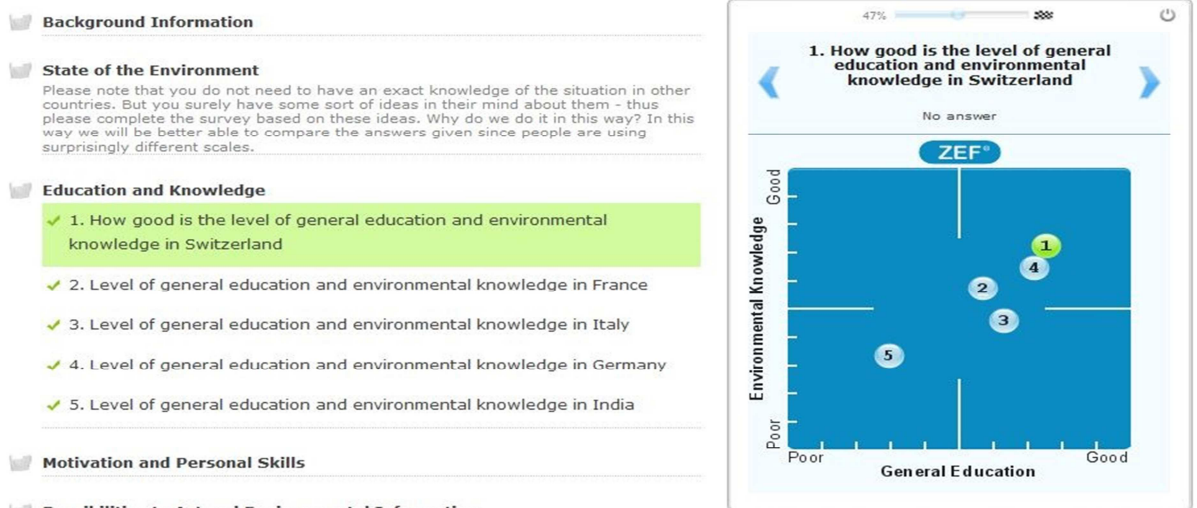
Fig. 6. An example of an answer from Switzerland to the question about the education and knowledge. Each point on the two dimensional space represents the answer for the correspondingly numbered country.

4.4 Implementation of the Survey
The online survey service provider ZEF Evaluation Engine® hosted the online questionnaire. The data collection period started in August 2012 and continued to 25 September 2013. Respondents were selected from the spheres of academics, business, industry, administration and NGOs, and were expected to have a relatively good understanding of environmental matters. Different means were applied to select respondents and contact them: 1) suitable experts from several international organizations (Birdlife International, Greenpeace International, International Club of

Rome, and HELCOM); 2) the leaders and contact persons from projects under the EU Life Programme from the last 7 years; 3) suitable organizations via Facebook communities.

4.5 Data analysis and validity check

From a total of 1861 responses during the survey time, 527 passed the initial screening process that eliminated empty responses and those responses that clearly showed the respondent had not grasped the idea of two dimensional space. Because each individual response held data concerning five countries, the raw response data were segregated and allocated to the correct countries. The resulting number of expert answers from the countries varied from zero to 417 and 460 (Germany and India, respectively). For statistical reliability, we decided to leave out from further analysis those countries that had less than 10 answers. Therefore, we obtained a sufficient number of answers from 57 countries. In the 57 countries, the median number of expert answers per country is 19, and ten countries have fifty or more answers. Thus, we obtained 2286 answers for the 57 countries (Fig. 7).
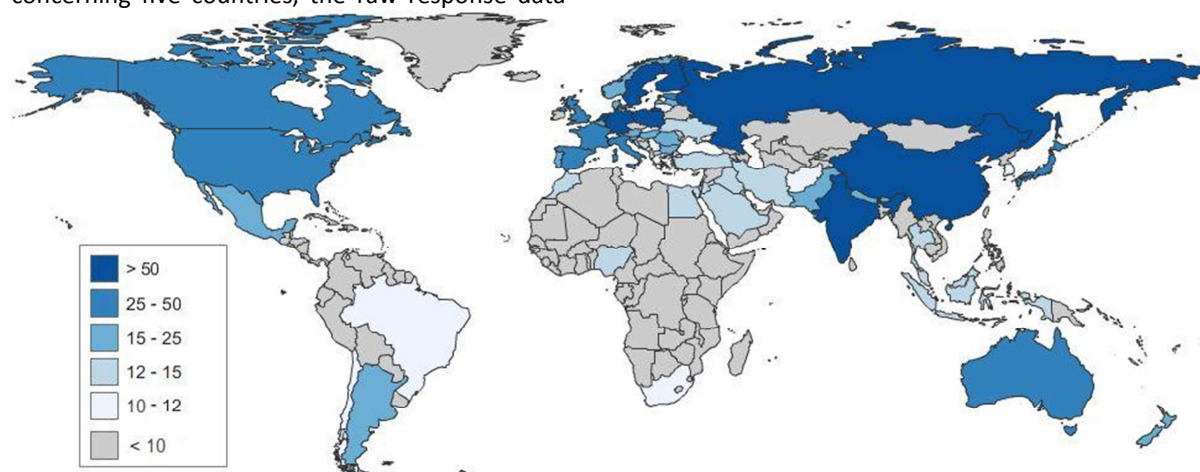

Fig. 7. Geographical distribution of 2286 answers for the 57 countries.

To assess the validity of our data, the answers were compared (Fig. 8). The points labelled with number 1 indicate answers about the respondents' home country, and numbers 2 and 3 refer to neighbouring countries, number 4 usually to Germany and number 5 to India. The ellipse around each point indicates the deviation of the answers. The relatively small ellipses around points 4 and 5 show that respondents from all round the world have judged the situation of Germany and India similarly. This is a very convincing outcome. Moreover, Fig. 8 shows that there is no excessive patriotism in the responses. Since points 2 and 3 are consistently very close to point 1, the respondents have not favoured their own country inequitably, nor have they been unduly modest in their answers.

If any of the abovementioned challenges 1-5 of the existing international surveys (Chapter 3.1) would have manifested, the results in these validity checks would have become much more scattered. As in the earlier pilot study (Harju-Autti 2013), we can conclude that these challenges of the existing international surveys are not causing unsurmountable challenges for this methodology.

Fig. 8. Validity check of the data. Number 1 indicates answers about the respondents' home country; numbers 2 and 3 refer to neighbouring countries; number 4 usually to Germany and number 5 to India.

To calculate the EAI, the arithmetic mean of the three measured elements of EA was taken: General Education, Motivation to Act, and Personal Skills. Therefore,

$$EAI = (EDUC + MOTIV + SKILLS)/3$$

The scale for every indicator (and consequently for the EAI) ranges from 0 to 100, and the averaged results for the countries settle between 20 and 80 with some variation between questions. Fig 9 shows the maximum, minimum and median values of the country means for every variable. We can see from the results in Fig 9 that sensitivity and relevance of each question was satisfactory since all the questions provided answers with a wide range of values.
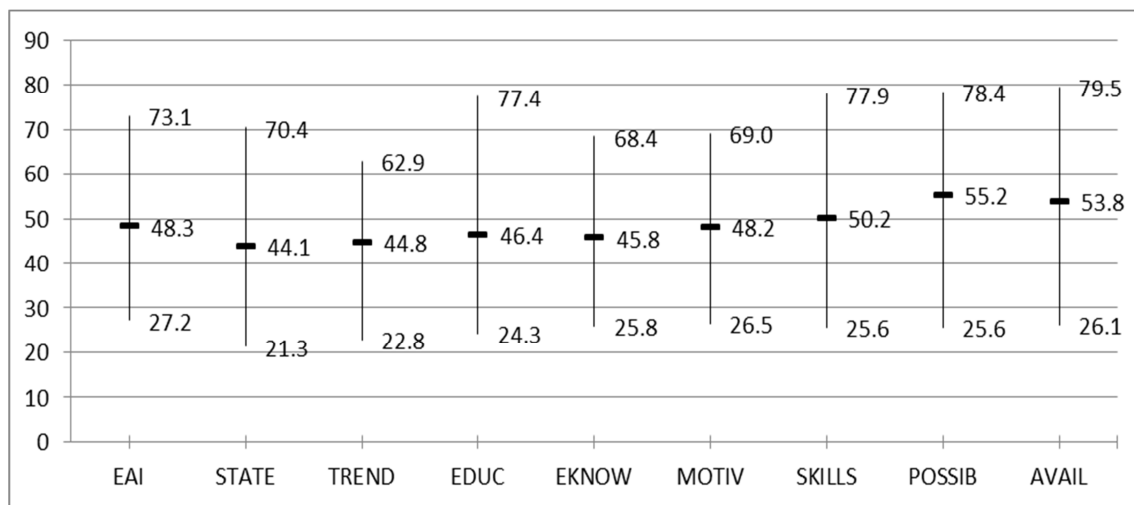
Fig. 9. The minimum, maximum and median values of country means for each survey question, and the EAI .

To further explore our indices, we made a cross-correlation table (Table 1). The correlations of EAI with general education (EDUC), motivation to act (MOTIV) and personal skills (SKILLS) are calculated only for reference, as they should be high because the EAI, by its definition, directly depends on the three indicators. It is noteworthy that all of the correlation coefficients are very high, none below 0.74. In effect, Cronbach's alpha between the eight indicators (excluding EAI) is as high as 0.98. Therefore, a country that scores high in any of the indicators is likely to score high in all of the other indicators as well.

The correlation of 0.87 between the EAI and STATE gives strong support to our **hypothesis 2** that EAI in countries is positively correlated with a good state of the environment.

Table 1. Correlation coefficients between our eight variables and the EAI.

	STATE	TREND	EDUC	EKNOW	MOTIV	SKILLS	POSSIB	AVAIL	EAI
STATE	-								
TREND	0.79	-							
EDUC	**0.91**	*0.80*	-						
EKNOW	*0.84*	*0.83*	**0.93**	-					
MOTIV	0.75	0.79	0.80	*0.85*	-				
SKILLS	0.78	0.75	*0.88*	*0.87*	*0.82*	-			
POSSIB	*0.86*	0.80	*0.90*	*0.83*	*0.84*	*0.84*	-		
AVAIL	*0.85*	0.74	**0.93**	*0.90*	0.76	*0.85*	*0.90*	-	
EAI	*0.87*	*0.83*	**0.95**	**0.94**	**0.92**	**0.96**	**0.91**	*0.90*	-

Some indicators have consistently higher correlation coefficients. For example, motivation to act (MOTIV) and state of the environment (STATE) both have relatively low correlation coefficients with all of the other indicators, and conversely, environmental knowledge (EKNOW) and possibilities to act (POSSIB) both have relatively high correlation coefficients with all of the other indicators. With the EAI, the highest correlation coefficients are found with general education (EDUC), environmental knowledge (EKNOW), motivation to act (MOTIV) and personal skills (SKILLS). This gives further proof that the definition of the EAI — consisting of motivation, knowledge and skills — is very valid.

5. Results and discussion

5.1 EAI in the 57 countries

For presenting the EAI results, we used a six-colour scale. The green colour indicates values on the 'good' half of the scale and yellow and orange indicate values on the non-desirable half of the scale. Fig. 10 shows the values of the EAI globally. The countries close to the Equator appear to have lower EA than countries closer to the poles. The countries scoring highest on the EAI are Austria, Sweden, Finland, Germany and Denmark. Of the non-European countries, the best performers are Japan, New Zealand and Canada. The weakest EAI scores are found in Southern Asia, Mexico and Africa.

5.2 Perceived current state of the environment

The map of the perceived current state of the environment in the 57 countries (Fig. 11) looks quite similar to the EAI map (Fig. 10), though, keeping in mind the high correlation coefficient between them (Table 1), this is not surprising. The most obvious difference between the two maps in Figs. 10 and 11 is the change in the colours for the USA and China. Overall, the map of the perceived state of the environment is more yellowish/reddish than the EAI map, i.e. fewer countries score over 50 on STATE than on EAI. Especially, many European countries shift from green to yellow (France, Spain, UK, Belgium, Poland, Slovakia, Greece), though a few (Bulgaria, Latvia, Lithuania) show a shift to greener colours (see Figs. 10 and 11). The countries scoring highest on the perceived current state of the environment are Sweden, Finland, New Zealand, Norway and Denmark.

5.3 Perceived trend in the environment

The map of the perceived trend in the environment (Fig. 12) presents a very worrying overall situation: the state of the environment is perceived to be deteriorating in most countries. Especially, in many parts of Asia and Middle East the TREND value is below 38. The situation in the Americas is slightly better than in Asia, but not as good as in Europe.

With regard to geographical differences (see Figs. 10–12), it is obvious that some European countries are outperforming other geographical areas. For example, in the EAI map (see Fig. 10) the European countries stand out, so that Japan, which has the 10th highest EAI in the world, is the highest scoring non-European country. However, we must note that there are very high differences within the European countries.
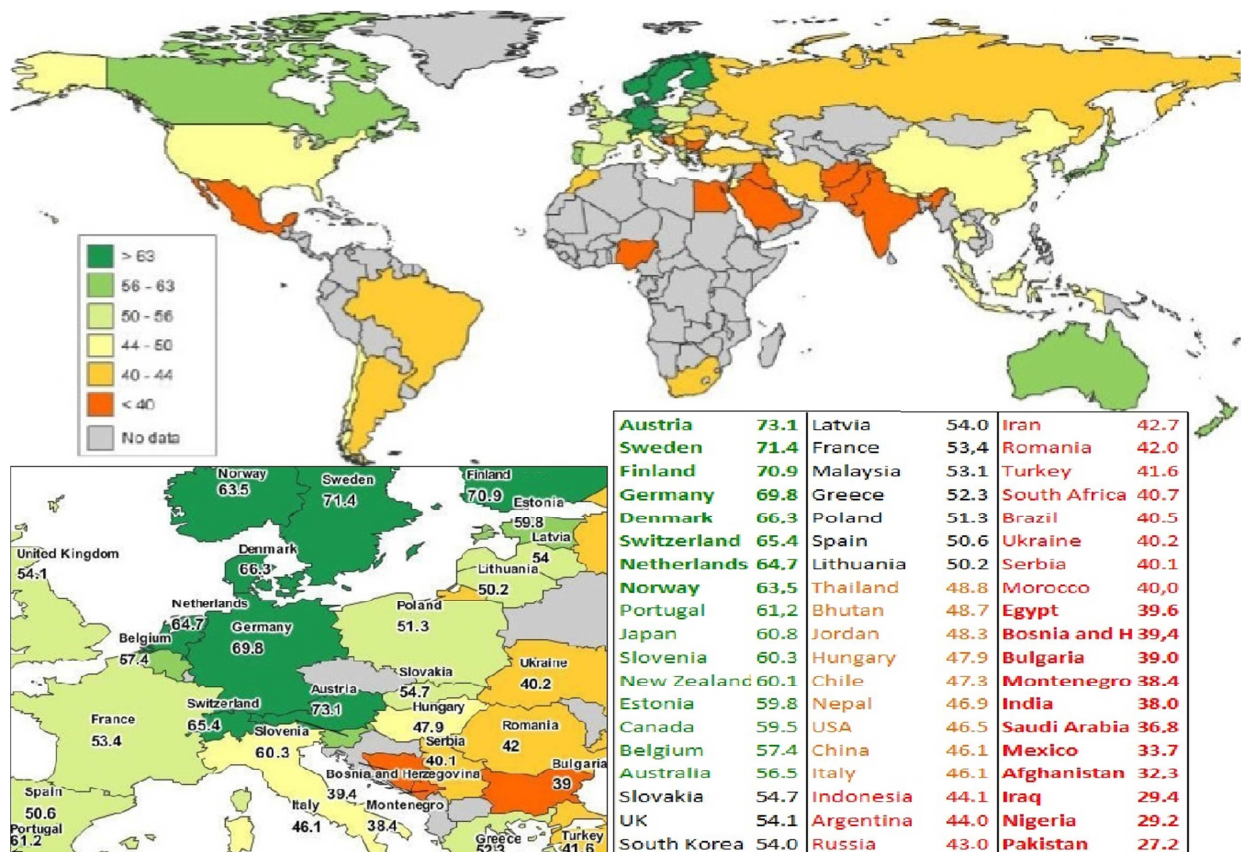
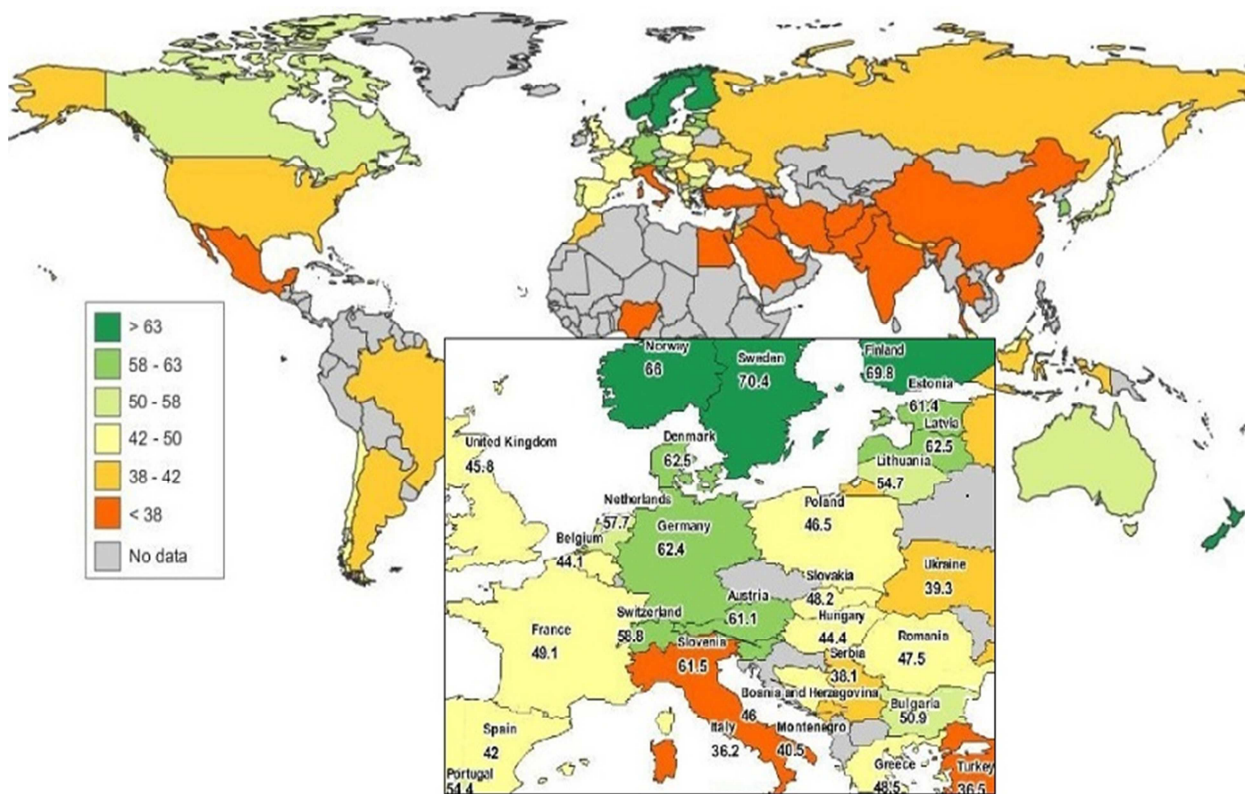| Austria	73.1	Latvia	54.0	Iran	42.7
Sweden	71.4	France	53,4	Romania	42.0
Finland	70.9	Malaysia	53.1	Turkey	41.6
Germany	69.8	Greece	52.3	South Africa	40.7
Denmark	66.3	Poland	51.3	Brazil	40.5
Switzerland	65.4	Spain	50.6	Ukraine	40.2
Netherlands	64.7	Lithuania	50.2	Serbia	40.1
Norway	63.5	Thailand	48.8	Morocco	40,0
Portugal	61,2	Bhutan	48.7	Egypt	39.6
Japan	60.8	Jordan	48.3	Bosnia and H	39,4
Slovenia	60.3	Hungary	47.9	Bulgaria	39.0
New Zealand	60.1	Chile	47.3	Montenegro	38.4
Estonia	59.8	Nepal	46.9	India	38.0
Canada	59.5	USA	46.5	Saudi Arabia	36.8
Belgium	57.4	China	46.1	Mexico	33.7
Australia	56.5	Italy	46.1	Afghanistan	32.3
Slovakia	54.7	Indonesia	44.1	Iraq	29.4
UK	54.1	Argentina	44.0	Nigeria	29.2
South Korea	54.0	Russia	43.0	Pakistan	27.2

Fig. 10. EAI in the 57 countries.

Fig. 11. Perceived current state of the environment (STATE) in the world.
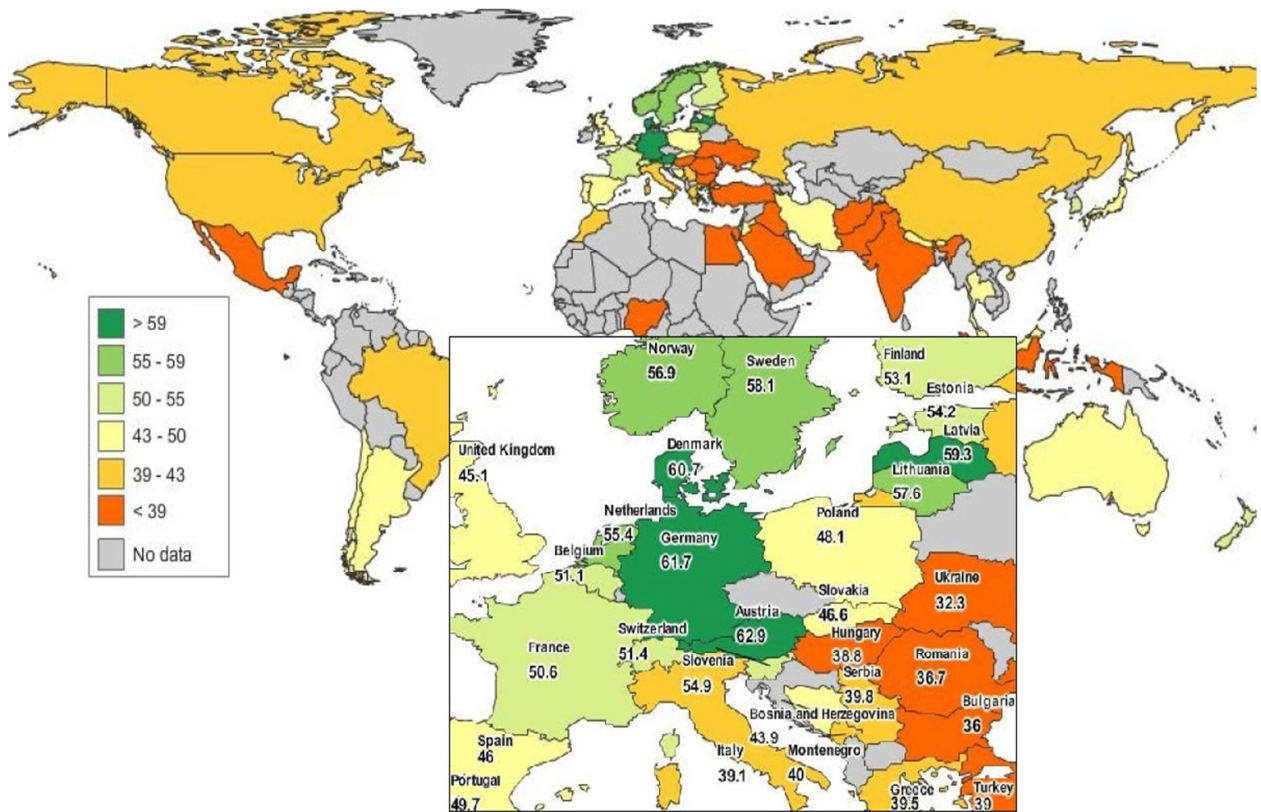
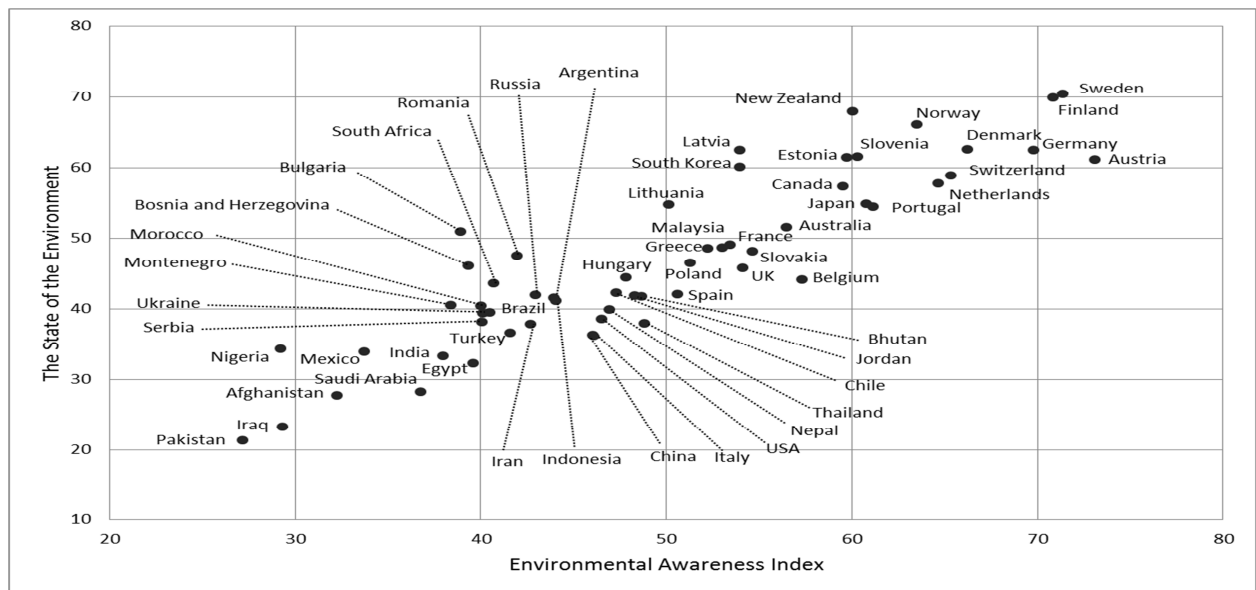**Fig. 12.** Perceived trend in the environment (TREND) in the world.

Fig. 13. Correlation between the EAI and the perceived state of the environment in the 57 countries.

To understand how the EAI and the perceived current state of the environment are related to each other, we plotted these two variables in a single graph (Fig. 13). As noted earlier, these two correlate well with each other (correlation coefficient 0.87). When comparing countries' positions in Fig 13, we see that generally the world's most populous countries rank poorly. In the top-right corner all countries except Germany

(4th) and Japan (10th) are rather small countries. Of the European countries, 69% rank in the top half and only 31% in the bottom half. For Asia, the same figures are 33% and 67%, respectively. Furthermore, all countries from South America, Africa and the Middle East rank in the lower half.

5.4 Comparison with other national-level indices

We compared the EAI with other national-level indices, especially the ones that in previous research have been connected somehow with EA. The selected indices form three groups for the following analysis.

5.4.1 Some general national-level indices and the EAI

The first group consists of general indices measuring the level of countries' development, education and economy. Table 2 shows correlation coefficients between twelve general indicators and six of our indicators: the EAI, perceived current state of the environment (STATE), perceived current trend in the environment (TREND), level of general education (EDUC), motivation to act (MOTIV), and personal skills (SKILLS).

Table 2. Indices measuring human development, including measures for the level of education and national wealth, both of which have been linked to EC. Coefficients are Pearson correlation coefficients. Levels of significance: correlation of 0.53 significant at 0.0001 level, 0.45 significant at 0.001 level, and 0.36 at 0.01 level.

Index	EAI	STATE	TREND	EDUC	MOTIV	SKILLS
Human Development Index (HDI) [a]	*0.71*	*0.62*	*0.63*	*0.71*	*0.52*	*0.77*
GII: Gender Inequality Index [a]	**-0.82**	**-0.73**	*-0.68*	**-0.80**	*-0.66*	**-0.84**
Global Peace Index [b]	**-0.80**	**-0.77**	**-0.73**	**-0.76**	**-0.74**	**-0.77**
Environmental Performance Index (EPI) [c]	*0.77*	*0.67*	*0.64*	*0.75*	*0.69*	*0.76*
EPI trend [c]	0.14	0.12	0.07	0.13	0.16	0.12
PISA: average score (2009) [d]	*0.74*	*0.64*	0.48	*0.73*	*0.66*	*0.72*
HDI: Education index [a]	*0.65*	*0.66*	*0.60*	*0.70*	*0.44*	*0.69*
Combined gross enrolment in education (%) [a]	*0.68*	*0.66*	*0.62*	*0.68*	*0.52*	*0.72*
Public expenditure on education (% of GDP) [a]	0.46	*0.60*	*0.54*	0.52	0.32	0.42
Expected Years of Schooling (of children) [a]	*0.68*	*0.65*	*0.65*	*0.69*	*0.54*	*0.69*
HDI: Income index [a]	*0.72*	*0.58*	*0.65*	*0.69*	*0.56*	*0.76*
Population living below $1.25 PPP per day (%) [a]	-0.31	-0.08	-0.34	-0.28	-0.22	-0.32
GNI per capita in PPP terms [a]	*0.78*	*0.64*	*0.62*	*0.75*	*0.65*	*0.80*

a (HDR, 2013); b (Institute for Economics and Peace, 2013); c (Yale University, 2012); d (OECD, 2013)

The Gender Inequality Index (GII) and Global Peace Index (GPI) stand out with their correlation coefficients below -0.8. This indicates that EAI generally correlates with gender equality – as stated in our **hypothesis 6** - and peacefulness. Moreover, as was to be expected, all indicators of education correlate positively with EAI and general education. The social science literature often assumes that wealth is the foremost cause of public environmentalism, at least in the west (Ignatov, 2006). This study shows that this assumption is rather well grounded, since the national wealth has a high positive correlation coefficient 0.78, supporting our **hypothesis 1**. To further explore the correlation between national wealth and EAI, a scatter plot diagram of them was produced (Fig. 14).
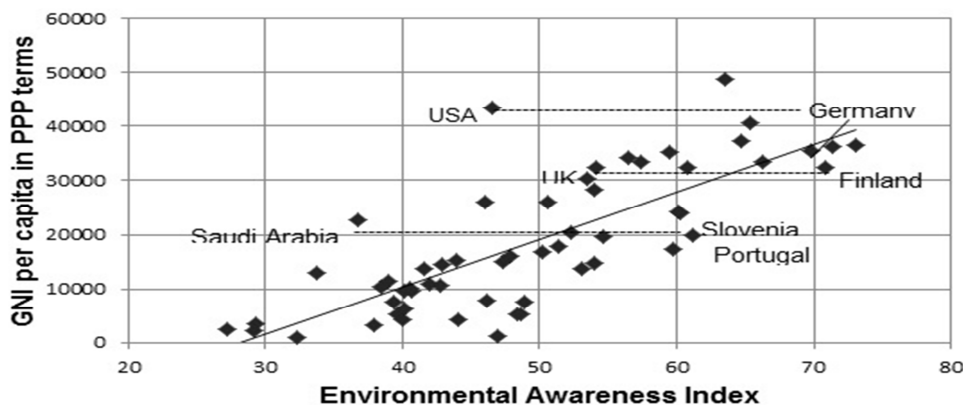
Fig. 14. Correlation between EAI and GNI per capita.

In Fig 14 an evident positive linear correlation is seen between the EAI and the country's wealth. However, a nation's level of EAI is by no means determined by its GNI. For example, the United Kingdom and Finland are two countries with the same level of wealth, but with a significantly different level of EAI. Differences between the USA and Germany are even more striking. Saudi Arabia, compared with Slovenia and Portugal, is another example of disconnection between the level of wealth and the EAI. Most of our indicators (EAI, STATE, EKNOW, MOTIV and SKILLS) behave similarly with all of the twelve general indices. This is not surprising considering their high internal consistency. Especially, EAI, EDUC and SKILLS correlate well with the other national-level indices. It is important to note that motivation to act (MOTIV) is not correlating very well with the other

national-level indices. This is interesting because previous research has largely focused on studying motivational factors such as EC. This strongly indicates that significantly better correlations with the other national-level indices are achieved by studying EA with our wider approach (EAI consisting of motivation, knowledge and skills) than by studying only EC.

5.4.2 Perceived environmental problems and EAI
Along the lines of Brechin's (1999) study, we were interested in comparing the level of EA with perceived seriousness of local and global environmental problems. Thus, Table 3 contains correlation coefficients between six of our indicators and some statements on the seriousness of environmental problems.

Table 3. Correlation coefficients between the study variables and four measures about the perception of the state of the environment, both locally and globally WVS (2011).

	EAI	STATE	TREND	KNOWL	MOTIV	SKILLS
Environmental problems in your community: Poor water quality						
Very serious	**-0.72**	*-0.67*	-0.53	*-0.67*	*-0.64*	**-0.75**
Somewhat serious	-0.33	-0.25	-0.25	-0.33	-0.31	-0.30
Not very serious	0.44	0.37	0.30	0.39	0.40	0.47
Not serious at all	***0.75***	**0.70**	*0.56*	***0.72***	*0.67*	***0.76***
Environmental problems in your community: Poor air quality						
Very serious	*-0.70*	*-0.66*	*-0.54*	*-0.67*	*-0.62*	**-0.71**
Somewhat serious	-0.09	-0.02	0.01	-0.13	-0.04	-0.10
Not very serious	*0.62*	*0.54*	0.41	*0.59*	*0.56*	*0.62*
Not serious at all	*0.65*	*0.63*	0.51	*0.65*	*0.55*	*0.67*
Environmental problems in the world: Pollution of rivers, lakes and oceans						
Very serious	-0.24	-0.16	-0.29	-0.24	-0.27	-0.18
Somewhat serious	0.40	0.35	0.36	0.41	0.39	0.34
Not very serious	0.00	-0.14	0.14	-0.02	0.08	-0.04
Not serious at all	-0.36	-0.36	-0.12	-0.34	-0.28	-0.41
Environmental problems in the world: Global warming or the greenhouse effect						
Very serious	-0.19	-0.13	-0.18	-0.21	-0.19	-0.13
Somewhat serious	0.37	0.33	0.29	0.40	0.32	0.31
Not very serious	-0.07	-0.17	-0.01	-0.09	0.00	-0.11
Not serious at all	-0.38	-0.33	-0.20	-0.38	-0.29	-0.42

It is obvious that perceptions on community level environmental problems in general correlate better with all our indices than do views on global-level problems. That is consistent with Brechin's findings. Furthermore, we note that the tendency to consider community-level environmental problems to be (very) serious is negatively correlated with the EAI, and in fact with all six of our indicators. Moreover, the view that community-level environmental problems are not serious (at all) is positively correlated with our indicators. Thus, EA tends to be lower in countries where people encounter serious environmental problems in their community. However, concern about global environmental problems is not tied to the level of EA (or to our other five indicators).

5.4.3 Values and attitudes and the EAI

In research on environmentally significant behaviour, Schwartz's self-transcendence values (universalism and benevolence) have been connected positively to altruistic behaviour and support for environmentalism, while their counterparts, self-enhancement values (achievement and power), have a negative impact on expressions of EC (e.g. Dietz et al., 2005; Schultz & Zelezny, 1998; Schultz & Zelezny, 1999). Therefore, we chose to calculate correlation coefficients between our indicators and four values statements that measure Schwartz's value orientations (Table 4). The results indicate that higher levels of EA seem to be found in nations that are more likely to accept universalistic and benevolent values. Being a little universalistic and benevolent have the highest correlation coefficient (0.25 and 0.21) with the EAI. These results indicate support to our **hypothesis 3**. Moreover, the correlations coefficients show clearly a negative correlation between achievement and power values orientations and EA (and the other five indicators), supporting our **hypothesis 4.**

Table 4. Correlation coefficients between the study variables and value dimensions of Schwartz that are connected with environmentally significant behaviour WVS (2011).

	EAI	STATE	TREND	KNOWL	MOTIV	SKILLS
Universalism: It is important to this person to look after the environment						
Very much like me	-0.22	-0.25	-0.13	-0.28	-0.15	-0.18
Like me	-0.01	-0.06	0.01	0.06	-0.10	-0.02
Somewhat like me	0.12	0.20	0.03	0.13	0.11	0.10
A little like me	0.25	0.25	0.13	0.26	0.26	0.20
Not like me	0.01	0.06	0.11	-0.02	0.01	0.04
Not at all like me	-0.42	-0.35	-0.30	-0.46	-0.45	-0.30
Benevolence: It is important to this person to help the people nearby						
Very much like me	-0.25	-0.29	-0.14	-0.29	-0.26	-0.17
Like me	0.02	-0.01	0.06	0.06	-0.05	0.03
Somewhat like me	0.11	0.16	0.02	0.12	0.14	0.07
A little like me	0.21	0.21	0.08	0.22	0.26	0.13
Not like me	0.14	0.20	0.16	0.13	0.16	0.11
Not at all like me	-0.39	-0.23	-0.30	-0.38	-0.37	-0.38
Achievement: It is important to this person to be very successful						
Very much like me	-0.47	-0.47	-0.22	-0.51	-0.37	-0.47
Like me	-0.45	-0.46	-0.05	-0.46	-0.38	-0.46
Somewhat like me	0.13	0.14	0.07	0.09	0.14	0.15
A little like me	0.32	0.30	0.04	0.35	0.28	0.26
Not like me	0.51	0.50	0.20	*0.55*	0.40	0.51
Not at all like me	0.21	0.29	0.02	0.23	0.10	0.27
Power: It is important to this person to be rich						
Very much like me	-0.49	-0.45	-0.23	*-0.54*	-0.30	*-0.56*
Like me	-0.47	-0.48	-0.17	-0.48	-0.34	-0.51
Somewhat like me	-0.38	-0.40	-0.24	-0.43	-0.29	-0.35
A little like me	0.10	0.07	0.05	0.12	0.09	0.08
Not like me	0.53	0.49	0.26	*0.57*	0.38	*0.54*
Not at all like me	0.17	0.22	0.06	0.17	0.09	0.22

Besides Schwartz's value dimensions, also Inglehart's postmaterialism scale has been commonly used in research on environmentalism. Therefore, we examined the relationship between postmaterialist value orientations and the EAI, to test our hypothesis 5. Furthermore, willingness to sacrifice oneself for the environment is another aspect of environmentally significant behaviour that has been used, e.g. by Stern et al. (1999) in their study. The World Values Survey (2011) contains a suitable item: willingness to give part of one's income for the environment.

Correlations between our variables and the postmaterialism index are displayed in Table 5. The high correlation coefficients (0.64–0.68) between the statements from the end of the postmaterialist scale and the EAI show that the support for postmaterialist values is strongly correlated with the EAI. These results indicate clear support to our **hypothesis 5**. On the other hand, the correlation coefficients between the statements of willingness to give part of one's income for the environment and our indicators are all insignificant. Therefore, the willingness to sacrifice economically for the environment seems not to be strongly correlated with the EAI.

Table 5. Correlation coefficients between our variables and different levels of postmaterialism, and expression of willingness to act pro-environmentally. WVS (2011)

	EAI	STATE	TREND	KNOWL	MOTIV	SKILLS
Inglehart's postmaterialism index						
Materialist	*-0.67*	*-0.56*	*-0.63*	*-0.63*	*-0.67*	*-0.63*
"1"	*-0.67*	-0.53	-0.57	-0.59	-0.65	-0.69
"2"	-0.08	-0.02	0.13	-0.02	-0.05	-0.17
"3"	*0.68*	*0.56*	*0.58*	*0.61*	*0.68*	*0.69*
"4"	*0.65*	0.49	0.51	*0.56*	0.63	0.69
Postmaterialist	*0.64*	0.52	0.46	*0.60*	0.59	0.67
Would give part of my income for the environment.						
Strongly agree	-0.29	-0.22	-0.20	-0.26	-0.31	-0.25
Agree	0.07	-0.03	-0.05	0.05	0.09	0.08
Disagree	0.10	0.19	0.12	0.12	0.09	0.06
Strongly disagree	0.02	0.01	0.10	0.01	0.03	0.02

Earlier cross-national studies have generally focused on EC or attitudes. In view of this study, we see it as a limitation. If EAI was replaced by EC in the above-mentioned six hypotheses, and previous scientific studies were reflected on them, the results would most likely be conflicting. For example, Marquart-Pyatt (2012) discovered that correlations between national level factors and EC differ significantly between the three dimensions of EC that she identified. This study strongly indicates that significantly better correlations with the other national-level indices are achieved by studying EA with our wider approach (EAI consisting of motivation, knowledge and skills) than by studying only EC.

5.5 Limitations of the study
This research attempts to shed new light on some of the challenges related to measuring environmental awareness cross-culturally, and proposes a new methodology with a rather limited empirical data. Further reproductions of EIA survey

could be executed by a well-known international organisation. We must bear in mind that the opinion of experts is something different from the opinion of the population (or a random sample of it). Moreover, EA with our wider approach (EAI consisting of motivation, knowledge and skills) is a different concept than customary focus on only EC. Hence, the ranking that is presented here refers to different facts than some other studies. However, given that the global measurements of environmental attitudes/concerns of a country's population have never been performed, the novel methodology presented in this study extends an understanding of cross-national variations of environmental awareness across the globe.

6. Conclusions:
For successful global research on EA, it was necessary 1) to establish a solid theoretical basis of EA and its relation to concrete behaviour; 2) to develop a universally applicable methodology for

country comparisons; and 3) to build an easy-to-use IT tool for data gathering for global comparisons of EA. A cross-national EAI was constructed and measured for 57 countries, consisting of 76.7% of the world population. Validity tests of the gathered data showed that the methodology and IT tool provided very relevant data for global analysis. The study shows that the set of eight questions is capable of pinpointing differences in the countries' EA - more questions would be too exhaustive for the respondents, and less would not be enough to depict the differences. The countries with highest EAI were found in Europe. Generally, countries near the Equator have weaker EAI scores. All the highest EAI scores were found in smaller countries. The only larger countries that perform in the top 15 are Germany (rank: 4), Japan (10) and Canada (14).

Based on a literature study, six hypotheses on the EAI were formulated. The results of this global study support all the six hypotheses:

1) The correlation coefficient of 0.78 between the EAI and GNI per capita indicates solid support of the hypothesis that there is a positive correlation between a nation's EAI and its national wealth (the affluence hypothesis).

2) The correlation of 0.87 supports strongly that EAI in a country is positively correlated with a perceived good state of the environment. Moreover, the EAI tends to be higher in countries where people do not encounter very serious environmental problems on a local level.

3) The correlation coefficients suggest a positive correlation between the EAI in a country and the self-transcendent values. However, the correlation is not very strong.

4) The correlation coefficients suggests a negative correlation between the nation's EAI and the self-enhancement value orientations.

5) The correlations 0.64-0.68 between the EAI and postmaterialism in a nation show a positive correlation between the EAI and postmaterialist values.

6) The correlation coefficient 0.82 supports a positive correlation between the EAI and gender equality in a country

The results indicate also that the perceived current state of the environment is rather worrying and in most countries deteriorating. This study shows that for cross-national EA studies it is possible to obtain reliable global results by

a) conceptually using a broader definition of EA, consisting of three concrete elements (motivation, knowledge, skills),

b) applying an expert study with direct cross-national comparisons — respondents themselves making comparisons between countries, and

c) employing a global (data may be obtained from all 194 countries) sophisticated IT tool for data gathering and processing.

This study provides a ready-to-use tool for future measurements of EA cross-nationally. The method used proved to be very effective: even with a rather modest amount of work it was possible to generate a sufficient number of answers for 57 countries. However, for future measurements of the EAI, more emphasis could be placed on data acquisition: if a well-known international organisation would apply the method, enough data could be rather easily obtained for 80-100 countries. Further reproductions of the global survey will produce useful time-series analyses, enabling future analyses of the development of EA in the world.

7.0 Acknowledgements:

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