

# A Yin-Yang approach to education policy regarding health and the environment: early-careerists' image of the future and priority programmes

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## Abstract

*Since the inception of sustainable development (SD), there has been a somewhat ignored contradiction between paradigms that are ecosystem-based and paradigms that are human-based or purely economic. We suggest that this contradiction can be unified through a balance of the two. The Chinese Yin-Yang philosophy is applied as a tool or approach to seeking balance between these ecocentric and anthropocentric paradigms. Priority education policy design for the merging of ecology and health are projected through an Ecohealth lens in response to increasing SD challenges and the intention of the international Ecohealth organization to contribute to SD goals. Meeting SD goals along the nexus of health and environment is further considered through early-careerist cultural assessments and projections. The groups considered for their professional image of the future are: members of the Ecohealth Association Student Section and Chinese early-careerists participating in a related conference. In response to SD goals, a problem-based learning design is suggested as an education policy priority. Rather than approaching SD as a boolean concept, for example, by either focusing on ecosystem sustainability or economic development, we suggest education policy for programmes and curriculums that will help emerging professionals balance these paradigms, so as to best address national and global challenges.*

*Keywords:* Ecocentric; anthropocentric; Ecohealth; climate change; food security; Yin-Yang.

## 1. Introduction

The roots of the sustainable development (SD) concept extend back to the World Commission on Environment and Development's (WCED) 1987 Brundtland Report. However, questions about who should be engaged and how SD should proceed remain problematic (Malley and Watts, 1989; Imram *et al.*, 2014). Imram *et al.* (2014) concluded that financial and economic systems have largely ignored ecocentric principles, and that there is a clear need for their

enhanced inclusion within SD. Consideration of SD goals could be one approach to bridging academia and society, in this case applying environmental philosophy beyond specialist journals (Jamieson, 2007). Historically, the development of education programmes has been based upon traditional disciplines and employment opportunities. Generally, responsibility for SD has fallen outside of this process. There is a related SD need for an approach to national policies that can respond to challenges or problems through enhanced education strategies. On a smaller and more discipline-specific scale, this approach is sometimes referred to as problem-based learning (Wiers *et al.*, 2002). We suggest that the current societal disconnect between education policies and SD may not benefit the public in any country, and that early-careerists are ready for a significant fusion of education disciplines.

One possible entry point for advancing SD in education programmes is through the large and complex field of human health, which contains a growing awareness of ecology through the concept of Ecohealth (Charron, 2012), and more specifically where ecocentrism has been linked to nursing (Wells, 2004). Ecocentrism is focused

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on the inherent capacity of ecosystems without consideration for anthropocentric goals involving the environment. The aforementioned health-environment examples somewhat recognize that an appreciation of ecocentrism, or the intrinsic capacity of ecosystems, is indeed germane to human health. In general, the global nexus of human wellness and the environment may well become increasingly problematic as a result of currently uncontrolled factors such as population growth and climate change. Given these escalating challenges associated with climate and population, we suggest there is a sound rationale for a line of SD health focus and related education development policy. The approach outlined herein involves both a reflection on an increased sense of balance for problem solving and futuristic considerations. In the current paper, the term *Ecohealth* is used in two contexts; first, in connection to the Ecohealth Association (International Association of Ecology and Health) and second, through a more general use of combining ecology and health, inclusive of issues such as environmental sustainability and food security, involving non-regulated ecosystems such as the oceans. In both uses of the term Ecohealth, the intention outlined within the literature clearly has been to encourage positive synergy along the nexus of human health and environment. Specific references are provided herein for documents and efforts that are directly connected to the Ecohealth Association (IAEH).

The inclusion and enhancement of the ecocentric approach has been considered important for the ecological sustainability of human societies (Stevens, 2012). In the journal *Climate Change*, Salinger (2010) indicated that: the need for an ecocentric worldview is required for Homo sapiens to survive on planet Earth. Political scientist Hall (2011) considered that: human-centered hierarchies have been identified as one of the fundamental drivers of ecological overshoot, biological extinctions and ecosystem collapse. However, clearly there is also a need for a human-centered perspective for holistic considerations of human health, for example, in what has been described as the ecosystem approach to health (Charron, 2012). Human-centered (anthropocentric) and ecocentric approaches may well be perceived as opposites, and we suggest that there is the potential for unity and better harmony in a balanced merger of these paradigms. The current work considers the need for enhanced linkages between ecology and health (Parkes et al., 2008) and the focus on expanding contributions to SDGs beyond their impact on human-centered ecosystems, a limitation previously prescribed by the IAEH (2013). In part, consideration is given to the perspective of Ecohealth early-careerists focusing on professional involvement in climate change as an ecocentric challenge. The objective of the current study is to examine the focus of early-careerists associated with the concept of Ecohealth, through their professional image of the future. Further, it is to create dialogue among established professionals spanning several continents through the

consideration of survey results and educational policy needs regarding SD, along the nexus of human health and the environment.

To facilitate a productive succession of academic leaders, continuity in an evolving field can be optimized by listening to the perspectives of early-careerists, through an emphasis on student dialogues (Hahn et al., 2012). Further, inter-generational considerations will likely be critical for maximizing the efficacy of transforming approaches, such as the Ecohealth lens, to more successfully meet the Sustainable Development Goals (SDGs), which have been stated as an objective by the Ecohealth Association (IAEH, 2013). The combination of human health and the ecosystem, which in part has been created by the IAEH through the term Ecohealth, can potentially provide a viewpoint or lens through which to consider the economics of the SDGs in a more holistic way. Reaching that goal may require a deeper consideration of the academic ethics associated with merging the term ecology with health, and the need to include ecocentrism. The current work considers perspectives from two groups of early-career Ecohealth practitioners, both individually and as a collective, as a way of examining their “Image of the Future” (Polak, 1973) for the Ecohealth lens. One group was identified through the student section of the IAEH, and the second was formed from Chinese nationals with interests in Ecohealth. Thus, in the current work, a deeper consideration is given to the Chinese culture and environment, as well as the in-country concept of anthropocosmic vision (Tu, 2001).

The Chinese Yin-Yang philosophy regarding the unity of opposites was previously introduced to the IAEH as an analogy to facilitate balance between ecocentric and anthropocentric paradigms. The inference is that one side of the Yin-Yang symbol could be looked upon as containing an inner circle core or principle-center of ecocentrism, with the larger section on that side representing the anthropocentric view to be considered. This side of the symbol would then  represent the health approach to ecosystem, with a core principle of respect for ecosystems and their capacities, external to the desires of humans. The circle in the other half of the symbol could then depict the principle of anthropocentric focus on the environment, with the larger section representing the ecocentrist view to be considered. This second side of the Yin-Yang symbol could then depict the ecosystem approach to health, with a core principle-center of concern for human health through an attention to the role of ecosystems. In essence, the current work is focused on extending the concept of cognitive applications in science and sustainability (Medin et al., 2007; Bang and Medin, 2010) to create SD balance along the professional nexus of human health and environment through education policy.

Consideration herein is given to this concept from a broader applied philosophical perspective, which includes education policy and the culture of practice for professional development by early-careerists associated with Ecohealth.

In addition, we consider the application of this derived balance of environmental paradigms for the promotion of societal change at the paraprofessional level, and how these approaches might be translated into education policy. Paraprofessionals, or non-professionals who are trained for limited and specific skills, have demonstrated an ability to span health and the environment (Anabieza *et al.*, 2010). Individual approaches to priorities and national considerations for balanced environment-related education policies are derived from assessments made in the authors' countries. The current work aimed at education along the nexus of health and environment parallels the concept of pragmatism, which has recently been projected as a philosophical perspective that moves beyond peer review and competition (Suter and Cormier, 2012) to meet specific challenges.

## 2. Methods

### 2.1. Cultural consensus among early-careerists and national comparisons

The use of cultural consensus theory in cognitive assessment has been well established as a standard in education psychology (Atran *et al.*, 2005; Medin *et al.*, 2007; Bang and Medin, 2010). One group of emerging researchers surveyed was from China, and was questioned regarding attendance at the 2012 Ecohealth Kunming Conference (CKA). The CKA participants were not previously members of the IAEH. The second international group consisted of individuals who were identified through their membership of the Ecohealth (Association) Student Section (ESS). The ESS group was asked to participate in an online survey of 47 questions using a *Likert Scale* as described in an Ecohealth Association internal report (Custer *et al.*, 2014). A Chinese translation was offered to a group of local early-careerists (CKA) attending the IAEH Kunming (China) 2012 Conference. The first 20 complete voluntary responses to the request for participation were accepted from each group. The results and discussion below focus on the questions that generated consensus. Principal-component analysis and factor loading (Abdi and Williams, 2010) were applied, as well as was a Scree test (Cattell, 1966), to determine agreement or consensus. The cultural consensus model or CCM (Romney *et al.*, 1986) is a factor-analytic methodology aimed at calculating and defining degrees of consensus and disagreement both within and among identified groups or populations. As outlined in Medin *et al.* (2007), the link between analysis and strong consensus is determined based upon results indicating that (1) *the ratio of the latent root of the first to the second factor is high*, (2) *the first eigenvalue accounts for a large portion of the variance*, and (3) *all individual first factor scores are positive and relatively high*. Consensus will not occur if there are underlying differences in areas such as belief

systems and/or knowledge platforms. Consensus across the two groups in the current work would indicate a strong international culture of projected practice and programming. Further applications of this approach include environmental decision-making (Atran *et al.*, 2005), particularly when considering multiple epistemologies (Bang and Medin, 2010).

As a combined group, the early-careerists demonstrated consensus based upon: (1) a ratio of 3.32 of the first root to the second root, a number which previously had been considered high for this form of analysis (Miller *et al.*, 2004); (2) a variance of 28.9, which was higher than the variance for any other factors; and (3) an average first factor score of 2.543, which previously had been considered in the high range (Medin *et al.*, 2007). The primary component analysis (Cattell, 1966) indicated that we could further consider questions in F1 — the first consensus factor in part due to the large break (or difference) between F1 and F2 (Custer *et al.*, 2014). The process was repeated for the two groups of early-careerists separately, to determine which questions generated consensus for the individual groups (ESS and CKA). Programme templates were then developed by in-country co-authors to include the perspective of early careerists, with consideration for national priorities and international comparisons (Table 1) over a range of classified incomes. These included high income (Canada), upper middle income (China), lower middle income (Philippines) and low-income (Kenya). Subsequently, a template for priority programming along the health-environment nexus was drafted for each country, based upon a hypothetical ten academic positions and national SD goals.

Note that curve shows a sharp drop after the first (F1) component. Other factors indicated that the second component could be used, but for the purpose of the current analysis, discussion was limited to the F1, which demonstrates the highest level of consensus.

## 3. Results

Results from the broad international survey group consisting of IAEH student members supported the development of a comparative approach to China and application to the design of templates for priority programming along the nexus of environment and human health in Canada, the Philippines and Kenya. Preliminary results from the survey groups defined above were presented at two conferences (the Boston Environment and Health Conference, 3–6 March 2013 and the Côte d'Ivoire Grand-Bassam Ecohealth Conference, 1–3 October 2013). Further discussion was generated through an internal report to the IAEH — [www.ecohealth.net](http://www.ecohealth.net) (Custer *et al.*, 2014).

The first consensus component measured by eigenvalues as F1 (Custer *et al.*, 2014) consisted of 12 of the 47 questions, and in a separate analysis CKA survey results

**Table 1. Summary of reference materials on the development of priority national programmes along the nexus of human health and the environment**

Country	<sup>1</sup> GDP IN U.S.* (2012 est)	% GDP spent		<sup>4</sup> Environment protection		<sup>5</sup> % People in tertiary education	<sup>6</sup> Per capita **GHG (metric tons)
		<sup>2</sup> Health	<sup>3</sup> Education	Index	Rank		
UNITED STATES	15.9 T	14.6	5.7	56.7	49	72	19.7
CANADA	1.5 T	9.6	5.2	58.4	37	60	17.9
CHINA	12.6 T	5.8	3.9	42.2	116	7.5	4.9
PHILIPPINES	431 B	2.9	3.1	57.4	42	30	0.8
KENYA	77 B	4.9	7.0	49.3	83	3.0	0.3

Notes: \* T=Trillion; B = Billion \*\* GHG = green-house gas emissions. All except #4 accessed Feb. 26, 2015. United States included for comparison.

<sup>1</sup> www.cia.gov/library/publications/the-world-factbook/rankorder/2001rank.html

<sup>2</sup> www.nationmaster.com/graph/hea\_tot\_exp\_on\_hea\_as\_of\_gdp-health-total-expenditure-gdp

<sup>3</sup> www.nationmaster.com/graph/edu\_edu\_spe-education-spending-of-gdp

<sup>4</sup> www.epi.yale.edu/epi2012/rankings (accessed August 30, 2013)

<sup>5</sup> http://www.nationmaster.com/graph/edu\_ter\_enr-education-tertiary-enrollment

<sup>6</sup> http://unstats.un.org/unsd/environment/air\_co2\_emissions.htm

**Table 2. Common survey consensus of two Ecohealth groups: Chinese Kunming Attendees (CKA) and Ecohealth Association Student Section (ESS)**

Perspective on Change	-2	-1	0	1	2
I plan to try to influence policy with my research or work.					X
I want to be professionally involved in mitigating climate-change.				X*	X**
Activism is important for improving wellbeing & ecosystem health.					X
A system can only be changed from the outside, not from within.		X			
Current Role of Transdisciplinary Ecohealth	-2	-1	0	1	2
Transdisciplinary or interdisciplinary research can best be promoted through conditions on funding.				X	
Transdisciplinary or interdisciplinary research can best be promoted through public relations.				X	
Ecohealth field in practice today encompasses ecosystem approach to health.			X*	X**	
Ecohealth field in practice today encompasses health approaches to ecology.			X		
Future Role of Ecohealth	-2	-1	0	1	2
Ecohealth concepts should be central to future sustainable development goals.			X		
South-south collaboration is important in building a better future.			X*	X**	
Consideration of the linkage between environmental health and mental health is critical in building a better future.			X*	X**	
Ecohealth will be a well-known and popular field in the future.				X	

Notes: -2 = strongly disagree; -1 = disagree; 0 = neither agree nor disagree; 1 = agree; 2 = strongly agree. X = common consensus between two groups; X\* = Chinese Kunming Attendees (CKA); X\*\* = Ecohealth Association Student Section (ESS).

generated consensus on an additional eight questions and for ESS, nine. CKA demonstrated less extreme view points on four questions (Table 2). Both groups appeared to agree on perspectives related to influencing policy, mitigating climate change, activism and working within the system. Funding and public relations were considered important to Ecohealth expansion and central to SD, with environmental-health linkages highlighted. CKA expressed uncertainty regarding the status of the ecosystem approach to health (note China's low environmental rating — Table 1), and both groups were uncertain of Ecohealth's current function regarding the health approach to ecology. The current work details the premise that the challenge within Ecohealth is to define a role as inclusive of these two

paradigms; based upon national needs, our critique of the nexus between human health and the environment and the early-careerist focus demonstrated on climate change, which requires (Salinger, 2010) an ecocentric approach (Table 2).

Both groups identified the importance of activism, and the ESS thought it important in their careers (Tables 2 and 3). CKA was focused on putting research into action and personal sacrifice, while ESS expressed interest in advancing Ecohealth (Table 3). The CKA group was attuned to gender equity needs, education development, and expressed the belief that environmental-health systems are in place, with only adjustments required (Table 3). ESS supported a top-down approach, was strongly in support of Ecohealth, called

**Table 3. Chinese Kunming Attendees (CKA) and Ecohealth Association Student Section (ESS) consensus on survey questions**

<b>Chinese early-careerists Kunming Conference attendees</b>					
<b>Perspective on Change</b>	<b>-2</b>	<b>-1</b>	<b>0</b>	<b>1</b>	<b>2</b>
In my career it will be important to contribute to the Millennium Development Goals.				X	
My future career will focus on translating research to action.					X
An element of personal sacrifice is important to me for making a contribution to sustainability beyond my profession/work/career.					X
My future career will focus on a balance of the two above.					X
<b>Perspectives on Ecohealth &amp; Global Realignment</b>					
<b>Perspective on Change</b>	<b>-2</b>	<b>-1</b>	<b>0</b>	<b>1</b>	<b>2</b>
Transdisciplinary or interdisciplinary research can best be promoted by education.					X
The linkage between environmental health and human health offers the opportunity to overcome political, cultural and religious cleavages, in view of a better future.				X	
Increasing gender equity is an essential component of sustainable development and improving human and ecological health.				X	
Fundamental paradigm changes are not necessary, but simply tweaking current systems is (incentivizing, taxing, funding allocation, curriculum & reorganization)				X	
<b>International Ecohealth student section early-careerists</b>					
<b>Perspective on Change</b>	<b>-2</b>	<b>-1</b>	<b>0</b>	<b>1</b>	<b>2</b>
Activism is important to me in my future career.				X	
The Kunming Position Statement generally represents my perspective.				X	
I want to be involved in advancing the ecohealth field.					X
A top-down campaign to promote transdisciplinary or interdisciplinary research and interventions could be effective.				X	
<b>Perspectives on Ecohealth &amp; Global Realignment</b>					
<b>Perspective on Change</b>	<b>-2</b>	<b>-1</b>	<b>0</b>	<b>1</b>	<b>2</b>
Ecohealth will be more significant in linking sustainability and health in the future.				X	
Ecohealth approach within government can lead to better environmental decisions.					X
Greater acceptance and use of indigenous knowledge could provide significant help in understanding the human-ecosystem relationship.					X
Greater acceptance and use of indigenous knowledge could provide significant help in solving sustainable development challenges.				X	
Fundamental changes to economic, compensational and motivational paradigms are required to globally improve wellbeing.					X

Notes: -2 = strongly disagree; -1 = disagree; 0 = neither agree nor disagree; 1 = agree; 2 = strongly agree.

for further engagement on indigenous knowledge (or the knowledge of indigenous peoples) and strongly believed that fundamental global changes are needed in areas of socio-economics and education (Table 3).

## 4. Discussion

### 4.1. Priority Ecohealth programme templates for dialogue within select countries

The survey results were similar to the country specific priorities for the environment and human health nexus identified by established Ecohealth researchers and co-authors, inclusive of ecocentrism. Desired Ecohealth professionalism on climate-change engagement would require ecocentric paradigm inclusion (Salinger, 2010).

Early-careerists (through their focus on climate-change and environmental action – Table 2) and established researcher perspective of the authors (Table 4) both favour a balance between the Ecosystem Approach to Health and the Health Approach to Ecosystem within Ecohealth. Thus, the current work projects an Ecohealth field that perhaps can best be considered as a holistic mega-discipline with two paradigms in balance; the ecosystem approach to health and the health approach to ecosystem. The priorities for education programmes outlined (Table 4) are not intended as a final statement for individual countries. However, they represent a template or starting point for broader professional and societal discussions regarding reflexive education priorities. These professional perspectives, found in several countries, indicate a consistent need for education policy on SD to promote a balanced consideration of the two aforementioned paradigms.

**Table 4. Author-defined preliminary priority ecohealth programme templates for a hypothetical (10) staff distribution between the Ecosystem Approach to Health (EAH) and the Health Approach to Ecosystems (HAE)**

Areas of emphasis for the ecosystem approach to health (EAH) and the health approach to ecosystem (HAE) for hypothetical priority programmes along the nexus of human health and the environment

Country	EAH Staff #	HAE Staff #	Areas of emphasis
China	3-5	5-7	<b>HAE:</b> water governance & management; sustainable agriculture; ecology; ecological economy; GIS. <b>EAH:</b> environmental health & toxicology; public health–nutrition; infectious diseases. <b>In addition:</b> ethnic minorities; human rights; indigenous knowledge; outreach & advocacy
Philippines	4	6	<b>HAE:</b> marine & fisheries management & socio-economics; governance & capacity development; community relations & organization; facilitating paraprofessional ecohealth networks for food security; preparation — coastal disaster risk & climate change; sustainable agriculture. <b>EAH:</b> public health; diarrheal diseases; maternal & early childhood nutrition. <b>PRIORITIES:</b> marine Sc. ecohealth
Canada	5	5	<b>HAE:</b> climate change mitigation; traditional ecological knowledge and incorporating indigenous and ecocentric approaches in society. <b>EAH:</b> global applications for assistance in less developed economies, countries and communities. <b>PRIORITIES:</b> continued global leadership on EAH; transform national culture to reduce green house gas emissions
Kenya	5	5	<b>HAE:</b> paraprofessional ecohealth networks for food security; traditional ecological knowledge; ecology; sustainable agricultural intensification; governance for adaptation to climate change; <b>EAH:</b> malaria; zoonotic diseases in general; leptospirosis; rift valley fever; dengue; chikungunya; nutrition. <b>In addition:</b> communication specialists in local languages; cultural psychology; transportation

#### 4.2. Projected profiles for programmes along the nexus of human health and environment

The current work specifically includes a focus on the perceptions and culture of a group of Chinese early-careerists working along the nexus of environment and health. This emphasis, as well as the current and potential global impact associated with the mere size and population of the country, provides a rationale for a detailed examination of SD status in China. Further, this research provides an opportunity for outreach by China and the formulation of international dialogue on SD research and curriculum, an approach that has been identified as a key priority by the Chinese (Niu *et al.*, 2010). Comparative approaches and considerations are provided for Canada, the Philippines and Kenya to identify examples and variations on the need and opportunity for collaboration on SD education policy and curriculum development globally. The dialogue between colleagues on the current work addressed both the health approach to ecosystem and the ecosystem approach to health. Considering the linkage between these two broad paradigms and the emphasis based upon the conference and survey group in China, the applicability of the Yin-Yang philosophy emerged during analysis. Further, the current work suggests that the concept of balance in the Chinese philosophy of Yin-Yang may hold promise for the development of education policy approaches as they pertain to SD across a wide range of other countries. From the consensus across the two survey groups regarding future professional engagement on climate change alone, we can conclude that there is an underlying image of the future amongst early-career Ecohealth professionals, and includes ecocentrism within the broad nexus discussed above.

The ESS group strongly felt that there is a need to restructure global economies and motivations for compensation. Further, ESS indicated that there is a need to better include indigenous (or ecocentric) perspectives in future Ecohealth approaches, and that activism is an important part of their future careers (Table 3). The following sections provide details on the possible focus for ecocentric inclusion regarding the need for policy to initiate SD education in China, The Philippines, Canada and Kenya. The concept of developing paraprofessional networks for inclusion of the ecocentric approach is currently under consideration by the co-authors in their home countries. This approach to taking balanced SD philosophy into mainstream society was initiated in the Philippines for coastal fishermen (Anabieza *et al.*, 2010), and is discussed below. Prior to that and in an effort to fit the cognitive Yin-Yang concept into an applied perspective within the country of origin, the next section details how this concept and application apply to China.

##### 4.2.1. China

A very low environmental protection index for China (Table 1) is reflected in a wide array of related environment-health issues. Further, although per capita green house gases (GHG) are relatively low, China's total is among the highest in the world. Recent economic advancement has brought new skyscrapers, cars, hospitals, housing, education facilities and thousands of kilometers of new roads. Infectious disease control has improved, although still a persistent problem in poorer rural areas. Schistosomiasis infection declined over 90% from the 1950s to 2003 (Zhou *et al.*, 2005). Tuberculosis declined from 2,500,000 in 1990 to 1,400,000 in 2011

(WHO, 2014.). However, while development has reduced the infectious disease burden, historic environmental degradation has occurred. Cancer is now the leading cause of death in both Chinese urban and rural populations (Earth Policy Institute, 2012). There are over 450 cancer villages, where diagnosis can be 10 or even 20 times the national average. These villages are in areas where almost 60% of the country's GDP occurs (Liu, 2010). The illnesses are correlated with major rivers and their tributaries, the target for transportation, unregulated industrial waste disposal and drinking water (Liu, 2010).

Forty-two percent of China's rivers and 77% of key lakes and reservoirs are too polluted to provide drinkable water. Fourteen of the lakes in the country and 18% of the rivers' water are deemed unsafe for any use (MEPPRC, 2009). Ecological destruction by a multitude of forces, including electronic and net fishing, sand dredging, pollution, dams and disruption by ships has devastated aquatic habitats for many populations of wildlife (Turvey *et al.*, 2007; Zhao *et al.* 2008). Decline in total water resources and increases in freshwater withdrawal (FAO, 2013) are exasperating an uneven water distribution, where the northern half of the country gets only 20% of the water resources per capita compared with the southern half (National Bureau of Statistics, 2003). Water quality decline is linked to agriculture becoming more input-driven and detached from seasonal cycles. Agriculture close to urban markets exacerbates the use of polluted water, and heavy metals contaminate many foods. Rice irrigated with Beijing's Qinghe River was shown to accumulate Cd concentrations of 1.03 mg/kg in its seeds, ten times the amount the US EPA allows per kg of drinking water (Wang *et al.*, 2003). Rice grown in an important agricultural area, which is also the major E-waste recycling area of Zhejiang Province, exceeds tolerable daily intake (TDI) for Pb, and reaches 67% TDI for Cd (Fu *et al.*, 2008).

China's commercial use of feed concentrate increased from 86 to 241.4 million metric tons from 1980 to 2005, effectively removing livestock from their supporting ecological systems and waste-nutrient cycles. Agricultural intensification of both crops and livestock has led to a P<sub>2</sub>O<sub>5</sub> overload in 23.5% of China's croplands between 1998 and 2000, with at least 46% of said overload contributed by livestock (Gerber *et al.*, 2005). China's first-ever pollution census found agriculture contributed 13.2 million metric tons of organic water pollutants (Qiu, 2010). This environment effectively spawned the recent pandemic threats of SARS and H7N9. In China, the ecocentric consideration of environmental sustainability needs to be part of any significant steps along the nexus of environment and human health. There is also a drive to embrace Western fast/processed foods. There are more than 1,400 Pizza Huts and 4,800 Kentucky Fried Chicken outlets in China (YUM Brands, 2014.). McDonalds had also set a goal of having 2,000 restaurants in the country by the end of 2013 (McDonald's Corporation, 2012). The kcal/day/capita

more than doubled from 1,426 to 3,036 between 1961 and 2009 (FAO, 2012.). Thus, food security has improved dramatically but new forms of malnutrition are emerging. According to the China National Nutrition and Health Survey, 22.8% of Chinese people were overweight and 7.1% were obese by Chinese standards, or a 39% and 97% increase from 1992 levels (Yang *et al.*, 2008).

The cultural and policy context of China as it relates to SD is not generally well understood outside the country. China's Confucian society promotes a hierarchical approach to social harmony. The culture is magnified through increasingly complex spheres of influence. Leaders perceived to be benevolent and wise hold authority in the family, and are then promoted up to community and eventually to national levels. These promotions are generally made by internal selection and do not involve public voting. Unfortunately, authority manipulation can easily substitute power structures for benevolence in this system. The rigorous structure of Confucian education has become a rote process that can stifle creativity, self-expression and any questioning of the establishment. A re-examination of Confucianism could lead to a more harmonious society through a renaissance in ecological connection. Fundamentally, Confucians see humans as capable of resonance with each other, as well as other animal species, trees, rivers, lakes, oceans, mountains and seasons; constantly inspired for a metaphysical destiny (Tucker and Berthrong, 1998). A successful Chinese programme along the nexus of human health and the environment should fit this cornerstone of Chinese culture and revive a sense of humanity that is not anthropocentric, but more appropriately anthropocosmic (Tu, 2001).

With all of these aforementioned challenges in mind, an image of the future for China's approach to SD involving Ecohealth can be identified. Recognizing the mid-range per capita production of green house gases, the low rate of expenditure on both health and education and the large GDP (Table 1), there is a need for a fundamental in-country anthropocosmic (Tu, 2001) shift, which could support national harmony (Table 3). The CKA group sought a balance between research action and personal sacrifice to work within the systems. They also support critical issue advocacy and SDGs in general (Tables 2 and 3). An inclusive approach defining leadership wisdom on the health approach to ecology is suggested. A national reconsideration of the Ecohealth tagline *ecosystem approach to health* could be warranted, so as to include the huge challenges in China regarding environmental sustainability. The Yin-Yang unity of opposites is a strong Chinese cultural and philosophical base for balance; herein, we consider both the design of human health considerations within the ecological capacity and the influence of ecological settings for human health. Thus, the next generation Ecohealth tagline could be: *ecosystem approach to health ~ health approach to ecosystem*. A priority programme in China should focus on this reflexive balance,

perhaps somewhat of a Yin-Yang (or unity of opposites) for Ecohealth, and beyond the limitations and negativity associated with an exclusive human-centered ecosystems concept. The belief of the CKA group in activism (Table 2) needs expression to meet the challenges of the environmental-human health nexus, perhaps focusing on increasing China's expenditures for health and education (Table 3) and promoting participatory and reflexive curriculum development, beyond rote strategies, and working toward a broader acceptance of principle-centered advocacy.

The recent emergence of gender equity in China opens significant opportunities for other forms of balance and harmony within culture and environmental linkages. As women are becoming more emancipated and accepted in graduate education or high-level academic work, the historic perspective of women as *di san zhongren*, or third class persons, is becoming less dominant. However, in retrospect, a desire to prioritize participation of local young female researchers on the Kunming Statement (IAEH, 2013) would have required significant groundwork due to on-going gender challenges. Although this was beyond the scope of the association's 2012 statement planning, there may be steps to consider regarding subsequent culturally-relevant conference approaches in this and other countries with emerging gender equity.

#### 4.2.2. The Philippines

The Philippines has a food security challenge that significantly includes the non-agricultural coastal and marine ecosystems producing protein, a critical area for ecocentric focus. Priority programmes identified are for marine and fisheries management, as well as linked socio-economic improvements within this sector. In part, this should include the facilitation of paraprofessional Ecohealth networks for food security (Anabieza et al., 2010) and disaster risk preparation (Table 4). The Philippines' emerging economy has a strong emphasis upon tertiary education; however, that country also has a low level of actual expenditure on both health and education (Table 1). This nation could potentially move forward on priority Ecohealth programming through in-country GDP priority setting. However, there are unique historical, cultural and situational challenges. Taking into consideration the nine largest developing fishing countries in Asia (Silvestre and Pauly, 2004), the Philippines ranks first in per capita consumption of fish at 36kg/year, ahead of: India, Pakistan, Indonesia, Bangladesh, Vietnam, Thailand, Myanmar and Malaysia. Declining fish harvest and marine sustainability are critical issues for the large Philippine population, their culture, economy and nutritional status. Fisherfolk are also the poorest Filipinos, with poverty rates approaching twice the national average (Israel, 2004). There is a lack of trained marine people at the local government level to manage mandates on coastal environment and related human health. Based in part

upon support from the Canadian International Development Research Centre (IDRC) for biodiversity conservation and ecocentrism in the 1990s, one fisherfolk alliance (<http://pamana.50webs.com>) has been identified as *Paraprofessional Ecohealth Practitioners* (Anabieza et al., 2010).

Balancing SD within an inclusive ecocentric and anthropocentric approach through paraprofessionals has the potential to be broadly transformational at the societal level. This can lead to better democratic processes supporting SD, which would need to be at least partly based upon enhanced adult education policy. In the Philippines, there is also a significant need and some progress on developing a marine science Ecohealth programme to provide professional facilitation (Watts et al., 2010; Pajaro et al., 2013; Watts and Pajaro, 2014; Raquino et al., 2015). A Philippine marine science and coastal management programme could also provide templates for similar challenges that exist in many other countries. Although small-scale fisheries are the focus of considerable development efforts, solutions to challenges associated with environmental sustainability and fisherfolk poverty remain problematic. The Philippine-based approach to paraprofessional ecohealth practitioners (PEP; Anabieza et al., 2010) has significant global application, and not just for marine settings. The four countries discussed in the current work have now joined in the application of the PEP approach for a wide range of ecosystems. In addition, Bhutan, India, Bangladesh, Nepal and Uganda have either joined in PEP workshops or are involved in proposals to establish PEP networks. One of the critical components of the PEP approach is the inclusion of ecocentric considerations in balance with the anthropocentric ecosystem approach. This participatory approach and related education development policy could be a *SD tipping point*, moving beyond the specialty journals and into mainstream society regarding our oceans, and from a global perspective.

#### 4.2.3. Canada

In contrast to the Philippines, Canada represents different challenges in addition to some parallel issues. Canada spans an area 30 times that of the Philippines, yet has a population one third the size. Thus, the population density is almost 100 times greater in the Philippines, resulting in significant problems associated with scale. Interestingly however, the dependence upon marine ecosystems in the Philippines (Silvestre and Pauly, 2004) is actually similar to that of the Canadian Inuit culture (Koutouki et al., 2015), and requires some form of parallel education policy development. The priority for Canadian Ecohealth inclusions, in terms of the health approach to ecosystems, and identified through the current process are: climate change mitigation, traditional ecological knowledge, and incorporating indigenous and ecocentric approaches in society (Table 4). The looming challenge of climate change could be a rationale for a Canadian Ecohealth programme to encompass GHG

emissions, which are approaching 50 times the per capita pollution of Kenya (Table 1). Canada is often looked upon as a global standard for quality of life, although it is perhaps critical that this country is not seen as the measure for a good development standard due to extremely high per capita GHG emissions. It is also globally important to preserve the critical outreach role that the Canadian community of Ecohealth practices regarding the ecosystem approach to health.

Canadian outreach includes action within Sub-Saharan Africa (SSA), recognized as the food crisis epicenter of the world (Scholes and Biggs, 2004). Significant efforts by Canada are, for example, focused on countries such as Côte d'Ivoire and Kenya. Dialogue between the community of practice for Ecohealth in Canada (CoPEH-Canada) and individuals or groups working on climate change mitigation, could be strategic in terms of setting international goals for sustainability and SD. A Canadian undergraduate programme with the unique combined focus of international development and climate change mitigation could provide a template for other countries such as the United States, which are in a similar situation in terms of large individual climate change responsibilities due to high levels of GHG emissions per capita (Table 1). Redefining North American society regarding climate change may be the most critical goal regarding the future of SD along the global nexus between environment and human health.

The historic challenge regarding Canada's relationship with indigenous peoples, and in particular regarding the potential of Ecohealth (Parkes, 2011), could also be considered further through a programme that expands upon traditional knowledge through an ecocentric approach (Mosquin, 2002) inherent to indigenous peoples, as suggested elsewhere (Koutouki *et al.*, 2015). Work to establish PEP networks based on indigenous Canadian perspectives have been initiated in the Lake Winnipeg Basin and the territory of Nunavut through workshops and pilot studies.

#### 4.2.4. Kenya

Human health depends upon biodiversity (Chivan and Bernstein, 2008), and ecosystem protection is a strategy for preventing tropical disease emergence (Confalonieri, 2005). For Africa, Fjeldsa (2007) and current co-authors suggest biodiversity needs to be further considered at the local, livelihood and larger ecological scales. Water management is also considered to be critical for disease prevention (Colwell and Wilcox, 2010); for example, concerning river blindness (Yameogo *et al.*, 2004); malaria and yellow fever (Junglen *et al.*, 2009); and African swine fever (Jori and Bastos, 2009). Research has found indications that global climate change could lead to increased rates of cholera in Africa (Paz, 2009), and more generally is expected to be of great significance in lowering food security throughout SSA (Thompson *et al.*, 2010). These outcomes specifically link African SD back to the

priority of reducing the huge per capita GHG emissions in North America (Table 1), as discussed above.

Low GDPs in countries such as Kenya (Table 1) imply a need for international support on programme development combined with in-country advocacy. Kenyan priorities for the health approach to ecosystems are: paraprofessional food security networks, traditional ecological knowledge, ecology, sustainable agricultural intensification, and governance for climate change adaptation. Kenya has limited focus on education and health (Table 1), and there is a need for a broader consideration of advocacy to appropriately initiate education and other policies. Professionals have the potential to establish programmes, yet lack a coordinating factor to mainstream ecohealth. However, the Great Lakes University of Kisumu (GLUK) has expressed interest in programming to establish networks of Ecohealth practitioners. This could provide a template for food security programming within SSA.

The development of systems for effective African maritime organizations (Ncube and Lyon-Baker, 2011); aquaculture (Hishamunda and Ridler, 2006; Kaliba *et al.*, 2007) and fish distribution could subsequently improve protein security. Food security measures should include innovation platform training, such as that involving a current co-author, in the Tana River District, and as part of adult and more formal education through policy. Training should be aimed at improving practitioner and institutional governance capacity through appropriately legitimizing and enhancing authority of individuals, institutions, and networks concerning food security, sustainable livelihoods, and enhanced access to necessary resources. Over-fishing, environmental degradation, and exotic species introduction characterize the status of SSA lakes (Balirwa, 2007). Estimates are that the number of fishing boats in Lake Victoria increased from 12,000 in 1983 to 52,000 in 2004 (Geheb *et al.*, 2008). However, there are efforts to use model scenarios to set priorities in the Lake Victoria Basin (Odada *et al.*, 2009), including consideration of destructive phosphorous runoff changing the lake's ecology (Hecky *et al.*, 2010). Further, the utilization of non-indigenous crops, which are used as a result of food globalization, needs to be reconsidered for their direct effect in elevating diabetes, cardio vascular disease and cancers (Raschke and Cheema, 2007).

#### 4.3. Synthesis

Global progress on SD may in part require an enhanced approach to the historic development of education programmes, which have been based upon job potential and discipline-specific approaches. A reflexive response to SD through education will require national policies that are problem-based, and respond specifically to the setting of individual countries. The challenge emerging with climate change and the desires illustrated within the global perspective on SDGs give credence to the development of

policies on national education priorities and PBL as a significant example of pragmatism (Suter and Cormier, 2012), thus moving beyond individual disciplines and peer review to address crucial world issues. Environmental sustainability and food security inclusion on defining national education programmes can likely best be accomplished by a balancing of anthropocentric and ecocentric paradigms. For example, in a large part of the world, protein security is dependent upon the marine ecosystem and ecocentric attitudes. Ecohealth concerned early-careerists demonstrate an excellent opportunity for leadership with regard to sustainability along the nexus of environment and human health. The significant desire to focus on climate change challenges through their professional activities demonstrates a projection of an Ecohealth mega-discipline, which includes ecocentric (or as defined in China as the anthropocosmic vision) approaches (Table 2). Generally, youth or early-careerists in the current research demonstrated an openness to policy change that is centered around problem-based approaches to the fusion of education disciplines. This perspective was also unanimously supported by the authors in reviewing the area of critical national needs (and subsequent problem-based learning targets) regarding climate change, environmental sustainability and food security.

The perspectives and goals of the surveyed early-careerists, as well as the opinions of the current authors, exemplify a perceived need to balance the two paradigms, or the ecosystem approach to health and the health approach to ecosystem, and thus provide a compass to help define priority Ecohealth programmes to maximize collaboration (Table 4) and SD. Borrowing from Chinese culture, these phrases combined could represent the Yin-Yang of a holistic Ecohealth contribution to SD. That said, it is also critical to maintain and build upon the significant leadership through the ecosystem approach to health and the on-going role globally needed for those approaches (Charron, 2012). We suggest that realizing the goal of broad Ecohealth contributions to SDGs will require policy-based changes in education design that need to be discussed at both national and international levels. One primary consideration is that some form of inclusion or enhancement on the health approach to ecology is clearly required for SD progressions associated with climate change. Further, the health approach to ecology also appears important for transcending the results from the historic focus on anthropocentric ecosystems. Based upon Ecohealth early-careerists' focus on professional engagement on climate change alone (Table 2), the ecocentrism or, as considered within China, the anthropocosmic vision, is within the image of the future for Ecohealth practices. To a limited extent, this inclusion is already represented through on-going Ecohealth efforts that promote enhanced collaboration based upon ecological units such as watersheds (Morrison *et al.*, 2012). Strategic focus perhaps now should be on how to balance anthropocentric and ecocentric designs at policy and programme levels.

Additional inclusion of food security will involve more of an ecocentric consideration of capacity, such as that involving the Philippine marine bioregions (Pajaro *et al.*, 2013) and those of other maritime countries. The uncertainty regarding the role of Ecohealth in terms of the health approach to ecology or ecosystems expressed by the early-careerists (Table 2) may in large part be a critical area or target for policy development. Within the Ecohealth Association, primary consideration perhaps should be given to the inclusion of the ecocentric approach within the organizational profile. Further, the concept of promoting Ecohealth to meet SDGs (IAEH, 2013) may be best represented by placing more focus on the balance between anthropocentric and ecocentric paradigms.

Ecohealth as an association might best support the restructuring of global economies suggested by ESS (Table 3), through the consideration of how to balance the two paradigms outlined above for the environment and human health nexus. Clearly, success in advancing the ecosystem approach to health needs to be balanced with efforts on the health approach to ecosystem. In the global context, national environmental budgets are generally a small fraction of that for human health (Table 1). Ecohealth as an emerging mega-discipline could be in a significant position to facilitate the future balancing of these budgets and paradigms to best encompass SDGs in a collaborative manner. Excellence through the Ecosystem Approach to Health paradigm will not in itself lead to stronger programmes that meet SDGs. Rather, a balanced inclusion of the Health Approach to Ecosystem is suggested through national education policy and related advocacy. The early-careerist survey results and perceived national priorities in the current work suggest a global need and desire to project Ecohealth beyond the human-centered ecosystem paradigm. National education policies should be considered to support an Ecohealth lens or mega-discipline that holds the two described paradigms in balance. This approach could create the strength of the Chinese concept of Yin-Yang and promote the collaboration platform required to contribute to future SDGs along the environment – human health nexus, as projected by the 2012 Ecohealth Kunming Statement (IAEH, 2013).

## 5. Conclusions

Sustainable Development associated with the nexus of human health and the environment has comparable education needs across a wide range of cultures and countries, as demonstrated by early careerist surveys and established professional perspectives. The concept of Ecohealth, or the merging of human health with the ecosystem, might best be accomplished through a balance of the ecosystem approach to health and the health approach to ecosystem. Application of the Yin-Yang philosophy to the balance between these two paradigms and within a reflexive

country-based initiation of SD education policy is suggested. A Yin-Yang Ecohealth design could allow for the direct inclusion of issues regarding environmental sustainability and food security into education and curriculum policy. This expansion within the concept of Ecohealth has the potential to put the economic aspect of SD within a holistic framework that includes ecocentrism, and is considered critical for climate change mitigation.

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## References

- Abdi, H., Williams, L.J., 2010. Principal component analysis. *Wiley Interdisciplinary Reviews: Computational Statistics*, 2(4): 433-459.
- Anabieza, M., Pajaro, M., Reyes, G., Tiburcio, F., Watts, P., 2010. Philippine alliance of fisherfolk: Ecohealth practitioners. *EcoHealth*, 7: 394-400.
- Atran, S., Medin, D.L., Ross, N.O., 2005. The cultural mind: Environmental decision-making and cultural modeling within and across populations. *Psychological Review*, 112: 744-776.
- Balirwa, J.S., 2007. Ecological, environmental and socioeconomic aspects of the Lake Victoria's introduced Nile perch fishery in relation to the native fisheries and the species culture potential: Lessons to learn. *African Journal of Ecology*, 45: 120-129.
- Bang, M., Medin, D., 2010. Cultural processes in science education: Supporting the navigation of multiple epistemologies. *Science Education*, 94(6): 1008-1026.
- Cattell, R.B., 1966. The scree test for the number of factors. *Multivariate Behavioural Research*, 1: 245-276.
- Charron, D.F., 2012. Ecosystem Approaches to Health for a Global Sustainability Agenda. *EcoHealth*, 9: 256-266.
- Chivan, E., Bernstein, A. (Eds.) 2008. *Sustaining Life: How Human Health Depends on Biodiversity*. Oxford University Press, Oxford.
- Colwell, R.R., Wilcox, B.A., 2010. Water, ecology and health. *EcoHealth*, 7: 151-152.
- Confalonieri, U.E.C., 2005. The millennium assessment: Tropical ecosystems and infectious diseases. *EcoHealth*, 2: 231-233.
- Custer, B., Koné, B., Kouassi, E., Ontiri, E., Watts, P., Yi, Z., 2014. Reflexive evolution of the ecohealth paradigm: a possible Yin-Yang Design. *Report of the IAEH. Ecohealth*, 11: 286-289.
- Earth Policy Institute, 2012. Data center on population, health and society. Available at [http://www.earth-policy.org/data\\_center/C21](http://www.earth-policy.org/data_center/C21) (accessed 23 August 2015).
- Fjeldsa, J., 2007. How broad-scale studies of patterns and processes can serve to guide conservation planning in Africa. *Conservation Biology*, 21: 659-667.
- FAO, 2012. Statistical yearbook of the food and agricultural organization. Available at <http://faostat.fao.org/> (accessed 23 August 2015).
- FAO, 2013. Aquastat: Global water information system. Available at <http://www.fao.org/nr/water/aquastat/main/index.stm> (accessed 25 August 2015).
- Fu, J., Zhou, Q., Liu, J., Liu, W., Wang, T., Zhang, Q., Jiang, G., 2008. High levels of heavy metals in rice (*Oryza sativa* L.) from a typical E-waste recycling area in southeast China and its potential risk to human health. *Chemosphere*, 71: 1269-1275.
- Geheb, K., Kalloch, S., Medard, M., Nyapendi, A., Lwenya, C., and Kyangwa, M., 2008. Nile perch and the hungry of Lake Victoria: Gender, status and food in an East African fishery. *Food Policy* 33: 85-98.
- Gerber, P., Chilonda, P., Franceschini, G., Menzi, H., 2005. Geographical determinants and environmental implications of livestock production intensification in Asia. *Bioresource Technology*, 96: 263-276.
- Hahn, M.H., Barrett, M.A., Horowitz, P., 2012. Student dialogues: EcoHealth offers a home to the Interdisciplinary student. *EcoHealth*, 9: 241-242.
- Hall, M., 2011. Beyond the human: Extending ecological anarchism. *Environmental Politics*, 20(3): 374-390.
- Hecky, R.E., Mugidde, R., Ramlal, P.S., Talbot, M. R., Kling, G.W., 2010. Multiple stressors cause rapid ecosystem change in Lake Victoria. *Freshwater Biology*, 55: 19-42.
- Hishamunda, N., Ridler, N.B., 2006. Farming fish for profits: A small step towards food security in sub-Saharan Africa. *Food Policy*, 31: 401-414.
- International Association for Ecology and Health (IAEH), 2013. Kunming position statement: Ecohealth contributions to the Millennium Development Goals (MDGs). Report to the IAEH. doi: 10.1007/s10393-013-0839-1.
- Imram, S., Alam, K., Beaumont, N., 2014. Reinterpreting the definition of sustainable development for a more ecocentric reorientation. *Sustainable Development*, 22: 134-144.
- Israel, D.C., 2004. Economics and environment in the fisheries sector. In: Department of Agriculture-Bureau of Fisheries and Aquatic Resources (Eds.), *In Turbulent Seas: The Status of Philippine Marine Fisheries*. Coastal Resource Management Project of the Department of Environment and Natural Resources, Cebu City, Philippines. pp. 131-137.
- Jamieson, D., 2007. Whither environmental philosophy? *Ethics & Environment*, 12(2): 125-127.
- Jori, F., Bastos, A.D.S., 2009. Role of wild suids in the epidemiology of African swine fever. *EcoHealth*, 6: 296-310.
- Junglen, S., Kurth, A., Kuehl, H., Quan, P.L., Ellerbrok, H., Pauli, G., Nitsche, A., Nunn, C., Rich, S.M., Lipkin, W.I., Briese, T., Leendertz, F.H., 2009. Examining landscape factors influencing relative distribution of mosquito genera and frequency of virus infection. *EcoHealth*, 6: 239-249.
- Kaliba, A.R., Ngugi, C.C., Mackambo, J.M., Osewe, K.O., Senkondo, E., Mnembuka, B.V., Amisah, S., 2007. Potential effect of aquaculture promotion on poverty reduction in sub-Saharan Africa. *Aquaculture International*, 15: 445-459.
- Koutouki, K., Watts, P., Booth, S., 2015. The Canadian arctic marine ecological footprint and free prior informed consent: Making the case for indigenous public participation through inclusive education. *Review of European, Comparative & International Environmental Law*, 24(2):160-170.
- Liu, L., 2010. Made in China: Cancer villages. *Environmental Science and Policy for Sustainable Development*, 52: 8-21.
- Malley, D.F., Watts, P.D., 1989. A scientific silence. *Policy Options*, 10: 34-36.
- McDonald's Corporation, 2012. McDonald's Corporation 2012 annual report. Available at <http://www.aboutmcdonalds.com/content/>

- dam/AboutMcDonalds/Investors/Investor%202013/2012%20Annual%20Report%20Final.pdf (accessed 15 August 2015).
- Medin, D., Ross, N., Cox, D., Atran, S., 2007. Why folkbiology matters: Resource conflict despite shared goals and knowledge. *Human Ecology*, 35(3): 315-329.
- Miller, M.L., Kaneko, J., Bartam, P., Marks, J., Brewer, D.D., 2004. Cultural consensus analysis and environmental anthropology: yellowfin tuna fishery management in Hawaii. *Cross-Cultural Research*, 38(3): 289-314.
- MEPPRC (Ministry of Environmental Protection of the People's Republic of China), 2009. Report On the State of the Environment In China 2008. Available at [http://english.mep.gov.cn/down\\_load/Documents/201002/P020100225377359212834.pdf](http://english.mep.gov.cn/down_load/Documents/201002/P020100225377359212834.pdf) (accessed on 25 August 2015).
- Morrison, K.E., Parkes, M.W., Hallstrom, L.H., Neudoerffer, R.C., Bunch, M.J., Venema, H.D., 2012. Ecohealth and watersheds: Watersheds as settings for health and well-being in Canada. Network for Ecosystem Sustainability and Health (Publication Series No. 3) and the International Institute for Sustainable Development, Winnipeg, MB. Available at [http://www.iisd.org/pdf/2012/ecohealth\\_watersheds\\_canada.pdf](http://www.iisd.org/pdf/2012/ecohealth_watersheds_canada.pdf) (accessed 20 August 2015).
- Mosquin, T., 2002. Ecocentrism and indigenous peoples' perspectives. *Biodiversity*, 3.
- National Bureau of Statistics, 2003. *China Statistical Yearbook*. China Statistics Press, Beijing.
- Neube, M., Lyon-Baker, M., 2011. Beyond pirates and drugs: Unlocking Africa's maritime potential and economic development. *African Security Review*, 20: 60-69.
- Niu, D., Jiang, D., Li, F., 2010. Higher education for sustainable development in China. *International Journal of Sustainability in Higher Education*, 11: 153-162.
- Odada, E.O., Ochoa, W.O., Olago, D.O., 2009. Understanding future ecosystem changes in Lake Victoria basin using participatory local scenarios. *African Journal of Ecology*, 47: 147-153.
- Pajaro, M., Watts, P., Ampa, J., 2013. The northern Philippine sea — a bioregional development communication strategy. *Social Science Diliman*, 9(2): 49-72.
- Parkes, M.W., 2011. Ecohealth and Aboriginal health: A review of common ground. National Collaborating Centre for Aboriginal Health. Available at [http://nccah.netedit.info/docs/Ecohealth\\_Margot%20Parkes%202011%20-%20EN.pdf](http://nccah.netedit.info/docs/Ecohealth_Margot%20Parkes%202011%20-%20EN.pdf) (accessed 25 August 2015).
- Parkes M.W., Morrison, K.E., Bunch, M.J., Venema, H.D., 2008. *EcoHealth and Watersheds*. International Institute for Sustainable Development, Winnipeg.
- Paz, S., 2009. Impact of temperature variability on cholera incidence in southeastern Africa, 1971-2006. *EcoHealth*, 6: 340-345.
- Polak, F.L., 1973. *The Image of the Future*. Elsevier Scientific Publishing Company, New York.
- Qiu, J., 2010. China takes stock of environment: survey finds agriculture causing major damage. *Nature News*, published online 12 February 2010. doi:10.1038/news.2010.68.
- Raschke, V., Cheema, B., 2007. Colonization, the new world order, and the eradication of traditional food habits in east Africa: Historical perspective on the nutrition transition. *Public Health Nutrition*, 11: 662-674.
- Raquino, M., Pajaro, M., Watts, P., 2015. Marine biodiversity integration for Philippine local development plans. *Management of Environmental Quality*, 26(2): 159-171.
- Romney, A.K., Weller, S., Batchelder W., 1986. Culture as consensus: A theory of culture and informant accuracy. *American Anthropologist*, 88: 313-338.
- Salinger, J., 2010. The climate journey over three decades: From childhood to maturity, innocence to knowing, from anthropocentrism to ecocentrism. *Climatic Change*, 100: 49-57.
- Scholes, R.J., Biggs, R., (Eds.), 2004. Ecosystem services in southern Africa: A regional assessment. Millennium Ecosystem Assessment. Available at <http://www.millenniumassessment.org> (accessed 15 August 2015).
- Silvestre, G., Pauly, D., 2004. Management of tropical coastal fisheries in Asia: An overview of key challenges and opportunities. In: Department of Agriculture-Bureau of Fisheries and Aquatic Resources (Eds.), *In Turbulent Seas: The Status of Philippine Marine Fisheries*. Coastal Resource Management Project of the Department of Environment and Natural Resources, Cebu City. pp. 150-167.
- Stevens, P., 2012. Towards an ecosociology. *Sociology*, 46(4): 579-595.
- Suter, G.W., Cormier, S.M., 2012. Pragmatism: A practical philosophy for environmental scientists. *Integrated Environmental Assessment and Management*, 9(2): 181-184.
- Thompson, H.E., Berrang-Ford, L., Ford, J.D., 2010. Climate change and food security in sub-Saharan Africa: A systematic literature review. *Sustainability*, 2: 2719-2733.
- Tu, W., 2001. The ecological turn in new Confucian humanism: Implications for China and the world. *Daedalus*, 130: 243-264.
- Tucker, M.E., Berthrong, J. (Eds.), 1998. *Confucianism and ecology: The interrelation of heaven, earth, and humans (religions of the world and ecology)*. Harvard University Press, Cambridge, MA.
- Turvey, S.T., Pitman, R.L., Taylor, B.L., Barlow, J., Akamatsu, T., Barrett, L.A., Zhao, X., Reeves, Stewart, R.R., Wang, B.S., Wei, K., Zhang, Z. Pusser, X., Richlen, L.T., Brandon, M., J.R., Wang, D., 2007. First human-caused extinction of a cetacean species? *Biology Letters*, 3: 537-540.
- Wang, Q.R., Cui, Y.S., Liu, X.M., Dong, Y.T., Christie, P., 2003. Soil contamination and plant uptake of heavy metals at polluted sites in China. *Journal of Environmental Science and Health*, 38: 823-838.
- Watts, P., Macose, E., Angara, E., Pajaro, M., 2010. A programmatic approach to empowerment in CRM: Aurora, Philippines. *Gateways*, 3: 120-138.
- Watts, P.D., Pajaro, M.G., 2014. Collaborative Philippine-Canadian action cycles for strategic international coastal ecohealth. *Canadian Journal of Action Research*, 15(1): 3-21.
- Wells, K., 2004. Advocating the ecocentric paradigm in nursing. *Journal of Holistic Nursing*, 22: 6-8.
- Wiers, R.W., Van de Wiel, M.W., Sa, H.L., Mamede, S., Tomaz, J.B., Schmidt, H.G., 2002. Design of a problem-based curriculum: A general approach and a case study in the domain of public health. *Medical Teacher*, 24: 45-51.
- WCED (World Commission on Environment and Development), 1987. *Our Common Future*. Oxford University Press, Oxford.
- WHO (World Health Organization), 2014. Global tuberculosis report. Available at [http://www.who.int/tb/publications/global\\_report/gtbr14\\_annex2\\_country\\_profiles.pdf](http://www.who.int/tb/publications/global_report/gtbr14_annex2_country_profiles.pdf) (accessed 25 August 2015).
- Yameogo, L., Resh, V.H., Molyneux, D.H., 2004. Control of river blindness in west Africa: Case history of biodiversity in a disease control program. *EcoHealth*, 1: 172-183.
- Yang, G., Kong, L., Zhao, W., Wan, X., Zhai, Y., Chen, L.C., Koplan, J.P., 2008. Emergence of chronic non-communicable diseases in China. *The Lancet*, 372: 1697-1705.
- YUM Brands, 2014. Yum! Restaurants China. Available at <http://yum.com/brands/china.asp> (accessed 30 August 2015).
- Zhao, X., Barlow, J., Taylor, B.L., Pitman, R.L., Wang, K., Wei, Z., Stewart, B.S., Turvey, S.T., Akamatsu, T., Reeves, R.R., Wang, D., 2008. Abundance and conservation status of the Yangtze finless porpoise in the Yangtze River, China. *Biological Conservation*, 141: 3006-3018.
- Zhou, X.N., Wang, L.Y., Chen, M.G., Wu, X.H., Jiang, Q.W., Chen, X.Y., Zheng, J., Jürg, U., 2005. The public health significance and control of schistosomiasis in China — then and now. *Acta Tropica*, 96: 97-105.