

¹Work and Life of Living Legends in Ecological Economics: Robert Costanza

Barry D. Solomon

Michigan Technological University, USA

Dr. Robert Costanza is the Gordon and Lulie Gund Professor of Ecological Economics and Director of the Gund Institute for Ecological Economics at the University of Vermont, a position he has held since the summer of 2002. Any discussion of the field of ecological economics and its living legends would be incomplete without mention of his outstanding, world renown, accomplishments and seminal influence on this transdiscipline. It is hard to know where to start since he is one of the most intense and passionate scientists and human beings I have ever met, and his curriculum vitae nearly matches his age (54 pages), so I will begin with his background.

After growing up in Miami and dabbling with a career in science or aerospace engineering while at Purdue University, Costanza returned to Florida where he received all his degrees at the University of Florida. His first degrees were in architecture and urban & regional planning; he ultimately earned his doctorate in systems ecology & environmental engineering with a minor in economics (1979). It was at the master's level that Costanza first worked for the late and famous systems ecologist Howard Odum, on an energy study. He went on to join a large project on the wetlands of South Florida and eventually became his best student. Dr. Odum exposed Costanza to his idea of "emergy" (embodied energy) as a unifying system of energy flow through living systems, which in 1980 was the subject of the latter's first and only sole-authored of five articles in *Science* magazine (and the first of his many papers that I would read). It was at Florida that Costanza developed his incredibly productive research habits, where he would quietly work in his corner of the main room in the Center for Wetland. He was also reputed to have been one of the first students at Florida to write his entire dissertation on the mainframe computer. After graduation and a brief stint in the Governor of Florida's Energy Office, Professor Costanza's first academic positions were at Louisiana State University (where he first worked with Professor Herman Daly),

¹ From this Issue, *International Journal of Ecological Economics & Statistics (IJEES)* is starting this series, this will publish about the work and life of living legends in Ecological Economics, who has significantly influenced the world of Ecological Economics. This is a humble gesture to pay respect to the great academicians and researchers by *IJEES*.

University of Illinois, Royal Swedish Academy of Sciences, and the University of Maryland (where he re-united with Daly), before he moved to Vermont in 2002.

Professor Costanza was the co-founder and longest serving president of the International Society for Ecological Economics (1988-1998) and was chief editor of its journal, *Ecological Economics*, from 1989-2002 (Solomon, 2005). He still serves as the journal's founding editor and is on editorial boards of eight other scholarly journals. His other honors, awards and notable achievements include: past presidency of the International Society for Ecosystem Health; the Society for Conservation Biology's Distinguished Achievement Award; National Wildlife Federation's Outstanding Publication Award; a Pew Scholarship in Conservation and the Environment; the Kenneth Boulding Memorial Award for Outstanding Contributions in Ecological Economics; an honorary doctorate in natural sciences from Stockholm University; and membership on several scientific advisory committees.

Professor Costanza has published extensively in leading journals such as *Science*, *Nature*, *Ambio*, *BioScience*, *Conservation Biology*, *Ecological Economics*, *Journal of Environmental Economics and Management*, *Environment*, *Environmental Management*, *Journal of Environmental Management*, *Ecological Modelling*, *Trends in Ecology & Evolution*, among many others, and has (co-) edited or (co-) authored 20 books. He has authored 136 articles in refereed journals and over 400 total publications. The Institute for Scientific Information (ISI) has named him as an ISI Highly Cited Researcher since 2004 (cf. Costanza et al., 2004); his famous co-authored *Nature* paper, to be discussed below, has been cited alone over 850 times!

Professor Costanza has been a prominent research scholar in several areas and has primarily focused on the interface between ecological and economic systems, especially at larger spatial and temporal scales. Typical applications of his research have included valuation of ecosystem services, biodiversity and natural capital; ecological-economic modeling; landscape level simulation modeling; analysis of energy and materials flows through economic and ecological systems; among several other subjects.

Because of space concerns I will focus on his contributions in three areas, while recognizing the overlap between these subjects: valuation of ecosystem services, ecological-economic modeling, and sustainability science, governance and biodiversity.

Professor Costanza's work on valuation of ecosystem services began with his first paper on energy in *Science*, which adapted input-output analysis and regression analysis to show a strong relationship between embodied energy and economic value for a 92-sector model of the U.S. economy. Follow-up work resulted in a series of publications in 1984-1986 that applied several methods, including an award-winning *Science* article that used 100 years of time series with three years of cross-sectional data and highlighted the role of energy return on investment in the U.S. economy. A major research focus that began in the late 1980s,

which has continued throughout Professor Costanza's career, is an attempt to model and value coastal wetlands. His most prominent publication in valuation of ecosystem services is of course the seminal 1997 article in *Nature* where Costanza and co-authors estimated the value of the world's ecosystem services and natural capital to range between \$16-54 trillion per year, or higher than the global GDP! This paper was highlighted and hotly debated in many other scholarly journals, and also was discussed in several prominent popular magazines and newspapers. Not only has this work revolutionized the field, but it has also led to great progress in externality research in environmental economics and other related areas. The practical application of this research was demonstrated in a 2006 paper in *BioScience*, where Professor Costanza and co-authors outlined how knowledge of ecosystem services can be used to assess the tradeoffs involved in different management options for humans embedded in ecosystems.

Rigorous ecological-economic modeling is fundamental to the progress of ecological economics, and Professor Costanza has made noteworthy contributions here too. For instance, he was an early user of the STELLA software in the late 1980s to simulate ecology-economy linkages, and worked with advanced versions over the next decade. He has collaborated with Swedish colleagues on a major conceptual discussion on the need for an evolutionary, dynamic understanding of the complex linkages between people and nature (*BioScience*, 1993); and the ecological footprint of cities in Baltic Europe and globally (*Ambio*, 1997). A more recent team-modeling project resulted in the development of the ambitious global unified meta-model of the biosphere (GUMBO), which has been used to assess the dynamics and values of ecosystem services.

As one of the founders of ecological economics, Professor Costanza has greatly helped to promote the field to develop the science of sustainability and biodiversity, including improved governance of natural systems. One central contribution he has made, along with Professor Daly and a few others, is developing the idea of natural capital and its lack of (full) substitutability with other forms of capital and other factors of production. The so-called "weak" vs. "strong" sustainability debate has been highlighted in many of his edited books that were released between 1991 and 2001. He has applied these ideas by, for example, examining the biodiversity characteristics of coastal and estuarine ecosystems as a function of the predictability and scale of the physical environment. A compelling 1995 paper in this field that Professor Costanza co-authored with Nobel Laureate Kenneth Arrow and several others in *Science* addressed economic growth, institutions, carrying capacity, and ecosystem resilience. Two other studies along the same vein published more recently in *Science* address sustainable governance systems for the oceans (reprinted in *Ecological Economics*), and economic reasons for conserving wild nature and natural habitats. Similar subjects were commonly addressed in *Ecological Economics* in the late 1990s, including issues of scale mismatches between ecological systems and socioeconomic institutions.

Finally, a recent research focus in this area has been sorting out the contribution of social and natural vs. other forms of capital to the quality of life at different spatial scales.

As suggested earlier, this tribute can only give a modest snapshot of the incredible number of contributions to ecological economic that have been made by Professor Robert Costanza, which continues to grow. For more details on his publications and related developments in the field see:

http://www.uvm.edu/gjee/about/Robert_Costanza_cv.pdf

Costanza, R., Stern, D., Fisher, B., He, L. and Ma, C., 2004, Influential Publications in Ecological Economics: A Citation Analysis, *Ecological Economics*, 50, 261-292.

Solomon, B.D., 2005, The Size Thing Revisited: The Optimal Scale of the Transdiscipline of Ecological Economics, *International Journal of Ecological Economics & Statistics*, 3, 1-20.