
Easter Island

A Case Study in Non-sustainability*

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Easter Island is a lonely island on Earth, much like Earth is isolated in the universe. Environmental practices on Easter Island can, therefore, provide useful lessons for environmental stewardship on planet Earth. Despite the isolation, the population of Easter Island thrived, much as it has on Earth. The islanders developed a sophisticated culture that left a legacy of giant stone statues. Yet modern explorers in the 18th century found the statues smashed and a people apparently headed toward civil war. What went wrong? While numerous explanations have been proposed, the most plausible is the non-sustainable use of a crucial renewable resource. Wood was obtained from a slow-growing, subtropical palm and was the pervasive eco-resource supporting the islanders' food (nuts, birds, boats for fish), economy (cooking, heating, housing materials) and culture (moving statues). Documented deforestation, attributable to overuse, resulted in the rapid collapse of the society. This historical example of non-sustainable environmental behaviour by a sophisticated society has many advantages as a case study for the current teaching of relevant lessons in sustainability.

- Sustainability
- Easter Island
- Lost civilisation
- Population collapse
- Environmental disaster
- Interdisciplinary
- Interconnectedness
- Societal ruin

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THE WORLD IS A LONELY PLANET IN THE UNIVERSE. WHILE IT DEPENDS ON THE Sun's gravitational force for its position and light/heat energy, its inhabitants rely entirely on its own earthly resources for their survival. These inhabitants, both human and non-human, are isolated. To date there has been no confirmed emigration from Earth and no visitations of species from elsewhere in the universe to planet Earth.

Easter Island is a lonely island on Earth. While it is subject to earthly weather and ocean patterns, it is remotely located in the South Pacific Ocean 3,200 km west of the nearest continent of South America. The first human inhabitants arrived from Polynesia about AD 400 and were isolated from other humans for over a millennium. They had to depend entirely on their own island resources for their survival.

Their legacy of giant stone statues, known as *moai*, suggests that, in spite of their isolation, the island population thrived and developed over this period much as it has on planet Earth. However, by the time that the modern explorers discovered Easter Island in the 18th century, something had gone terribly wrong with the society and its development. Most of the *moai* were smashed and toppled, and the people were headed towards civil war.

What went wrong on Easter Island? Recent research suggests that the demise of an advanced culture on the island can be attributed to the disappearance of one crucial resource on the island: wood (Flenley 1993). Wood is a renewable resource, but like all renewable resources it takes time for the resource to renew. Population growth and human decisions can result in insufficient time for effective renewal to take place. In this case, environmental collapse can precipitate economic and social collapse. This is what happened on Easter Island (Flenley 1993, 2001).

The recently documented history of Easter Island provides students today with a simple, easy-to-understand historical case study of an isolated society growing and developing but not practising sustainability through ignorance, neglect, self-interest or simply bad luck.¹ A careful review of this case study provides important lessons for the isolated inhabitants of planet Earth today. It also points to the ominous consequences of not practising sustainable behaviour for both individuals and society.

Geography, anthropology and history

Easter Island, also known by the indigenous name of Rapa Nui, is one of the most isolated places on Earth that is inhabited. A triangular-shaped island anchored at its corners by extinct volcanoes, Easter Island covers only about 117 km² (64 square miles) of area. Its maximum length is 24 km (15 miles) and maximum width 12 km (7.5 miles). It is located in the South Pacific Ocean 3,200 km (2,200 miles) west of Chile, the South American country to which it belongs. It is 2,000 km (1,250 miles) from the nearest inhabited land of Pitcairn Island, which has a population of under 50 people. The nearest inhabited islands further to the west are the Mangarévas which are 2,500 km (1,550 miles) away and the Marquesas which are 3,200 km (2,200 miles) away.

The island's latitude of 27° south (just south of the Tropic of Capricorn) provides a mild climate while its volcanic origins provided a reasonably fertile soil. The pollen record obtained from core samples from the volcano cauldrons using carbon dating methods shows that the island originally supported a great palm forest (Flenley 1993). Surrounded by an abundant ocean and supporting two extinct volcanic craters that con-

¹ Alternative theories about the possible reasons for this behaviour will be examined briefly later in the paper.

tained natural lakes for fresh water, Easter Island appeared to have many attractive features for human habitation. There was, however, no sheltered anchorage for boats.

It is now widely accepted that the first inhabitants were a small group of seafaring Polynesians accidentally blown off course or deliberately in search of a new settlement, perhaps seeking a new kingdom or escaping warfare or overpopulation elsewhere (Bahn and Flenley 1992).² Archaeological evidence suggests that they arrived with a full panoply of colonisation goods. Popular perceptions are that the original settlement came in two large double canoes with up to 40 people, along with their sweet potatoes, chickens and other food items. This concept fits nicely with an orthodox opinion of continued Polynesian exploration and settlement across the vast Pacific Ocean that began out of South-East Asia about 1,000 BC or even earlier (Ponting 1993). After Tonga and Samoa, they then settled the Marquesas around AD 300 or earlier and then moved south-east to Easter Island and north to Hawaii in the 5th century and on to the Society Islands about AD 600 and New Zealand about AD 800 (Ponting 1993).

The basic social unit was the Polynesian extended family, which jointly owned and cultivated its land. Closely related households formed clans each of which developed its own centre for family and ceremonial activities. These settlements were scattered across the island in small clusters of huts around a ceremonial centre with crops grown in the surrounding fields.

As the population grew the settlements proliferated. Each was characterised by a large stone platform known as an *ahu* situated at the centre of the settlement near the coast (Bahn and Flenley 1992). Similar to those found elsewhere in Polynesia, these *ahu* were used for burials and ancestor worship. On these *ahu*, the Easter Islanders added statues quarried in volcanic stone from sites on the island. The main Rano Raraku quarry site contained basalt stone used for the statues and the second Puna Pau quarry site, about 8 km (5 miles) away, contained red stone used for topknots that were placed on top of the heads of the statues. White coral collected from the ocean was used for the eyes of the statues. Early statues were quite small, but as the society developed the statues were made larger. The largest statues on site were over 6¹/₂ m (20 feet) high and weighed over 80 tons.

By the 16th century hundreds of *ahu* had been constructed and over 600 of the huge statues erected. The population peaked in mid-century at around 10,000 (±3,000) people and then suddenly collapsed. Many partially completed statues and topknots were left in and around the quarry sites. Several statues still *in situ* in the Rano Raraku quarry measure up to 22 (65 feet) and weigh up to 270 tons.

Probably the most riveting mysteries of human history are those posed by various so-called lost or vanished civilisations, such as the Maya, Khmer and Anasazi peoples. Easter Island is no different. The first European to visit Easter Island was the Dutch admiral Jacob Roggeveen on Easter Sunday (5 April) 1722, which is why the island was given its European name (Bahn and Flenley 1992). Roggeveen found an island denuded of trees and inhabited by a society of about 3,000 people living primarily on agricultural produce. A Spanish expedition in 1770 reported a primitive society that lived in squalid reed huts or caves engaged in warfare and resorting to cannibalism in a desperate attempt to supplement the meagre food supplies available on the island (Ponting 1993). Subsequent visits by better-known captains such as Englishman James Cook in 1774 and Frenchman J.F. La Pérouse in 1786 confirmed previous reports (although the French considered the population 'happy'). They provided even lower population esti-

² Bahn and Flenley (1992) provide a history of Easter Island. See also Fischer 1993 for additional information.

mates³ and noted that a number of the statues had been toppled and the platforms damaged.

The 'mystery' of Easter Island that emerged from these visits and lasted well into the second half of the 20th century was how a late stone age culture represented by the physically small, squalid and apparently barbarous population observed by the Europeans could have been responsible for creating, moving and erecting the massive statues that clearly represented the past glory of the culture. Was this an example of another lost civilisation?

The 'mystery' explained

The Europeans reported that the islanders believed that the statues had walked to the platforms under the influence of a spiritual power. The first and perhaps most well-known modern theory was advanced by Norwegian archaeologist Thor Heyerdahl (1950, 1958) who argued that the island was first settled by native South Americans from whom they inherited a tradition of monumental sculpture and stone work (similar to the magnificent Inca achievements). He attempted to demonstrate the feasibility of his theory by designing a reed raft (named the *Kon Tiki*) according to the specifications of early vessels and sailing it from South America to Easter Island. His raft drifted to the north and landed on one of the Tuamotu islands. Heyerdahl accounted for the decline of the population by the subsequent displacement of the South American culture by a less advanced Polynesian culture that resulted in a series of civil wars between the so-called 'long ears' and the 'short ears', which destroyed the complex society and reduced the population on the island.

Other more exotic theories have also been proposed to account for the mystery. An earlier Atlantis-type theory was proposed by John Macmillan Brown (1924) who argued that Easter Island is a remnant of a great continent (sometimes called Mu) that housed an advanced civilisation, which sank beneath the ocean. A more recent and even more exotic theory was proposed by Swiss writer Eric von Daniken (1970) who suggested that the Easter Island statues are part of the evidence (along with such unexplained phenomena as the giant Nazca Lines of Ica, Peru) of visitations by an extraterrestrial civilisation to planet Earth.

The accumulation of archaeological evidence, particularly over the last quarter of the 20th century, has resulted in an alternative explanation focusing on environmental collapse. Some authors postulate that planetary environmental changes may have precipitated the decline of Easter Island society (Hunter-Anderson 1998), while others argue that the islanders themselves were responsible for the environmental disaster that befell them (Bahn and Flenley 1992; Flenley 1993, 2001; Mieth *et al.* 2002; Diamond 2004).⁴ These could be mutually reinforcing explanations.

3 The population continued to decline. In 1862 the Peruvians raided the island and enslaved many Rapanui who were sold as household servants or agricultural workers on mainland Chile. Subsequent epidemics (especially smallpox and tuberculosis) and missionary-induced emigration resulted in further population decline until only about 100 people remained by the mid-1870s. Sheep ranching began around 1870 and Chile officially annexed the island in 1888. Between 1888 and 1952 the island was used as a sheep ranch, which further denuded the landscape. The population gradually increased over this period. About 3,000 people live on Easter Island today.

4 Forest fires emanating from lightning strikes are another possible explanation for the destruction of the forest, but evidence of widespread fire has not been uncovered. Mieth *et al.* (2002) report localised burning for agricultural purposes on the Poike Peninsula dated to the 14th century. Also there is the possibility that volcanic activity resulting in earthquakes or tidal waves (tsunamis) knocked down the statues, but this would not explain the population and environmental collapse.

The easiest explanation for a population and hence societal crash is that a climate change acted as the trigger if not the bullet for an environmental disaster. Hunter-Anderson (1998) argues that deforestation on Easter Island was the result of long-term climate change that started well before colonisation. This theory supports Orliac and Orliac's (1998) observation that Polynesians were well aware of their environmental dependence and enriched ecosystems rather than impoverished them. MacIntyre (1999) also cautions that the possibility that climate variability contributed to the collapse of Rapa Nui should not be overlooked.⁵ He notes that relatively small decadal climatic fluctuations may mean that a marginally supportable population in one decade may become far too many a decade later.⁶

MacIntyre (1999) introduces a simple population growth model incorporating a carrying capacity that he calls the maximum supportable population (MSP). If this MSP were constant, the model would predict slower population growth with larger populations until a sustainable population was achieved after which no further growth would occur (or births would equal deaths). To explain the population crash on Easter Island, MacIntyre reduces the MSP starting from around AD 1350 to 1400. This decrease in the MSP can reflect the impact of global climate change or the effects of deforestation, or both. Once carrying capacity drops below the actual population society is in trouble. Note that in this approach population does not 'overshoot' the MSP, which is the usual explanation of environmental collapse (Meadows *et al.* 1992; Brander and Taylor 1998); rather, it is the MSP that drops below the population.

The more popular theory is consistent with this approach but attributes the decline in the MSP to deforestation perpetuated by the islanders themselves. Bahn and Flenley (1992) refer to this behaviour as cultural suicide whereby the islanders exploited their crucial forest eco-base so heavily that they did not give it time to renew and thus destroyed it. Subsequent soil erosion together with intentional fires to clear the land for more intensive agricultural use also contributed to further eco-base degradation (Mieth *et al.* 2002). The ensuing resource and food scarcity precipitated civil war, societal breakdown (including perhaps cannibalism) and a 70% reduction of the population over a relatively short period of time (roughly between 1550 and 1650). Other authors (Ponting 1993; Bush 1997) have adopted and popularised this theory.

As previously noted, the pollen analysis shows that, prior to colonisation, the island supported a great subtropical palm forest (Flenley 1993). The Easter Island palm, now absent from the island, was related to the still-surviving Chilean wine palm which can grow 25 m (75 feet) tall and 2 m (6 feet) in diameter. The tall branchless trunks of this palm provided ideal wood for constructing large canoes and for transporting and erecting large statues. It might also have been a valuable food source since its Chilean relative produces edible nuts and sap from which the Chileans make sugar, syrup, honey and wines.

The trees also provided a haven and nesting place for birds, which supplemented the islanders' food and contributed to the propagation of the palms through their droppings. The islanders also used the wood and palm leaves for housing and for cooking and heating. Finally, the forests were cleared to make land available for agricultural uses including the cultivation of sweet potatoes, taro and other food crops. Therefore, wood was a crucial and pervasive eco-resource supporting the islanders' food (fish, birds, nuts), economy (housing, cooking, heating) and culture (statues). The collapse of this resource

5 A variant on this theme is a prolonged drought as the cause of the environmental disaster, but as Flenley (1993) notes it seems unlikely that the forest should survive for 35,000 years, including the major climatic fluctuations of the last ice age and the postglacial climatic peak, only to succumb to drought once people arrived on the island.

6 However, after an extensive review of climatic information, MacIntyre (2001) concludes that the position of Rapa Nui appears to isolate it from major sources of interannual climate variability.

attributable to deforestation to satisfy the myriad of societal needs including agriculture resulted in the collapse of the society (Flenley 1993).

These findings are supported by core samples from the islanders' garbage dumps. Nearly one-third of the discarded food bones from the growth period (AD 900–1300) come from porpoises. The common dolphin, which is the Easter Island porpoise, weighs up to 75 kg (165 lbs) and generally lives out to sea. It could not have been hunted from the shore but must have been caught well offshore using seaworthy craft built from the large palm trees. Porpoise bones disappear completely from the dumps by around AD 1500, which suggests that the islanders had lost the ability to catch large fish by that time (Diamond 1997).

In addition to porpoise and an occasional seal, early islanders feasted on abundant sea and land birds that used the palms and other vegetation for food and nesting. Bird stew might have been seasoned with Polynesian rat meat, animals brought by the original settlers either deliberately or inadvertently.⁷ Unlike the rest of Polynesia, rat bones outnumber fish (as distinct from porpoise) bones at Easter Island archaeological sites (Diamond 1997).

Recent pollen and garbage dump analysis together paint a picture of an island⁸ that prospered and then perished due to the non-sustainable use of the society's crucial eco-resource, wood. Deforestation was well under way by AD 800, only four centuries after human settlement. Charcoal from wood fires becomes more abundant over time (indicating growing numbers of people), while the pollen of palms and other trees and woody shrubs decreases and then disappears. The pollen of grasses that replaced the forest simultaneously becomes more abundant. Sometime after AD 1400 the palm tree becomes extinct on the island, not only because of human use but also because the birds that dispersed its seeds died out and the now ubiquitous rats prevented its regeneration by eating the seeds.⁹ The 15th century marked the end of Easter Island's palm forest (Bahn and Flenley 1992).

The destruction of the birds followed that of the forest. Every species of native land bird (owls, herons, parrots) became extinct. Colonies of more than half the seabird species were eliminated. In place of native birds, the islanders turned to domesticated chickens for food. Later on, human bones appear in the garbage dumps. Cannibalism is part of the oral history of the islanders, but there is a lack of verifiable evidence (such as slash marks on the bones) for cannibalism. By this time fires for cooking and heating were fuelled by grass, sedge and sugarcane scraps and increasingly took place in the underground volcanic caves where the islanders sheltered.

After a millennium of growth and prosperity (AD 400 to 1400), Easter Island reached a peak in population and culture in the early 1500s. While their statues were getting larger, their trees were getting smaller and ultimately disappeared. Without wood (and rope) to transport statues their culture suffered. Without wood to build canoes their porpoise and fish catches declined. Without trees the birds disappeared and the resulting soil erosion reduced their crop yields. Chicken production and perhaps cannibalism only replaced part of the lost food. People were starving.

Local anarchy replaced social stability and a warrior class took over from the hereditary chiefs and cultural leaders in the 1600s and 1700s (Bahn and Flenley 1992). Spears and daggers appeared and people moved into caves for protection from both the elements and their enemies. By the mid-1700s rival clans were toppling and smashing each

7 Flenley (1993) notes that the mouse-sized Polynesian rat was regularly introduced by Polynesian voyagers wherever they settled as a source of protein food.

8 This elaboration closely follows Diamond 1997 and is consistent with Bahn and Flenley 1992 and Flenley 1993.

9 Mieth *et al.* (2002) provide additional evidence of rat-chewed palm nuts.

other's statues.¹⁰ By 1864 the last statue had been demolished. This was the society observed and reported on by the early European visitors.

The non-sustainable use and ultimate disappearance of one crucial renewable resource, wood, ultimately led to the demise of the population and society. This is a familiar story of growing populations facing shrinking resources, especially renewable resources such as fresh water and arable land. Homer-Dixon (1994, 1999) documents recent examples where renewable resource scarcity has resulted in starvation and civil war.

Reasons for the demise

Why did this disaster happen? One explanation is ignorance. Even though they were isolated, the islanders had developed technology that surpassed most other societies of their era.¹¹ Certainly, they were not technically ignorant. The numerous *ahu* with their elaborately carved statues throughout the island are evidence of an advanced culture. Clearly they were not culturally ignorant. However, if people are not aware of their impact on their environment, then environmental degradation can result especially in growing populations. Polynesian peoples have a long history of being environmentally aware (Orliac and Orliac 1998), so this seems an unlikely explanation on Easter Island. Since the island is not large and each clan apparently had its own land, islanders were probably aware of the diminishing number and size of trees on the island even over their relatively short lifetimes. Also, it is very likely that there would have been a transferable oral tradition that would have indicated increasing difficulties in harvesting wood for its many uses by each succeeding generation.

A second explanation is neglect by individuals, by leaders or by society. When change is gradual and is measured in lifetimes or generations, it is easy to be neglectful. By the time that the change becomes rapid it is often too late for corrective action. On Easter Island the trees gradually became fewer, smaller and, as society adapted, maybe less important. The last palm disappeared around the mid-1400s, yet the real crisis did not appear until a century later by which time it was too late to do anything about the loss of the forest.

Economists frequently focus on the roles played by incentives and self-interest in human decisions. Unlike most Polynesian palms, the palm that was indigenous to Easter Island was a very slow-growing tree. The *Jubaea* palm normally requires 40–60 years before it reaches the fruit-growing stage and it can take even longer. Brander and Taylor (1998) estimate that the typical lifespan for islanders that survived infancy was around 30 years, so the length of time to tree maturity would have exceeded the lifetimes of virtually all islanders. Consequently, a programme of replanting and caring for seedlings would never have been of direct benefit to the cultivators. It would only benefit their children or grandchildren. Under these conditions the incentives for forest preservation, especially in a growing population, were not adequate. Moreover, even if recognised as a problem, these 'incentives' were determined by technical considerations (tree and human life expectancy) that would have been very difficult if not impossible to change.

Brander and Taylor (1998) apply a Ricardo-Malthus model of renewable resource use to Easter Island and demonstrate that overshooting and collapse is much more likely

¹⁰ See footnote 4 for a possible alternative explanation.

¹¹ Debate continues to this day on how the massive statues were transported and erected, and it is still not known how the heavy stone topknots were placed on the statues' heads (van Tilburg 1995).

for slower-growing tree species than for the more usual faster-growing species. Moreover, they go on to point out that Easter Island did not present a favourable environment for efficient institutional adaptation. While environmentally aware, the islanders probably did not understand the biology of the forest–soil complex or the incentive effects of alternative institutional arrangements, such as population control or forest preservation. By the time that disaster was imminent and the population might have been mobilised into action, institutional change would have been too late. Because of their isolation, the planting of a faster-growing species was not an available option. In short, the islanders were confronted by extremely unfavourable technical incentives (palm maturity that outstripped human longevity and limited technical knowledge) and a limited number of feasible options. The pursuit of self or clan interest in this environment, particularly in response to the needs of a growing population, was understandable but led to their downfall.

Finally, both Orliac and Orliac (1998) and MacIntyre (1999) raise the possibility that Easter Island's population collapse could simply be attributable to bad luck. The possibility that climate played a significant role cannot be overlooked, although MacIntyre's (2001) extensive review concludes that climate variability was not a likely cause.¹² Nonetheless, a prolonged period of climatic conditions that negatively influenced palm growth or maturity could have been sufficient to tip a marginally supportable population into an excessive population and start the downward spiral even without population growth. Hunter-Anderson (1998) notes that deforestation had been occurring even before human habitation began. Even if not decisive, climate change could have been a contributing factor in Easter Island's demise, reinforcing the effects of deforestation by the islanders.

Conclusions

The lessons of Easter Island emerging from recent archaeological evidence are only too clear for the world today. A lonely island with no emigration valve for its growing population and no ability to import knowledge or alternative technology from elsewhere, could not adapt to an environmental disaster that destroyed its economy and society. Non-sustainable harvesting of the crucial renewable resource, a slow-maturing palm that provided wood for canoes and food provisions (porpoises, fish, nuts, birds), as well as housing, cooking, heating and cultural activities (statue moving and erection), resulted in the collapse of a growing, wealthy and culturally advanced society, to become warfaring cave dwellers over a relatively short period of human history. The non-sustainable harvesting practices also contributed to soil erosion resulting in lower crop yields and the loss of other food sources (crops, rats), which could not be made up for using alternative domesticated foods (chickens, grass and, perhaps, humans).

Earth is a lonely planet with no emigration valve for its growing population and no ability to import knowledge or alternative technology from other parts of the universe. Its inhabitants too must survive on the once abundant resources within its realm. Fortunately, research that contributes to increasing knowledge and shared understanding of global environmental problems can lead to adaptation and solution of recognised problems. However, Earthlings must be careful not to be caught in the Easter Island trap of overshooting the maximum sustainable population or engaging in self-interested, non-sustainable behaviour that reduces the maximum sustainable capacity below the existing population. The recently documented history of Easter Island clearly

¹² See also footnotes 3 and 4 for other examples of 'bad luck'.

demonstrates that, under these conditions, collapse of population, economy and society is inevitable.

Postscript

Easter Island has many advantages as a case study for teaching lessons in sustainability analysis:

1. It is now a documented historical example that clearly demonstrates the consequences of non-sustainable environmental practices. It does not present what might happen but rather presents what did happen
2. It is simple. It focuses on the non-sustainable use of a single resource (wood). Since wood is a renewable resource, the case study can avoid discussion of alternative substitutes associated with the sustainable use of non-renewable resources
3. The analysis can be easily extended to demonstrate environmental interconnectedness. Examining the implications of deforestation for alternative food supplies (porpoises, birds) and for soil erosion (and crop yields) quickly incorporates the richness of most environment analysis into this case study
4. It is an interdisciplinary case study. It integrates the natural and social sciences. Students with varied backgrounds can all contribute to the analysis. Anthropology, archaeology, biology, business, demography, economics, forestry, geology, history, mathematics, ornithology, political science, soil science, zoology and other disciplines can all be advantageously captured in this case study
5. Although not a business case study *per se*, it incorporates many of the concepts familiar to business analysis, such as incentives, constraints, diminishing returns, property rights, information availability, cultural values and institutional structures, within a sustainability framework. It can also form the basis for sophisticated modelling and dynamic analysis, and an introduction to non-linear chaotic systems
6. It highlights the necessity for a comprehensive approach to developing a sustainability strategy. The case study demonstrates that high (technical and cultural) expertise is no guarantee of success with respect to sustainability. The existence of inappropriate incentives and unfavourable external forces (maturity cycles for trees and humans, and perhaps climate) played a decisive role in the outcome
7. It is likely that the islanders were all of a similar culture, so resource depletion and societal collapse cannot be attributed to multi-ethnic conflict, again simplifying the analysis
8. The isolation analogy with spaceship Earth is easy to grasp and the conclusions are unambiguous and easy to communicate. Non-sustainable environmental practices ultimately lead to economic and social collapse
9. It provides a framework for case studies of resource-dependent corporations, communities and countries that practise non-sustainable resource use, especially with respect to renewable resources

The sustainability lessons introduced and taught in this uncomplicated case study are numerous and pervasive. They clearly show the problem that a growing, reasonably well-informed, mono-ethnic, technically and culturally advanced society dependent on a single resource faces in ensuring that unregulated decisions that benefit individual

members do not lead to collective ruin. This situation is what the world potentially faces today with climate change and other environmental sustainability challenges.

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