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Island and Indigenous systems of circularity: how Hawai'i can inform the development of universal circular economy policy goals

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ABSTRACT. Given the dire consequences of the present global climate crisis, the need for alternative ecologically based economic models could not be more urgent. The economic and environmental concerns of the circular economy are well-developed in the literature. However, there remains a gap in research concerning the circular economy's impact on culture and social equity. The underdeveloped social and cultural pillars of the circular economy, along with universal policy goals calling for a context- and need-based framework, makes it necessary to bridge natural and social science objectives in the circular economy. Islands can serve as model systems for studying the circular economy. We examine how Hawai'i, through the philosophy of aloha 'āina, the Hawaiian ancestral circular economy, and contemporary community approaches toward advancing Indigenous economic justice can be one model system for understanding principles of circularity and policy advocacy. We introduce the concept of the ancestral circular economy and how aspects of this Indigenous institution can inform the development of universal circular economy policy goals. Furthermore, we present aloha 'āina as a framework for reciprocal care between human–environment relations while addressing the social and cultural pillars that aid in the development of these dimensions of the circular economy.

Key Words: *ancestral circular economy; circular economy; Indigenous; island systems; regenerative economy; social justice; sustainability*

INTRODUCTION

The universal transition toward a circular economy is one that begins with policy-makers, businesses, and the finance sector's ability to directly determine the materials and products they deem best fit to put on the market. It is not until these products are already in the consumption stream that communities are then recognized as key uptakers of the circular business models and products that are preset for them. The need to align policy and reform efforts among private, government, and university sectors—as it relates to innovations in design, production, and consumption—is an identified target in efforts to develop viable circular economies. However, the implementation of policy aimed at a circular transition will need to be place-specific, recognizing that the starting points of each place will be different depending on context and need (Ellen MacArthur Foundation 2021). Although the Ellen MacArthur Foundation (2021) *Universal Circular Economy Policy Goals* report provides an overarching policy framework for transition, it falls short in addressing the social and institutional restructuring that is necessary for innovation. We find that social equity and social justice should be integral outcomes of the circular economy. While the goals of circularity are considerably focused on economic prosperity coupled with environmental sustainability, its impact on social equity and equality is rarely brought to the forefront (Sauvé et al. 2016, Moreau et al. 2017). Murray et al. (2017) noted that circular economy models emphasize the redesign of material waste cycles (thus contributing to more sustainable business models) but fail to include the social dimension of sustainable development. In an analysis of 114 definitions of circular economy, Kirchherr et al. (2017:221) also found that models of the circular economy are frequently depicted as a “combination of reduce, reuse and recycle

activities,” while its impact of social equality and community stakeholders is scarcely mentioned.

It is difficult to envision a circular economy that can be environmentally sustainable without also achieving social reforms of the current oligopolistic market systems because these very systems inhibit our communities' ability to act as agents of environmental change. This unclear stance on the social predispositions and impacts necessary for transition, along with the Ellen MacArthur Foundation's (2021) call for a more contextual and need-based framework, necessitates a bridge between natural and social science objectives in the circular economy. High islands can serve as scalable models for the complexities of continental systems, and for this reason, many scholars have looked to Hawai'i and the social-ecological systems there (Vitousek 2002, Winter et al. 2018a). The Indigenous people of Hawai'i (Ōiwi, Hawaiian) have a form of Indigenous agency, known as aloha 'āina, which has shaped frameworks of thinking (Winter et al. 2021). The philosophy of aloha 'āina describes a set of core values and practices grounded in the relationship of kinship between environment and people (Beamer et al. 2021). When employed, aloha 'āina serves as a guide in the stewardship of ecological systems and resources, as well as an agent of change within our current social, political, and economic systems (Winter et al. 2021). Practicing aloha 'āina includes being active in mind, spirit, action, and policy to fulfill an unswerving commitment to act as protectors of land, natural resources, and the overall health of the natural world. Situated firmly at the core of Ōiwi society, aloha 'āina today defines a movement to achieve social, cultural, and ecological justice in Hawai'i through the integration of ancestral knowledge and practices into contemporary social-

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ecological management efforts (Goodyear-Ka'ōpua 2013a, Kealiikanakaoleohailani and Giardina 2016, Beamer et al. 2021). By bridging aloha 'āina with circular innovations, the overarching framework presented by the Ellen MacArthur Foundation can be shifted to identify policy-makers, businesses, and communities as fundamental determinants of markets and products. Context-specific policy development allows space for aloha 'āina in a circular economy. It would draw on both ancestral and community knowledge systems when deciding how to stimulate design; manage resources to preserve value; make the economies work; invest in innovation, infrastructure, and skills; and collaborate for system change (Ellen MacArthur Foundation 2021).

Our team is a multi-disciplinary and international group of researchers. We are 'Ōiwi (Indigenous Hawaiian) scholars from Hawai'i with expertise in Indigenous Hawaiian knowledge and biocultural ecology who have partnered with a team of industrial ecologists from the University of Augsburg. By putting into conversation differing worldviews, areas of expertise, and tools of inquiry, our partnership seeks to produce emancipatory research that bridges non-Western and Western approaches to sustainability studies. We are inspired by shared commitments to sustainability and a common goal of achieving sustainable and equitable societies. We have included the investigation of archival material and moderate participant observation in an ultimately empirical process to present a discussion of why islands are important models for studying the circular economy and sustainability. We see Hawai'i as a living laboratory for studying sustainable development, and explore the manners in which societal and cultural components are integrated into an Indigenous circular economy that has existed for centuries. In order to juxtapose an Indigenous circular economy with a market-based circular economy, we must (1) determine components of the Indigenous socio-cultural systems that supported a thriving economic infrastructure and promoted ecological health, which can now inform a modern circular economy, and (2) discuss aloha 'āina as an intervention that addresses the underdeveloped social and cultural pillars of the circular economy (Moreau et al. 2017, Vergunst 2019, Padilla-Rivera et al. 2020, Schröder 2020). To achieve this, we first conduct thorough literature reviews on the potential of islands as model systems for studying the circular economy, and key components of the ancestral circular economy in Hawai'i. We then delineate how Indigenous knowledge has the potential to inform the redesign of global economic processes toward sustainability. Subsequently, we introduce the initiative of the "Āina Aloha Economic Futures" (AAEF), with the goal of uplifting 'Ōiwi values to lead economic recovery efforts. The AAEF is informed by a community-centered engagement strategy which demonstrates that socioeconomic embeddedness is necessary to achieve the goals of a circular economy, as stated by Laurenti et al. (2018). Laurenti et al. (2018) also proposed an integrative framework, consisting of a material flow analysis, a structural agent analysis, and a circular economy framework to establish a circular economy in practice. Within this framework, the AAEF acts as the structural agent analysis that leads to an integrative circular economy framework. Material flow analysis has not yet been included in the AAEF initiative but can serve as a useful tool to monitor and manage resource flows, as discussed in the following section.

ISLANDS AS MODEL SYSTEMS FOR STUDYING THE CIRCULAR ECONOMY

The notion of the circular economy has gained traction as a potential solution to a number of critical challenges facing humanity, such as climate change, resource depletion, and biodiversity loss. The planetary boundaries are exceeded due to human industrial activities (Steffen et al. 2015). The idea of closing the loops is a strategic attempt to reduce negative impacts on environmental and human health. Nevertheless, a systematic study of the interactions between human activities and the environment are necessary in order to limit pressures toward the planetary boundaries (Graedel 1994). Industrial ecology is a growing field of science that examines industry embedded in nature through a systems approach. Within industrial ecology, the study of island metabolism is an emerging field (Deschenes and Chertow 2004). In the global development context, island societies are often seen as facing barriers toward economic growth. Because of isolation and size, island systems are perceived to be dependent on world markets (Kakazu 1994). However, islands are attractive as modeling systems in numerous disciplines because of several characteristics. Unique biological and cultural features provide many opportunities for discovery, while human–environment relationships provide examples of societies existing with relatively finite resources. Because of their bounded, isolated environments, and the discrete unit of available land, the speed at which the realities of complex environmental problems occurring within also complex natural systems can be rapidly seen and studied in island systems, such as sea level rise, natural resource overexploitation, food shortage, and pressure on energy resources (Singh et al. 2020). Because of the same characteristics, islands can also be potential sites for innovation toward sustainable living. The scale of islands makes these systems theoretically simpler for different political or economic sectors to collaborate in order to develop sustainability at a scale that is manageable (Kueffer and Kinney 2017).

A great body of literature has focused on environmental, social, cultural, and economic sustainability challenges within the island context (Connell 2018). Examples of analyzed issues include climate change (Merschroth et al. 2020, von Seggern 2021), food security (Gupta 2014, Bogadóttir 2020), water insecurity (Lefebvre 2018, Schiffer and Swan 2018, Fischer-Kowalski et al. 2020), resource management (Cecchin 2017, Bahers et al. 2020, Winter et al. 2020b), and waste management (Eckelman et al. 2014, Elgie et al. 2021). The circular economy is not the answer to all these challenges, but it incorporates these elements into building the basis for a sustainable economy. One important method for identifying possibilities to close loops is the study of material flows, also called material flow analysis. Houseknecht et al. (2006) applied this method on Hawai'i Island and found that only limited resource extraction, primary processing, or manufacturing was occurring locally, and the island's material flows were dominated by imports; consequently, the local economy was strongly dependent on service and tourism industries. According to Houseknecht et al. (2006), future research should focus on possibilities for substituting imported goods with locally produced or recycled resources, and approaches to improving overall material efficiency. A more recent study introduced the concept of a holarchic system for Hawai'i by using a material and energy flow analysis. It focused

on the metabolic linkages between interacting systems, and the proposed approach provides a basis for discovering material, energy, and societal connections (Chertow et al. 2020). These examples show the manifold challenges high islands are facing, and how the study of local conditions and solutions can bridge the gap toward sustainable development. While not all of the identified approaches may be applicable to different regions, a generalization of the island approach is possible (Towle 1984, Deschenes and Chertow 2004).

Given the current situation in Hawai'i, where approximately 90% of food is imported, policies have emerged to address issues of sustainability (Loke and Leung 2013, Ige 2016). The overextraction of resources, driven by the dominant market economy, has contributed to declines in native habitats and biodiversity, as well as the quality of other natural resources (i.e., biocultural resources) (Chang et al. 2019). In response, there are also calls to catalyze a circular economy for the sake of economic resilience in an uncertain future, as well as for the health of Hawai'i's biocultural resources and the well-being of its people (Beamer et al. 2021). A clearer understanding of Hawai'i's Indigenous economy (which has previously been categorized as subsistence) is needed to inform how Indigenous economies thrived while promoting the health of biocultural resources. Such an understanding could inform efforts to catalyze circular economies within the context of the dominant market systems of today. This may be a key to success in achieving Hawai'i's sustainability and economic goals (Hawai'i Green Growth 2018). It is not our intention to comprehensively analyze all the complexities of Indigenous economies. Rather, our goal is to identify circular principles in an Indigenous economy that may be critical in catalyzing an ecologically sustainable circular economy within today's dominant market structure. Using Hawai'i as a model system, we look to ancestral Hawaiian social-ecological structures before they were adulterated by the process of imperialism.

KEY COMPONENTS OF THE ANCESTRAL CIRCULAR ECONOMY IN HAWAII

Twentieth-century economists described the pre-colonial Indigenous economy in Hawai'i as "barter and trade" (e.g., Morgan 1948) or "subsistence" (e.g., Matsuoka et al. 1994). Both terms lack recognition of the nuance and complexities of the Indigenous Hawaiian economy. There are no words in the Hawaiian language for "barter and trade," indicating an imposition of foreign concepts on Indigenous culture and practice. Such a label incorrectly assumes a commodity-focused economy that is counter to the general understanding of the function of the Indigenous economies in Hawai'i. Subsistence economies are moneyless systems that rely on natural resources to provide for human needs through various means, such as hunting, fishing, gathering, agro-ecology, and aquaculture (Boyd et al. 2010). Subsistence economies have been described as evolutionary precursors to market economies. They are characterized as having minimal economic surplus, with the excess being used to trade for basic goods. Indigenous subsistence economies can, in fact, persist embedded within market economies (Kuokkanen 2011). However, economic theory that perceives the existence of a market economy as a precursor to civilization and describes subsistence economies as evolutionarily inferior to markets is overly simplistic and perpetuates false

dichotomies. Furthermore, this characterization carries value-laden assumptions embedded in the linear economy that suggest that prior to colonization, the economic system of Indigenous peoples merely allowed them to "subsist" (Beamer 2020). Rather than simply subsisting, we contend there are valuable components of Indigenous economies that enabled communities to thrive while achieving circularity. Surplus in these systems was often shared for community and natural resource regeneration. Indigenous economies persisted for centuries and produced minimal waste because of leadership and decision-making frameworks that sought to benefit future generations. There is much we can learn from these systems.

A more accurate perspective of Indigenous economies can be gained by examining the words and contexts in the Hawaiian language that relate to the exchange of goods, and by exploring the cultural foundations of those practices (Vaughan and Vitousek 2013). The Hawaiian understanding of land, and the relationship between land and people, can be understood through renowned 19th century 'Ōiwi scholar, David Malo, who stated, "ma ka noho ana a kanaka, ua kapa ia he aina ka inoa" (Malo 1838). This translates roughly to "it is because people live and interact with a place, that it is called 'āina." The idea behind this definition of 'āina, or "land", articulates how the concept of nature, environment, and land in a Hawaiian context is interconnected with humanity. This highlights the inherent relationship between people and the environment as one of reciprocity and stewardship. An evaluation of noncommercial distribution of small-scale inshore fishery catches based on a traditional system of sharing indicated that such networks provide benefits well beyond the provision of food that strengthen social and ecological resilience. The word "mahele" describes both the act of distributing harvest abundance among community members and the share each family received from the harvest. Management of the harvest followed a strict code of conduct based on the reciprocal and spiritual relationships between humanity and the environment (Vaughan and Vitousek 2013). The 'ōlelo no'ēau "hānai a 'ai," which is roughly translated to "feed [the fish], and [you may] eat," captures an application of Kānaka circular relationships to the management of fish stocks. This refers to the practice of feeding fish surplus land-based carbohydrate sources during their spawning season to increase fecundity. This represents a coupled approach to resource management by promoting abundance through specific human action geared to enhance natural resources (Winter et al. 2020b). Foundational 'Ōiwi scholar of the 20th century, Mary Kawena Pukui, explored the notion of "Ko koā uka, ko koā kai—Those of the upland, those of the shore," which refers to the exchange of products between relatives and friends (Pukui 1983). Those from the upland and those on the shore would exchange harvested resources, prepared foods, crafted items, or performances from their respective home areas as "ho'okupu," or gifts intended to cultivate relationships. Ho'okupu are offered freely with aloha (love) to express gratitude, respect, appreciation, and a desire to honor the relationships between the giver and the intended receiver, which may include other people, places and land, kūpuna (ancestors), and akua (gods). Ho'okupu are not given with an expectation of receiving something in return. The practice of ho'okupu is a method where resources are distributed while prioritizing reciprocal relationships (Kanahele 1986).

The persistent and intimate relationships that provide sustenance through practices such as mahele and ho'okupu derive from connections between people and the environment. An Indigenous approach to sustainability promotes regenerative relationships. As an example, the ancestral Hawaiian economic system mirrored the natural structures of the water cycle. Ancestral societies created social systems and institutions that mimicked water's natural regenerative processes while enabling social-environmental equity. Recognizing the water cycle as nature's original circular system, Hawaiian ancestral society used it as both an informant and guiding model within their economy. Abundance of, and accessibility to, water were primary indicators of wealth. These became essential in the creation of holistic resource management structures. Economic surplus in ancestral Hawai'i was accomplished through modeling and maintaining the circular cycles of our environment, which allowed for a continuous flow of resource redistribution and regeneration. Ancestral economies informed by water could be considered some of the earliest forms of circular economies.

These examples of embedded relationships between social and natural systems can provide insights in understanding circular economies. We introduce the term "ancestral circular economy" to describe the economic systems of Indigenous peoples prior to colonization. We examine the ancestral circular economy of Hawai'i, which had the ability to sustain a relatively high population (>1 million people) (Kurashima et al. 2019), to identify principles of circularity within this economy. A closer look at an island system and the persistence of an ancestral circular economy that endures within a capitalist market economy can inform how circular economies in capitalist market systems can be refined and sustained in the contemporary period.

Indigenous Hawaiian society developed high levels of socio-political hierarchy manifested in complex systems of land tenure, resource management, and taxation that had the capacity to sustainably support a large island population (Abad 2000, Winter et al. 2018b, Kurashima et al. 2019). Scholars such as Hommon (2013) have argued that Hawai'i is one of nine civilizations to have independently developed into a state system. The attainment of a state of 'āina momona (sustainable resource abundance with perpetual surplus), which supported the existence of the Hawaiian civilization, was achieved by using a Polynesian form of ecosystem-based management, coupled with innovative approaches to agro-ecology and aquaculture (Winter et al. 2018b, 2020a). Economic entities—goods and services—were not seen as purely economic. Instead, the relationship between socioeconomic needs of the population and resource management hinged on the interplay of social activities, spiritual processes, and economic entities (Kanahele 1986). In other words, the economy revolved around a give, take, and regenerate model (Beamer 2020) in order to balance social needs and environmental health. Three crucial features of the ancestral circular economy are (1) achieving optimal productivity using regenerative practices to yield enough to provide for the socioeconomic needs of the entire population, while (2) using and managing resources with minimal waste or pollution, and (3) redistributing resources regularly to achieve equity and prioritize network relationships.

Hawaiian monarchs took advantage of Hawai'i's strategic placement between Asia and North America by positioning the

Hawaiian Kingdom as a player in the nascent global market economy of the 19th century. This is documented through treaties with numerous other nation-states, including China, Japan, America, Britain, France, Spain, etc. (Beamer 2014a). Hawai'i continues as a regional hub of the global linear economy today, which further positions it as a viable model for circular economies. However, prior to European contact in 1778, the Hawaiian civilization was driven by a complex ancestral circular economy. Hawai'i was eventually occupied by, and claimed as a state of, the United States of America. Hawai'i's current economy is chained to the U.S. market economy, yet elements of the Hawaiian ancestral circular economy persist in an embedded form, especially in rural areas (McGregor 2007, Vaughan 2018). Components of the Hawaiian ancestral circular economy have been documented by Hawaiian historians (e.g., Kamakau et al. 1968, Malo 2006). Despite the global climate crisis and economic instability, many community efforts perpetuate and advocate for ancestral economic practices and values. A few of the main components of the Hawaiian ancestral circular economy are explored.

Balanced bottom-up and top-down resource governance

Hawai'i's relative isolation from other land masses made clear the precious and finite amounts of natural resources available to sustain life on the islands. As the Indigenous population expanded and increased, 'ōiwi royalty developed a complex set of palena or "place boundaries" that defined peoples' collective and regional rights to resources from the mountains and into the sea. These palena helped establish specific units of management, such as the moku (regions or districts) (Winter et al. 2018b) and the ahupua'a. Ahupua'a are defined as "culturally appropriate, ecologically aligned, and place specific unit[s] with access to diverse resources", and are one of the most important land divisions in resource administration (Gonschor and Beamer 2014:71). This system of boundaries, in partnership with a highly functioning governance structure, achieved a balance of bottom-up and top-down approaches toward the management and allocation of resources across society. People had access to a diverse set of terrestrial and marine resources within these "place boundaries" that empowered them to develop regenerative agricultural and aquacultural systems. This enabled a somewhat adaptive approach toward the management of resources. For example, the harvest of specific fish species could be regulated in a place-based manner that allowed for the protection of aquatic species during their spawning periods (Winter et al. 2018b). Additionally, intergenerational knowledge gathered by people rooted in ancestral places informed top-down approaches toward overall management that could be both place- and resource-specific. We find the balance of bottom-up and top-down decision-making, and shared governance over resources, as key principles of circularity in the Hawaiian ancestral circular economy.

Regular and systematic redistributions of wealth and power (Kālai'āina)

Socio-cultural institutions serve key functions in social-ecological systems. They develop and maintain a framework of values and ethics that is passed from generation to generation. These institutions are foundational to maintaining robust and resilient systems (Winter et al. 2020b), and can serve a similar function within market economies by contributing to feedback loops toward actualizing a circular economy. The Kālai'āina was an

institution embedded in the Hawaiian ancestral circular economy. This particular institution was designed to produce regular and systematic redistributions of wealth and power. It was foundational in achieving the social conditions that enabled the Hawaiian ancestral circular economy to accomplish a kind of equity and balance. The process of the Kālai'āina was inspired in part by the water cycle. Kālai'āina mimicked the natural processes of streams that would ebb and flow and thus kālai (carve) 'āina (land) while cycling nutrients downstream and later evaporate and produce rain that would again fill the streams. A Kālai'āina was the process in which land (and thus the resources of those lands) were redistributed at the beginning of the reign of every new mō'i (supreme sovereign of an island) (Kame'eleihiwa 1992, Beamer 2014a). These regular (often generational) redistributions of resources ensured that certain individuals, families, and factions of power would not be able to accumulate vastly inequitable amounts of resources. Unlike primogeniture in European feudal systems, where all the land and property of a lord went to the eldest son, the process of Kālai'āina ensured that the land holdings and resources of a particular mō'i were redistributed following his/her death. Both male and female descendants received resources once controlled by the mō'i, while native inhabitants of place continued to have access to diverse sets of resources. These regular redistributions of wealth and power prevented the emergence of an extremely wealthy class. Wai—the Hawaiian word for water, and waiwai—the Hawaiian word for wealth, demonstrate that health and abundance of natural resources were essential in the Hawaiian view of prosperity (Chang et al. 2019). The centrality of water in waiwai describes how wealth is defined by access to and management of freshwater and all the natural resources in the islands it supports (Sproat 2011). Along this vein, Kālai'āina ensured the rearrangement of wealth in every generation to prioritize environmental health through resource management. Therefore, a third key principle in the Hawaiian ancestral circular economy is the regular and systematic redistributions of wealth and power.

Environmental kinship

The Hawaiian ancestral circular economy is grounded in a genealogical connection between 'Ōiwi and the surrounding environment. This is based on concepts of lineal descent demonstrated in cosmogonic origin traditions and ancestral beliefs. Many of the islands of the Hawaiian archipelago were birthed by Papahānaumoku, earth mother. Her descendants also include Hāloa, the taro plant and staple crop of Hawaiian society, and eventually, the first Hawaiian people. In this way, the land and people of Hawai'i are genealogically connected (Kame'eleihiwa 1992). Operating from the worldview that people are lineal descendants of the land, the responsibility to care for and steward the environment and natural resources in a kinship manner is inherent and ingrained in all aspects of Indigenous society (Kana'iaupuni and Malone 2006, MacKenzie et al. 2007). This central familial relationship between people and the environment has been sustained for centuries, and is continuously referred to in Indigenous-led efforts in Hawai'i today (Beamer et al. 2021, Winter et al. 2021).

Kin-centric interactions that are incorporated by Indigenous peoples into land management techniques enhance ecosystems and maintain environmental integrity (Kimmerer 2017, Salmón 2000, Whyte 2020). Due to the rise of cultural revitalization

movements in recent decades, there has been increased interest in biocultural approaches to environmental restoration in Hawai'i (Chang et al. 2019). The employment of biocultural approaches has led to tangible successes when Indigenous practices, based on perceiving the environment as kin, guide conservation efforts (Bremer et al. 2018, Morishige et al. 2018, Friedlander et al. 2000, Winter et al. 2020c). We find that seeing ecosystems as kin is another key principle of the Hawaiian ancestral circular economy, and it serves as the foundation for building circular practices and outcomes in that economy.

FILLING THE GAP: ALOHA 'ĀINA AS SOCIAL JUSTICE IN HAWAII

The circular economy has historically aimed to make human industrial processes more sustainable by closing material cycles (Kirchherr et al. 2017, Urbinati et al. 2017). The related field of sustainability is based on economic, social, and environmental pillars (Gibson 2010, Hansmann et al. 2012). On a political level, the circular economy aims to incorporate the economic, environmental, and social pillars of sustainability (European Commission 2020). Up until this point, the circular economy has focused mainly on the economic and environmental pillars, with limited investment in the social or cultural perspectives (Sauvé et al. 2016, Moreau et al. 2017, Murray et al. 2017, Padilla-Rivera et al. 2020). The gap in research on the social dimension is confirmed by the extensive literature review by Kirchherr et al. (2017). They found that only 13% of circular economy definitions in their sample referred to all three sustainability dimensions. The most prominently considered dimension was the economic one (46% of definitions), followed by environmental quality (37–38% of definitions), while social equity was incorporated in only 18–20% of definitions (Kirchherr et al. 2017). In a recent review on social aspects of the circular economy, Padilla-Rivera et al. (2020) classified indicators found in the literature into four thematic areas. They found that the area of society had the highest percentage of indicators (49%), followed by labor practices and decent work (41%), human rights (2%), and product responsibility (2%) (Padilla-Rivera et al. 2020).

Employment was the social aspect most cited in Padilla-Rivera et al.'s (2020) review, which highlights the positive impact of the circular economy on job growth. This is particularly true for studies with a more strategic, generic, and aggregated goal and scope. One example is the Greenfield optimization problems for strategic supply chain design, under which studies on closed-loop supply chain design fall (Messmann et al. 2020). Social equity is one of the most common aspects within the thematic area of society. Despite its frequent citation, the authors found that “there is no knowledge about how a circular economy could support the promotion of social equity, there has been no detailed analysis, and it is necessary, explicitly, that a circular economy empirically supports this fact” (Padilla-Rivera et al. 2020:9).

Social justice is an integral part of broader political frameworks of sustainable development, such as the 2030 Agenda for Sustainable Development (and Sustainable Development Goals), which were adopted by the United Nations Member States in 2015. So far, the circular economy has been criticized by some authors for not explicitly targeting the social dimension of the Sustainable Development Goals (Geissdoerfer et al. 2017, Millar et al. 2019, Borrello et al. 2020). The circular economy, as a

concept for sustainable development, focuses mainly on the planetary boundaries. The planetary boundary approach defines a safe operating space for humanity, in which the stability and resilience of the Earth system is not disturbed (Rockström et al. 2009). Closing material cycles, reducing resource use, and reducing emissions facilitates operating within environmental limits. Raworth (2012) complements the concepts of the nine planetary boundaries with 12 more dimensions of the social foundation, which are derived from internationally agreed upon minimum social standards. Raworth (2012:4) points out that “sustainable development means ensuring that all people have the resources needed — such as food, water, health care, and energy — to fulfill their human rights”. This must be accomplished while correcting the imbalances that have pushed critical earth-system boundaries to an unstable state (Raworth 2012). This highlights that not only material needs should be considered in a transition into circular systems, but also societal needs, such as fairness, equity, and justice. Circularity should not be achieved at any price; rather, the quality of closing the loops and the effects on society demand careful consideration. To achieve an integration of all sustainability aspects, the circular economy agenda thereby needs to become more contentious and political (Hobson and Lynch 2016, Kębłowski et al. 2020, Borrello et al. 2020, Corvellec et al. 2021).

Indigenous knowledge has exceptional potential to inform the redesign of global economic processes toward sustainability (Senanayake 2006, Watene and Yap 2015, Klein 2020, Beamer et al. 2021). The following conversation is situated in an emerging trend in literature that articulates the value of Indigenous economies in the modern context. In Aotearoa, recent triumphs in political activism have led to Māori reasserting their rights to serve as kaitiaki, or guardians, in alignment with traditional practices to perpetuate intergenerational well-being of the land and people (Wolfgang et al. 2020, Rout et al. 2021). In North America, Indigenous communities that have retained traditional methods of living sustainably inform processes that connect environmental ethics with sustainable ecological practices both in and out of the private sector (Trosper 2009, Miller et al. 2019). Ultimately, Indigenous frameworks of economy and economic development challenge dominant narratives of the unfettered capitalist-driven economy by emphasizing relationships rather than individualism. While these examples do not represent the breadth of Indigenous economic views, they provide insight into movements around the globe that are similar to aloha ‘āina in Hawai‘i.

Aloha ‘āina informed the development of the Hawaiian ancestral circular economy, and the principles of circularity we discussed earlier. This has evolved over time to frame community responses to crucial modern issues, including climate change, oligopolistic markets, militarism, and resource management (Beamer et al. 2021). Within a Hawaiian ancestral circular economy, nearly every resource held a purpose and role within a broader system that recognized kinship between people and nature. As caretakers of these resources, ‘Ōiwi worked to ensure that every resource and material held values and a function, thereby eliminating the idea of waste as a “natural” result of resource and material flow. While social, political, and economic landscapes shifted drastically throughout Hawai‘i’s Ali‘i and Kingdom eras (Table 1), the ancestral circular economy remained at the forefront of many

economic progressions. The linear economy that rapidly advanced with the American occupation of Hawai‘i suppressed the ancestral circular economy into smaller management systems. This forced the ancestral circular economy into kīpuka (centers of spiritual power wherein Hawaiian customs, beliefs, and practices continue to be a practical part of everyday life) which must now work to undo centuries of social-environmental damage (McGregor 2007:8–15).

Table 1. Time periods in Hawai‘i with corresponding economic classifications.

Time period	Economic classification
Pre-Ali‘i - Ali‘i Era (4000 BC–1810 AD)	Ancestral circular economy (ACE)
Kingdom Era (1810–1893 AD)	ACE within the global market economy
Occupation Era (1893 AD–present day)	Linear economy with pockets of ACE
Possible futures with circular economy transition	ACE within the global market economy

Aloha ‘āina can inform the gap in research on social justice components within the circular economy. While some may contest kinship relationships between people and nature, at a minimum, we must identify people and communities as stakeholders playing a functional role in ecological and economic system stewardship. This is essential to filling the research gaps in social justice in the circular economy. In contemporary times, aloha ‘āina is a place-based framework for achieving justice—social and environmental—through political and activist practice (Goodyear-Ka‘ōpua 2013b, Beamer 2014b, Grandinetti 2019). The continuation of Indigenous circularity in community efforts can be seen in examples across Hawai‘i. In recent decades, there has been a revival of putting ancestral economic thought into practice across the islands. For example, in 2006, Hā‘ena on the north shore of Kaua‘i became the first designated community-based subsistence fishing area. This allows community members to co-develop place-based management strategies for fishing areas based on Indigenous values and intergenerational practices (Delevaux et al. 2018). Thereafter, a number of communities received the same designation, including Ka‘ūpulehu on Hawai‘i Island’s Kona coast (Delevaux et al. 2018) and Mo‘omomi on Moloka‘i (Akutagawa et al. 2016). Another example is the community-based non-profit Kāko‘o ‘Ōiwi, which has restored nearly 2 acres (0.8 ha) of lo‘i (traditional stone-faced terraced pondfields for growing kalo) since 2008, which has resulted in environmental, cultural, and economic benefits (Bremer et al. 2018). Projects like these are developed in holistic, interconnected contexts. Because these projects operate inside and outside the market economy, and because they prioritize ancestral Indigenous values, it is difficult to assess overall outcomes based solely on traditional market economy valuation measures. Rather, success is measured by associated cultural, environmental, and economic benefits that result from the application of Indigenous knowledge. In the case of the Hā‘ena community-based subsistence fishing area, long-term monitoring has determined that the increase in fish abundance and diversity (Rodgers et al. 2021) is a direct result of local-level management founded in place-based, intergenerational knowledge and practices (Delevaux et al. 2018). The biocultural restoration of social-ecological systems in Kāko‘o ‘Ōiwi has proven to meet multiple sustainability goals at both state and

Table 2. ‘Āina Aloha economic futures guiding principles.

Principles	Description
‘Āina Aloha	We are of and from this ‘āina that ultimately sustains us. We employ strategies for economic development that place our kuleana to steward precious, limited resources in a manner that ensures our long-term horizon as a viable island people and place.
‘Ōpū Ali‘i	Our leaders understand that their privilege to lead is directly dependent on those they serve. From the most vulnerable to the most privileged, we seek to regenerate an abundance that provides for everyone. decision-makers understand and embrace their duty and accountability to Community. Our social, economic and government systems engage and respond to a collective voice in integrative ways to balance power and benefit.
‘Imi ‘Oī Kelakela	We are driven by creativity and innovation, constantly challenging the status quo. We are mindful and observant of needs, trends, and opportunities, and seek new knowledge and development opportunities in ways that enhance our way of life without jeopardizing our foundation of ‘āina aloha.
Ho‘okipa	We are inclusive and embrace the collective that will call Hawai‘i home, grounded in the fundamental understanding that it is our kuleana to control and manage our resources in a way that allows us to fulfill our role as hosts here in our ‘āina aloha.

community levels (Bremer et al. 2018). By prioritizing environmental abundance and community well-being, Indigenous-led movements in aloha ‘āina may serve as examples in addressing the social and cultural gaps in circular economy research. These innovative efforts grounded in ancestral knowledge not only model sustainability but also redefine economic valuation measures. All these projects seek to achieve social equity and ecological abundance by balancing community governance and decision-making.

Another example of aloha ‘āina in practice is the ‘Āina Aloha Economic Futures initiative, which formed in response to the economic crisis caused by the COVID-19 pandemic. The global pandemic imposed a forced pause on tourism. Many local residents welcomed this as an opportunity to re-evaluate tourism’s extractive effect on Hawaii’s economic industries. In May 2020, a group of established ‘ōiwi community organizers formed the ‘Āina Aloha Economic Futures, with the goal of uplifting ‘ōiwi values to advise economic recovery efforts. The group reflects “the interconnected and overlapping roles that individuals, ‘ohana, organizations, coalitions, and networks play” in Hawai‘i communities (‘Āina Aloha Economic Futures 2020). The ‘Āina Aloha Economic Futures Declaration was the first in a four-step community-based process to advise sustainable and equitable recovery grounded in ‘āina aloha-beloved homeland. This declaration was delivered to the Governor in mid-May 2020. It outlines four ancestral principles (Table 2) that have guided and continue to guide Hawai‘i communities toward resiliency at local, national, and international levels. The declaration was created by 14 collaborative authors, and by December 2022, more than 3000 community members, businesses, colleges, and organizations had signed on in support of the group’s economic development strategies centered around ‘āina aloha. More significant than the sheer number of supporters that have signed on is the breadth of diverse sets of interests that endorse the initiative. The list includes long-time community leaders and activists, such as Uncle Walter Ritte, Auntie Pua Kanaka‘ole-Kanahele, and Uncle Neil Hannahs, as well as some of the most powerful economic drivers for the Hawai‘i economy, such as the Hawaii Tourism Authority, the Kamehameha Schools, KHON2 news outlet, and Hawai‘i Community Foundation.

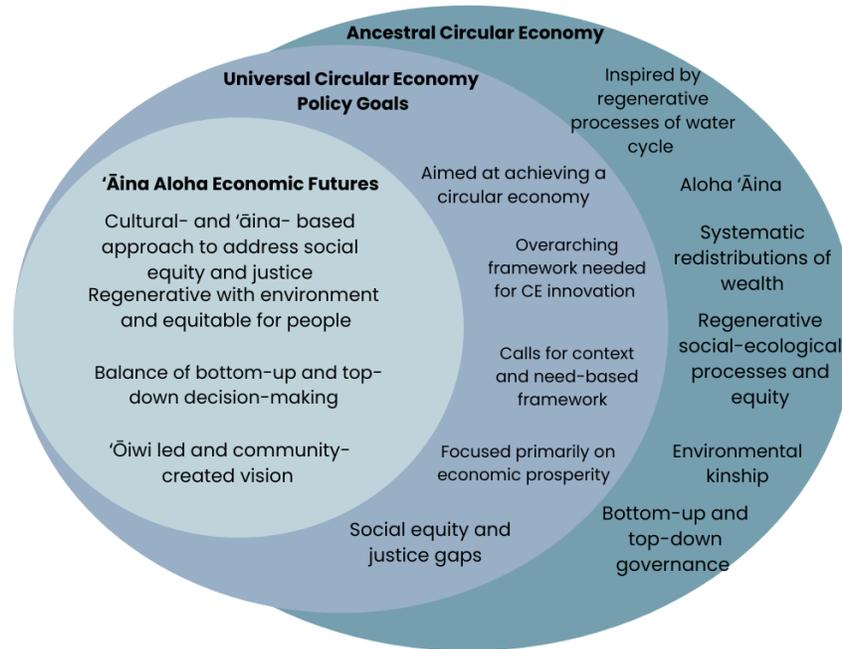
The AAEF policy playbook is an example of applying Indigenous economic values in the contemporary context, and demonstrates how ancestral circular economy principles continue to direct Indigenous-led economic initiatives. The AAEF policy areas of

achieving circular economies and advancing economic equity in Hawai‘i would be informed by ancestral circular economy values, as both would enact necessary changes to improve environmental health and community well-being. Policy areas such as developing regenerative business and prioritizing community and environmental well-being in decision-making recall from the ancestral circular economy the redistribution of wealth and power. By shifting away from extractive industries, and investing in areas that foster community agency, wealth and power may be redistributed in an effort to empower communities and prioritize environmental health. Investing in local food systems and empowering community-based resource management recall the ancestral circular economy value of balanced resource governance, which enacted bottom-up and top-down approaches toward managing resources and allocating them across communities. Both of these policy areas would encourage the application of intergenerational knowledge to resurrect regenerative agricultural and aquacultural systems that revitalize abundance.

The initial co-authors of the AAEF are all committed ‘ōiwi organizers in Hawai‘i whose individual efforts have garnered community trust over decades of experience in diverse fields. They considered the unprecedented conditions caused by the global pandemic to be an opportunity to take action in commanding positive transformation for Hawai‘i’s economy and environment. Although it is a technically “informal” organization, as of December 2022, the members had collectively volunteered hundreds of hours and delivered their achievements through the use of virtual platforms. It is important to note that the AAEF is not merely a theoretical approach. There are communities around Hawai‘i whose current work aspires to catalyze viable circular economies in ways that inspired the AAEF framework. Several of these communities, such as He‘eia on O‘ahu, Waipā on Kaua‘i, and Puanui on Hawai‘i Island, are attempting to do so at the ahupua‘a scale. Future research will explore the process of catalyzing a circular economy in these communities.

The AAEF initiative is a representation of how ‘ōiwi leaders continue to apply aloha ‘āina and ancestral circular economy principles to address modern-day challenges. Engaging community members at every step allows community voices to inform the development of documents and tools (such as the Huliau Action Agenda and the AAEF policy playbook), while the AAEF co-authors use their extensive networks and decades of community organizing to actualize results. The AAEF’s

Fig. 1. Circular economy (CE) policy goal gaps and Indigenous informed economy.



introduction of more than a dozen measures to the 2021 Legislative Session exemplifies top-down and bottom-up decision-making and shared governance in an attempt to institutionalize goals outlined in the AAEF policy playbook. The AAEF assessment tool, informed also by community voices, continues to guide various entities in the evaluation of policies, projects, and programs to prioritize the advancement of the AAEF’s core principles. Next steps for the initiative revolve around formal establishment to reinforce and continue efforts to fulfill their mission: “taking action to bring to life a resilient economy through [the] core value of ‘āina aloha” (Abad et al. 2020). The methods, practices, and accomplishments achieved by the AAEF can inform gaps in universal policy goals by (1) modeling engagement with all stakeholder groups that make up communities, and 2) incorporating Indigenous knowledge systems and values in the design and employment of a circular economy. What the AAEF is missing so far is integration with the industrial ecology method of material flow analysis, as pointed out by the integrative circular economy framework (Laurenti et al. 2018). Material flow analysis could also be applied to the case of Hawai’i in order to monitor the status quo and identify which material flows need to be optimized and where loops could be closed in resource and waste management.

CONCLUSION

Water was the primary organizer of the ancestral circular economy. Economic structures and institutions such as the Kālai’āina mimicked circular aspects of the water cycle in order to achieve equity and productivity between people and the environment. Water-informed circular processes of resource redistribution and regeneration allowed for intergenerational and sustainable resource management and consumption within

ancestral society. Three thousand miles (4828 km) away from the nearest continent, Ōiwi society thrived with finite resources because of the ancestral circular economy. Key principles of the ancestral circular economy in Hawai’i are (1) prioritizing the enhancement of relationships between people and nature, (2) creating balanced governance structures, (3) conducting systemic and regular redistributions of wealth and power, (4) promoting regenerative social-ecological processes and equity, and (5) maintaining environmental kinship. While we have not presented an extensive account of ancestral circular economies in Indigenous systems, we have framed a sustainable economic infrastructure that promoted the health of social-ecological systems while supporting a thriving island civilization for centuries. These principles continue to be perpetuated and actualized while also evolving within today’s Indigenous-led political and environmental movements (Sachs and Clamp 2016, Whyte and Cuomo 2016, Burow et al. 2018). The adoption of a circular economy in Hawai’i today would not involve taking on a completely foreign economic strategy (Fig. 1). Like other Indigenous communities (Gutierrez 2018, McDonald et al. 2019, Nelson 2019), Hawai’i has the potential to build upon and reclaim ancestral economic and ecological values of stewardship that promoted reciprocity, redistribution, and relationships to achieve a circular economy.

A future circular economy is possible because Hawai’i has already demonstrated the existence of an ancestral circular economy within the global market economy (see Table 1). The ‘Āina Aloha Economic Futures initiative, community-based subsistence fishing area designations, Kāko’o Ōiwi, Waipā, and Puanui are all examples of ancestral circular economy principles that have persisted throughout Hawai’i’s history to influence economic

possibilities of tomorrow. Hawai'i is positioned to be an ideal setting for studying the effects of sustainable development and circular economy on a smaller and more controlled scale. While there continue to be social and cultural gaps in publications on the circular economy, we find there are also similarities between the ancestral circular economy and the universal circular economy policy goals. The Ellen MacArthur Foundation's universal circular economy policy goals that closely align with ancestral economic principles include (1) requirements for multi-stakeholder collaboration for system change; (2) investments in innovation, infrastructure, and skills required to install circularity; (3) management of resources to preserve value and function; and (4) circular design aimed at eliminating waste and pollution. Given these similarities, however, the social-environmental justice and equity components embedded within the ancestral circular economy can strengthen current research and policies to inform the circular economy transition. Our findings have the potential to inform modern applications of the circular economy. The social and cultural dimensions of circular economy reform have received less focus than environmental and economic dimensions. This has resulted in a need for publications that address important social equity gaps and the concerns of community stakeholders. Key ancestral circular economy concepts, such as aloha 'āina and the principles of circularity we have identified, can aid in filling these gaps and closing loops.

Aloha 'āina is founded on the relationship of kinship between 'Ōiwi and the environment. It informed the key elements of the Hawaiian ancestral circular economy, and ensured continued investment in maintaining the well-being of people and the natural systems through shared governance. There is an urgent need to develop just and equitable economic structures that are regenerative to the environment. The tremendous effort and thoughtful research on the development of the circular economy provides hope for alternative futures, especially in relationship to the economic and environmental dimensions of sustainability. However, there is a need for more intellectual investment and inclusive research in the social and cultural dimensions of sustainability. This paper is one needed intervention in the social and cultural dimensions of sustainability. We find that using Indigenous perspectives of economies, such as the Hawaiian ancestral circular economy, to inform gaps in research while confronting social equity issues can contribute to comprehensive circular economy policies. Indigenous knowledge systems and economies have persisted for millennia because of kinship relationships with nature, and because they were circular. Uplifting them will inform the potential futures for circular economy around the world.

Data Availability:

Data/code sharing is not applicable to this article because no data code were analyzed in this study.

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