Mancala's Eco-Conscious Game Design

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ABSTRACT

This thesis asks whether mancala, specifically Bao la Kiswahili, contains eco-conscious qualities suitable for adapting into new games. It analyzes Bao's mechanical, cultural and artistic qualities by drawing on de Voogt's studies of Bao, Graeber and Wengrow's notion of custodianship and Kimmerer's framework of reciprocity. The game's sowing cycles, recursive loops, communal ownership and ageing boards are shown to enact reciprocity and regeneration rather than extraction. These findings are abstracted into an eight-principle design framework: cycles, long-termism, tactile affordances, non-human embodiment, materiality, community, ethical constraints and ritual, in order to guide future eco-conscious game design.

Keywords

Mancala, Bao la Kiswahili, eco-conscious design, game design, reciprocity, custodianship, procedural rhetoric, ethnophilosophy

POSITIONALITY STATEMENT AND THE AUTHOR'S FIRST INTRODUCTION TO BAO LA KISWAHILI

I would like to start this thesis by outlining my positionality. I do this following Scott-Fordsmand's (2025) ethnographic philosophy approach, which emphasises the embedded position of the researcher, in order to clarify the ways my positionality might impact my understanding of the research I am conducting.

I am a white bi man from the UK. My family was born in the British colonies: my Italian Irish mother was born in Hong Kong on a military base and my father to a Greek family in Kampala, Uganda. My recent history is colonial. Aged 19 I wanted to see where my father was born and know something of that land. Whilst backpacking in Uganda, Rwanda and Tanzania I encountered Bao la Kiswahili. It was different from the simplified western adaption I had played (Hanson and Hanson, 2003) before. Its board was enigmatic and beautiful (Alexandroff, 2009, Figure 2) (Alexandroff 2025, Figures 1, 3 - 14).

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Figure 1: Bao board and plant (Photograph by Jack Alexandroff, 2025)

I have maintained a curiosity about this mancala variation since first playing it, loving its tactile qualities and how its loops reward forward planning. I acquired in Zanzibar a large board which I now treasure, while at the same time harbouring complex feelings towards it.

During research for this thesis, I discovered how old boards that have been worn down by regular use gain a spiritual importance (de Voogt, 1997). The heavily-used quality of my Zanzibar board (Figure 3) asked to be played on in ways the freshly carved ones in the shop did not. I now feel a sense of shame about depriving the original owners of their worn down board, smoothed by hundreds of hands.

The colonial past of importing uncredited labour, knowledge and worst of all humans into the West to extract their value will always cast a shadow over any work done by global northerners trying to understand global south cultures. I intend to factor in my positionality wherever possible in this text.

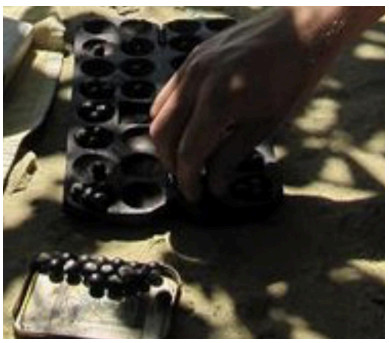

Figure 2: Alexandroff, J. plays Bao, Tanzania (Photograph by Jack Alexandroff, 2009)

INTRODUCTION

This thesis examines: which, if any, qualities of mancala, specifically the Tanzanian version Bao la Kiswahili (hereafter known as Bao) (Alexandroff, 2025, Figure 1), contain an eco-consciousness suitable for adapting into new games by analysing Bao's mechanical, tactile and cultural qualities. This study identifies design features that resonate with environmental management: sowing and harvesting cycles, finite but shared resources, recursive loops, and rules that encode a communal justice. The production principles and artistry of the game boards reinforce these themes (Alexandroff, 2025, Figure 4). As op de Beke, Raessens, Werning and Farca observe (2024, p.13), "We open this brief history with a reference to Mancala because the game suggests an unexpectedly immediate connection between ecology and play, one that predates the digital age." They identify the gap in the research that this thesis begins to address.

Combined with de Voogt's studies of Bao mastery and Bao board aesthetics (de Voogt, 1995, 1997), this thesis examines the ethnophilosophical approaches from Graeber and Wengrow's description of custodianship (Graeber & Wengrow, 2021) and Kimmerer's framework of reciprocity (Kimmerer 2013a, 2013b). It argues that Bao incorporates eco-conscious thinking as part of its play and use. These findings are abstracted into a design framework to guide future work seeking to harness eco-conscious design.

Figure 3: Seeds and pits (Photograph by Jack Alexandroff, 2025)

CONTEXTUAL REVIEW

The research undertaken for this thesis incorporated both granular level texts about the play of mancala as well as broader ecological, ethnographic and philosophical writings. I will outline two texts concerned with the play of mancala and its introduction to Western culture. I will go on to discuss more analytic studies of mancala and its cultural and anthropological significance. Finally I summarize the thinkers who have informed the broader issues of ecological thought and non-Western philosophies.

Though not an academic text, and written for the popular reader, *All about mancala: its history and how to play* by S. Hanson & J Hanson (2003) provides a useful overview of many types of mancala. Their book is a popular resource for understanding the rules of a wide variety of mancala games. It touches, if lightly, on the cultural meanings of the different versions and provides an overview of its anthropological context.

Great board games of the ancient world provides a more targeted exploration from Donovan (2022). In his work on outlining mancala's North American adaption, *Kalah* (Champion, 1958), he showcases the oversimplification insensitive cultural imports can often inflict. He also outlines how mancala intersects with anthropology, play, culture and game theory.

Figure 4: Playing outside (Photograph by Jack Alexandroff, 2025)

Bikić and Vuković (2010) demonstrate how, as mancala moves and shifts ethnographically, it absorbs new qualities at a rate and drift that is potentially traceable. They trace one of these historical threads to examine a Balkan version of mancala in *Board Games Reconsidered: Mancala in the Balkans.* Their paper tracks how mancala's qualities shift through cultural transmission. By examining non-African versions of the game they help to emphasise the reductive risk of understanding mancala through a purely "African" lens.

One of the preeminent scholars of Bao in the global north is de Voogt. His work in *Limits of the mind: Towards a characterisation of Bao mastership.* (1995) examines the cultural context of Bao la Kiswahili. He constructs a picture of Bao's living culture, building a dossier of its masters and how its competitions proceed. The insights this research reveals about Bao's gameplay are core to this thesis.

De Voogt's account of his participation in organising a Bao championship reveals the need for ethnologists to be embedded within their subject. In *Ethnographic Philosophy: A Qualitative Method for Naturalised Philosophy* Scott-Fordsmand (2025) outlines a framework of how to engage with this approach. The choice of which version of mancala this thesis investigated was informed by Scott-Fordsmand's framework.

Building on this methodological grounding, the anthropologists Graeber and Wengrow (2021) demonstrate how reductive Western narratives about "less developed" and "more developed" societies fly in the face of evidence. Arguing humans have organised themselves in ever-shifting ways and pushing back on the agricultural trap implied by *Guns, Germs, and Steel* (Diamond, 1997) and stated in

Sapiens (Harari, 2014). Graeber and Wengrow demonstrate that humans can adopt custodial relationships to land management rather than extractive ownership-based ones. They argue that humans continuously decide how they relate to the natural world and that these relationships shift with the seasons and the years.

This sensitivity to plurality resonates with Mudimbe's (1988) *The Invention of Africa,* in which he highlights the damaging history of misapplying global north structures of thinking to global south philosophies. Mudimbe argues that anthropological and ethnographic discourse is stifled without global south thinkers having a voice. Challenging the epistemological status quo, his work led to the reappraisal of other non-Western structures of philosophy.

Author and biologist Kimmerer arguably embodies one answer to Mudimbe's call for a more diverse landscape of thinkers. In The Democracy of Species (2021) and Braiding Sweetgrass (2013a) she centres the concept of reciprocity, showing that everything, animate and inanimate, is in relationship to one another, and that by reflecting on the world through this lens, humanity might be able to shift its course and avert ecological disaster. Her framework draws on the language structure of Potawatomi, where shifting the concept of a bay to a verb allows Algonquian thought to perceive the bay as containing its past and future, it is in the process of baying. This shifting of umwelt helps to adopt eco-conscious modes of thought more effectively.

This thesis bridges Morton's (2013) conception of the hyperobject and Potawatomi conceptual structures. Morton positions collections of forces, actual and metaphorical, who act upon and are acted upon, as all part of one enormous single Hyperobject. They reposition climate change as a hyperobject, in doing so, they allow for the components that make up climate change to be understood as individuals and part of a wider system.

Repositioning ecosystems as active shifting hyperobjects rather than a terra nullius is a powerful tool in the work of embedding more eco-conscious thinking into our ways of living. By building structures to embody these inhuman agents, Chang (2011) argues games can enable non-human flow states. That by embodying a biological system we can construct more reciprocal relationships to the natural world.

In *Ecogames: playful perspectives on the climate crisis,* Chang (2024, citing Escobar) expresses frustration that much of what goes on under the guise of design at present involves intensive resource use. Many games relegate environments to background scenery predicating player success on the extraction and use of natural resources. This highlights how there is much room for adapting Kimmerer's and Morton's conceptualisation of ecosystems into game studies.

Chang's essay and other essays, such as *Ecogames: Playful Perspectives on the Climate Crisis (2024),* have functioned as a comprehensive map of many of the nuances of understanding eco-conscious design. The collection by Laura op de Beke, Joost Raessens, Stefan Werning and Gerald Farca outlines the importance of exploring global south thinking when studying environmental themes in game design.

Playing Oppression (Garcia, 2021) was another collection of essays that helped to illuminate the potential exploitation that global north studies of the global south present. The book's journey through a retrospective on exploitative qualities found in board games revealed pitfalls that the work of this essay was at risk of being caught in.

METHODOLOGY

Bao was selected firstly because I have a direct first-hand relationship to the game. Secondly, its extensive documentation in ethnographic and game studies makes it well studied, though, as previously stated, Bao's literature lacks eco-conscious design analysis.

This thesis understands eco-conscious game design not simply as a matter of presenting players with an environmental theme or minimising carbon footprint in its production, but rather to place players in the experience of ecological cycles. Chang (2024, p. 73) notes that sustainable games are difficult to define, "are they the same thing as suitably developed games? Are they games with overt environmental messaging?…" The view proposed in this thesis is praxis-oriented. A game is eco-conscious if it invites players to participate in processes of reciprocity and regeneration rather than extraction.

Graeber and Wengrow outline how humans have utilised their ecosystems in a wide range of ways. They state that "[human beings] have moved back and forth fluidly between different social arrangements, assembling and dismantling hierarchies on a regular basis" implying that alternative non-hierarchical relationships with the inanimate world are possible (Graeber & Wengrow, 2021, p. 115). They explore how the different ways different cultures relate to resources, shifts the degree to which extraction has positive or negative outcomes on the landscape, and emphasize that those relationships are often seasonal.

Figure 5: Sequence (Photograph by Jack Alexandroff, 2025)

Figure 6: Reappeared damage on Bao board (Photograph by Jack Alexandroff, 2025)

Robin Wall Kimmerer's work in *The Democracy of Species* and *Braiding Sweetgrass* highlights how many non-Western cultures understand the natural world in terms of reciprocal relationships (Kimmerer, 2021), (Kimmerer, 2013a). Rather than viewing resources as assets for extraction, she frames resources as participants in a living cycle. This reframing implies that human action is always part of a reciprocal system, whether we recognise it or not. The disruption of this balance harms both the human and non-human participants alike. Kimmerer articulates this directly in Returning the Gift, in terms whose aesthetic form carries its own philosophical weight (Kimmerer, 2013b):

> "Reciprocity—returning the gift—is not just good manners; it is how the biophysical world works. Balance in ecological systems arises from negative feedback loops, from cycles of giving and taking. Reciprocity among parts of the living Earth produces equilibrium, in which life as we know it can flourish. When the gift is in motion, it can last forever." (Kimmerer, 2013b)

Kimmerer, Graeber and Wengrow each challenge the narrative of agricultural inevitability that Yuval Noah Harari asserts in *Sapiens* when he states "we did not domesticate wheat. It domesticated us" (Harari, 2014, p. 79). Harari reduces human social development to a single, linear trajectory where humans are not agents in their relationship to the natural world and are therefore effectively incapable of shaping it. This framing relies on an anthropological model largely discredited 60 years ago (Graeber and Wengrow, 2021).

Next it is necessary to explore whether cultural objects can contain moral, ecological or social philosophies in embedded ways. This question is complicated by existing work on mancala. The study of mancala in relation to the perceived complexity of a society has functioned as a kind of null hypothesis for anthropological debate. It was originally proposed by Roberts, Arth and Bush (1959), then extended by Chick (1998), claiming the greater the complexity of the society, the more complex the form of mancala it favours. This deterministic claim mirrors Harari's conception of human development as linear. The hypothesis that as a society develops, its complexity is linked to the increasing complexity of game mechanics has been widely

critiqued. De Voogt (2021) has shown that game complexity is more reliably explained through cultural transmission. As de Voogt (2021, p.7) notes, summarising earlier work, “In the end and based largely on the extensive evidence on mancala games, Chick conceded that the main hypothesis was no longer tenable (Chick 2017; de Voogt 2017a).”

Zhang et al. (2023, p. 23) argues that mancala is nonetheless a “ powerful tool for promoting moral reasoning, critical thinking abilities, strategic planning skills, physical coordination and cultural understanding… they embody cultural traditions, transmit ancestral knowledge and foster social cohesion”. This reframes mancala as being capable of containing embedded moral, mathematical, ecological and social philosophy.

Suharti et al. (2025) reinforces Zhang et al.’s (2023) view on mancala's ability to carry cultural meaning; they show how mancala's mathematical properties teach its players about numeracy through play. It therefore follows that cultural objects may indeed be able to carry eco-conscious concepts in their mechanics, form and cultural function. The “design framework” portion of this thesis explores how these properties could be incorporated into future games.

To restate the tension in this debate more clearly: can we or can't we identify cultural philosophy in cultural objects? Kimmerer shows how phenomenological meaning is contained in the cultural construction of the grammar of Potawatomi, an Algonquian language. As she explains in *Braiding Sweetgrass* (Kimmerer, 2013a pp. 55-57), learning the grammar of Animacy, “to be a bay, a wiikwegamaa, is to be a living process…. Bay is a verb, it is a process of being. English has no such word”. Equally in *The Invention of Africa*, Mudimbe (1988 pp. 4-5) emphasises that African systems of knowledge are “dynamic processes in which concrete experiences are integrated into an order of concepts and discourses” arguing that global south philosophies are fluid, active and misunderstood.

Conversely, thinkers such as de Voogt and Mkondiwa (2020) push back against earlier anthropological claims, specifically Chick’s (1998) extension of Roberts, Arth and Bush’s (1959, p. 600) arguments that “the greater the complexity of a society the more complex the form of mancala it favours”. Voogt and Mkondiwa separately each dismantle the idea that societies can be placed on a linear sliding scale of complexity. This does make it harder to argue for the presence of embedded philosophy. Each case requires its own contextual reading, hence the need for investigations such as the one undertaken by this thesis to show whether Bao can contain eco-conscious design.

Figure 7: Patina (Photograph by Jack Alexandroff, 2025)

Examining how importing game systems has been conducted around mancala in the past, and noting failures or successes, would provide useful insights into how importing global south game systems has succeeded or failed in the past. While this would deepen the investigation of this thesis it is beyond its scope. The board game company "Happy Viking Crafts" is run by a husband and wife couple who have undertaken the earliest comprehensive guide to game adaptations of mancala and invented some variations of their own in *All about Mancala*. Their work, however, also acts to illuminate how exoticised myths about mancala confuse and reduce the depth to which it is understood in the global north. Happy Viking Crafts documents many variations of mancala, each with a suspiciously neat and unreferenced anecdote about the cultural meaning of each. While these do add flavour and serve to demonstrate how broad and diverse the many societies across the continent of Africa are, they also serve to exoticise the game's origins and, by extension, the people who invented it.

Some digital apps also attempt to recreate different versions of mancala. Some visually ape the physicality of the board and seeds, others adapt the systems to more digitally native operations. However these examples are pure adaptations. Instead, this thesis seeks to abstract the rules of one specific incarnation of mancala and in doing so create a design framework that carries the eco-conscious qualities of Bao into future games.

The analysis of Bao in this thesis starts by analyzing how the rules demonstrate eco-conscious themes via de Voogt (1997). It also analyzes the cultural context of how Bao is played and the production of the game. Following Scott-Fordsmand's (2025) ethnographic philosophy the game is treated not only as a rule system but also as a living practice.

Due to the limit in scope for this thesis I was not able to gather first hand ethnographic research but must rely on secondary sources. I have a Bao board that is not only from Zanzibar, but also has undergone many years of play before I owned it. This object gives me first-hand insights into the aesthetic and tactile qualities of Bao that are detailed in my analysis below and images throughout (Alexandroff, 2025, Figures 1, 3-14).

CASE STUDY & DISCUSSION

Bao la Kiswahili

The rules of Bao are below. They are simplified to help identify mechanics with eco-conscious affordances. This case study follows established practices in game research methods (Lankoski and Björk, 2015).

Players start with 12 seeds in their hands and 22 on the board (Alexandroff, 2025, Figure 8). Play involves sowing seeds from the hand into pits on the board. Each player has a loop of 8 by 2 pits they can play into. Players add a seed to their chosen pit and move all seeds in that pit around the loop. If they finish in a pit that contains 1 seed they can capture any seeds parallel in their opponent's loop. Due to the arrangement of the board, this can only happen in the middle 2 rows of pits. After all seeds in the hand are sown, the play continues but now the way the maths impacts the game has changed.

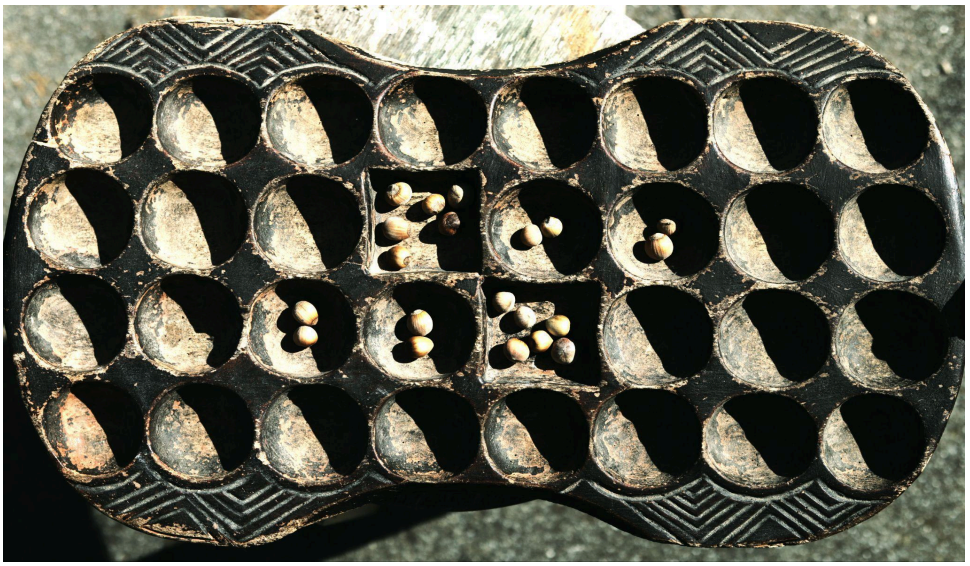

Figure 8: Starting positions for Bao la Kiswahili (Photograph by Jack Alexandroff, 2025)

There are further rules that relate to the Nyumba, which is the special square pit on each player's side. Whereas drawing from a pit normally requires the player to extract all the seeds present, the Nyumba allows for a small fraction of its seeds to be played instead, leaving the Nyumba's power intact.

Similar to losing one's queen in chess for a decisive exchange, in Bao players can use their Nyumba destructively. By playing all the seeds, the Nyumba (house) collapses and its steady drip function is lost but often this enables many laps of the board.

The game has 2 phases. The first phase is the N'mua, in this phase players add a seed each time they choose a pit to start from. In the second Mtaji phase, the game is a closed system. The total number of seeds in play remains the same.

What follows is a deeper exploration of how these elements function in creating eco-conscious qualities.

Seeds

Bao, like most mancala games, uses seeds as its player pieces. This allows for a tactile rooting of theme and function. As Hanson and Hanson note, "one theory is that mancala started as a record keeping system…[or perhaps it was] part of a spring planting ritual" (Hanson and Hanson, 2003, p. 9). In this account, the sowing of seeds into "fields," the "circular motion of sowing" representing the seasons of planting and harvesting, and the "capturing of pieces" representing crops brought in at harvest time, are all direct references to agricultural practices, particularly crop rotation and land management.

Figure 9: Food and counters (Photograph by Jack Alexandroff, 2025)

From the outset, mancala positions itself as a game rooted in plants. The counters are almost always seeds (Alexandroff, 2025, Figure 10) and even in instances where they are not seeds, the counters often represent some other form of fertility or productiveness such as shells or cows (Bikić & Vuković, 2010). In this way, the game pieces thematically emphasize cycles of nurturing, growth, and harvest rather than

the destruction of an opponent. Though there are winners and losers, winners are just those who have managed their resources more effectively. Many variants, such as Oware, explicitly forbid starvation (Culin, 1896), though Bao's unique rule set does not, instead treating immobilisation as the end condition (de Voogt, 1995).

The game foregrounds a regenerative approach to play. This involves cultivating one's back row of pits so as to have more freedom to make choices in later turns, thus invoking a nurturing or cultivatory tone. Equally, resources being unbounded to one player means the system implies a collective responsibility for the productivity of the land. Improper exploitation will lead to failure. This homogeneity of counters contains an implicit assumption that food is the same food to all, emphasised by counters often being literal food. Zhang et al. (2023, p. 25) similarly notes that mancala games were devised as "a simulation of farm sowing… rooted in farming culture" with continuous movement of counters embodying sowing and harvesting cycles.

Unlike most mancala versions, Bao initially only adds seeds to the system at play, never subtracting them. In Bogost's terms, this *Unit Operation* models fertility (Bogost, 2006). Once the system comes under careful management of the two players, that system feels more productive. This is achieved by the two phases of play, during the N'mua phase players add seeds to the system. By the time all 64 seeds are in play, turns may loop for many rotations.

Figure 10: Holes to plant seeds in (Photograph by Jack Alexandroff, 2025)

Pits

It is as though mancala asks its players to embody an ecosystem. As pits fill up with seeds it is as though a planted seed has grown into a plant ready to harvest. In reality, this would of course take months but for the players of mancala the metaphorical cycles of growth and harvest take place at a human speed. This invites players to inhabit the perspective of a managed ecosystem. The field when embodied through the play of mancala becomes a hyperobject (Morton, 2013) that can encompass the same field but through time. op de Beke, Raessens and Werning (2024, p. 34) describe how games can 'attune players to life cycles and lifeworlds that

are grander and slower, or more minute than those we are familiar with', speaking to the umwelt-shifting potential of mancala.

Though beyond this thesis's scope, Bikić and Vuković (2010) go some way to linking mancala's agricultural themes to the Neolithic transformation of the landscape into "furrows for planting" and "pens for livestock". Tracking how these themes have shifted across mancala's forms might speak to ideology's survival across tens of thousands of years, though the lack of archeological evidence makes such work extremely speculative.

Bao is structured around two adjacent clockwise circuits (Alexandroff, 2025, Figure 8). This design allows for cycles that are interconnected. The border between one player and the other's pits exemplify the interdependency of each actor in a system. One player's actions have repercussions on the other and yet they cannot directly affect each other's pits.

Bao's recursive propagatory property replicates careful resource management. This is echoed in one of Bao's more unique qualities, the Nyumba pit (Alexandroff, 2025, Figure 8). The player is rewarded for their ability to delay gratification. By resisting the temptation to collapse the Nyumba for a big decisive-feeling move, they can take advantage of its power for longer. However the game system is balanced and also acknowledges that there are instances where drastic interventions are necessary. This gives great weight to the Nyumba's power and the consequences of over extending.

Infinite Loops

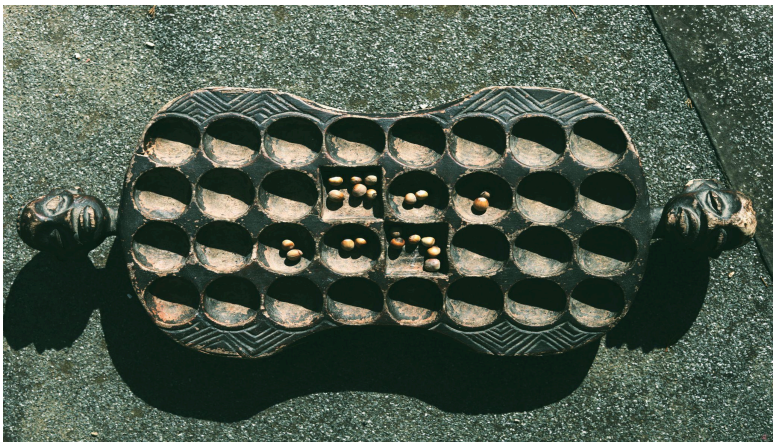

Figure 11: Looping (Photograph by Jack Alexandroff, 2025)

The primary way Bao enacts its meaning is through its looping gameplay. It emphasizes "arithmetic, sequencing and strategic foresight" (Ismael, 2002). Players must look far into the future to see how their actions might echo. Bao's recursive structure allows for theoretical "never ending moves" where sowing and resowing could "continue indefinitely" with one documented case repeating 218 sowings. (Kronenburg, Donkers and de Voogt, 2006, pp. 75, 77) The game shows that long-term thinking is necessary to maintain ecological security. (Alexandroff, 2025, Figure 11)

Mandatory Taking

During play a player picks up all the seeds from a chosen pit and sows them sequentially around the board, dropping one seed in each pit. When a player's final seed lands in a pit on their row (or inner row in 4 row games) that sits parallel to occupied opponent pits, the player must capture those opponent seeds, declining is not permitted.

Although often compared to chess, Bao's play-feel resists stalemates. Chess makes a useful comparison. When playing chess, pieces become caught in a web of threat, attack, and counterattack, because moves often attempt to delay the chain reaction building on the board. Bao forces a much more lively shifting of the play space. Each turn tends to have direct impacts on the state of the opponent's pits and any tendency to build up threat and counter-threat is broken by the mandatory taking rule. Mandatory taking creates a fluid shifting play field, mirroring the chaos of the natural world and seasonal cycles of destruction and rejuvenation.

Figure 12: Seeds in pit (Photograph by Jack Alexandroff, 2025)

Starvation

Generally, in mancala (though not Bao), making a move that deprives the opponent of their move the following turn is illegal and is referred to as starvation. Functionally this prevents the game from allowing traps or easy victories from more experienced players. The rule exists to prevent unscrupulous players from "starving" the game of its joy.

Its function can also be interpreted in a procedural rhetorical (Bogost, 2006) way, where the inference is that human kindness and community does not permit

members of society to take actions that are unfair. Acts like cornering the market, creating a monopoly or starving a person for material gain are understood through the system as immoral.

Echoes of this logic appear in some contemporary board games. In the semi-cooperative game *Clank!* (Dunning, 2016) antagonising the dragon can accelerate everyone's loss, while in co-ops like *Daybreak* (Leacock and Menapace, 2023) or *Pandemic* (Leacock, 2008) individual actions contribute to shared danger. However these games rarely explicitly encode starvation as a metaphor. Mancala makes resource deprivation legible as an ethical limit (Culin, 1896).

Bao is an unusual Mancala game as it does not have a starvation rule. "In Oware, players are not permitted to capture all the seeds of their opponent, as this would leave the other unable to continue. Such starvation rules are absent in Bao where immobilisation is itself the goal of play" (de Voogt, 1995, pp. 14-15). This essay argues that Bao's absence of a starvation rule does not represent an ethical blind spot. Bao's lack of the starvation rule is in fact a response to the way the final phase of the game is experienced. Once the first phase, the N'mua is finished, the game consists of a closed system; there are always 64 seeds in play, none being removed from circulation. Because Bao's possibility space grows so wide and because it has no drain on the circulation of seeds the victory condition must require one player to immobilize the other.

This extra complexity amplifies Bao's eco-conscious qualities. The more nuanced an understanding of the system, the more ability the player has, personifying how a deeper understanding of the biological cycles present in the land can lead to greater stability. Bao's rhythmic but chaotic play echoes the biologist and writer Merlin Sheldrake's description of the adaptability of life. He draws a comparison with jazz, "as a biologist, I think jazz is a great metaphor for life because all organisms are improvising their way through life, constrained in different ways" (Sheldrake, 2025, unpublished)

Form

Figure 13: Damage repaired (Photograph by Jack Alexandroff, 2025)

De Voogt (1997, p. 150) puts it very eloquently when he writes: “A mancala board can obtain aesthetic value when it is played upon. If we consider the smoothening of a board as an artistic process, then the artists are the players. The community playing on the boards is not just ‘the cultural setting’ but also the artist. Each player contributes to the process, and never will a process be repeated in the same way.”

Mancala boards are as diverse as their rule sets. Bao boards specifically, are often club property. By being collectively owned they reinforce the metaphor of collective resources.

The boards are most often made of wood. They are damaged over time and smoothed by play. (Alexandroff, 2025, Figures 6-7, 12-13) They invite each player to integrate themselves with the physical object through wearing it away. The marks on the board implore the player to think of those who they have played with in the past, and will in the future. When the board dies, the players are faced with the reality that all things are caught in the cycles of life and death.

The physicality of dropping seeds into cups creates a connection with nurturing life in every operation. The cold hard skin of the seeds clacking into the bright raised wood, drumming with each move. These aesthetic qualities ground the game in tactile delights that repeat rhythmically over and over. (Alexandroff, 2025, Figure 12)

Function

Some of the traditions hold that Bao boards must only be made by widowers (Donovan, 2022), anchoring its meaning in the work that must be done for the next generation. This mirrors the words of Canadian farmer Nelson Henderson who stated “The true meaning of life is to plant trees under whose shade you do not expect to sit”, (Henderson, 1982) Boards are made intentionally coarsely, their roughness smoothed through play as an essential part of the board’s aesthetic meaning. Equally its eventual destruction through use has meaning (de Voogt, 1997).

In the same way an ecosystem is the relationships between its components in motion. A mancala board only exists as it is in use. De Voogt (1997) goes on to apply this same logic to game states. That without seeing the flow of turn after turn, the meaning of the game state is lost. To compare it to chess one last time, a chess game state is immediately visible to a player familiar with chess and has meaning. A frozen snapshot of a single turn of mancala is divorced from its true state, that of flow. Meaning depends on “being there” and “being with…sharing social spaces with the practitioners not a static display” (Scott-Fordsmand, 2025, p. 2).

The board is integrated with community and heritage on the macro and micro scale, while its physical form grounds the game in an organic tactility. In these ways Bao mirrors the community action and mutual governance, enacting ”the bonds to every other in a reciprocal relationship” (Kimmerer, 2013a) and custodianship, that Kimmerer, Graeber and Wengrow identify as essential for averting climate catastrophe.

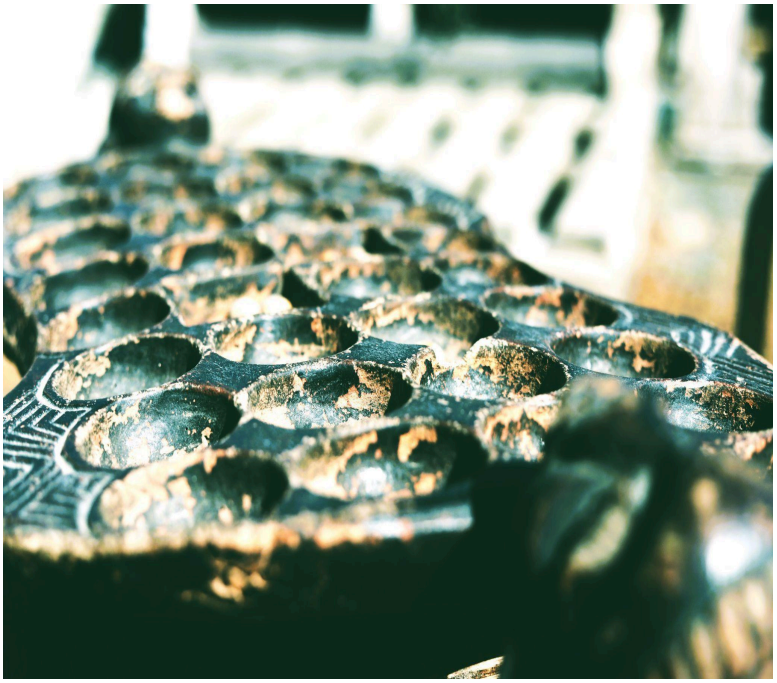

Figure 14: To be played upon (Photograph by Jack Alexandroff, 2025)

DESIGN FRAMEWORK

The eight principles below are abstracted from the preceding analysis. They interlock rather than stand alone. Some translate across digital and analogue formats; others (material ageing, communal ownership) are format-specific and require adaptation.

Cycles

Designers should focus core gameplay around generative loops that engender a feeling of growth over time.

In *Loop Hero* (2021, Four Quarters), players walk around a circuit over and over, each loop around the single path allows the player to add tiles, and strategic placement can allow them to make more loops before failing. In this way *Loop Hero* repositions the linear progress of an RPG as a looping ecosystem that, with careful custodianship, can become deeper, more complex and more alive.

Long-termism

Reward delayed gratification through systems of multiple small investments, where replayability and custodial thinking work together to build a deep relationship with a system over time.

Balatro (LocalThunk, 2024) presents an overwhelming array of synergies, but it is only through committing to a specific emphasis of play that the player begins to grasp why one card might be a better addition than another. The game signposted this quality with the “Egg” joker card. Each round it’s not sold, it gains 3$. However it takes up a valuable slot. Leveraging it at the right moment feels similar to the Nyumba, a sudden rush of liquidity filling the system.

Tactile Affordances

Reward planning while maintaining tactile pleasures. The clicking of beads and the satisfaction of small victories are as necessary as the potential for long-laid plans for the coming of Spring.

De Voogt’s account of Bao masters (1995) details a player celebrated not for his strategic genius but for his skill at throwing multiple seeds into consecutive pits; this detail highlights how important tactility is even to Bao’s greatest players.

Video games do not lack for opportunities for affordances and Juice (Jonasson and Purho, 2012). Board games are often limited by the cost of manufacture. One mitigation of this limitation might be building in roles for the player to add their own pieces.

Embodying the Non-Human and the Inanimate

Centre non-human perspectives such as landscapes or plants. *Mountain's* (O’Reilly, 2014) cultural legacy demonstrates the audience's openness to this type of messaging.

Mandate circulatory systems. Force the game to shift state over time like the seasons. *Peak* (Aggro Crab and Landfall Games, 2025) confronts the player with a new but solitary map each day, which centres on a relationship of player knowledge sharing about the topology of a slowly shifting landscape.

Flower and Eufloria represent two divergent responses to plant embodiment. Flower's poetic and Eufloria's strategic, the first is focused on an experiential beauty the second on the mechanical challenge faced by plants.

Materiality

Design for ageing; let surfaces record wear and tarnish, so the game object reveals its use over time. This will enhance the player's relationship to the object. Include ways participants can contribute materials to the game object themselves. For example: finding their own seeds to use as counters. Seeds, wood and glass feel good in the hand, they sound good when handled, and they look attractive. Acquiring one's own game pieces creates a personal narrative with how they came to be part of the game.

Material ageing in the truest sense is only possible in the physical games world. A natural extension of owning a deck of cards is appreciating its wabi-sabi ageing (Koren, 2008), documenting the many games through dog-eared cards and proving its value via the length of time it has spent in the player's possession. But precious few products are designed with their ageing in mind beyond preventing it. Public stone chess boards are often made so as to keep the black squares rough and the white squares smooth. No matter how much lichen greens and oranges their surface, the board remains legible while proudly declaring its age. The rough squares gather more lichen than the smooth ones. The difference in the relative speed both surfaces accrue lichen demarcates the black and the white squares.

Digital games might benefit from tying art to the install clock or a global timer. Showing the player how long the game has existed on their device will help it become stickier, building nostalgia associated with the passage of time. This approach contrasts with consumerist attitudes that frame ageing as an outcome to be avoided. Games like Duolingo exemplify this negative framing: the app's logo itself shifts over time to present an increasingly haggard owl mascot, only refreshed by the player re-engaging with the app, positioning age as something to be erased rather than celebrated.

Community and Heritage

Treat production and consumption as part of the same system. Recognise that players and designers exist as complementary components. Mancala shows wear as the board is played upon over and over. Games like *Risk legacy* (Daviau, 2011) mark the player's impact on the game with intention. When players can physically alter or leave traces on or in their games, they enter into a reciprocal relationship with the designer, past players and future players, placing the current player within a cycle of change.

Encourage collective ownership. This allows for meaning to accumulate over time. Games like *No Man's Sky* (Hello Games, 2016) allow for players to name animals;

these names appear in other players' games, demonstrating how shared authorship of the world reinforces a sense of community, heritage, and presence.

A meta mechanic example is Kitten Space Agency (RocketWerkz, 2025). The studio is modelling a growing business dynamic known as “pay what you want”. This is proving to be a viable way for audiences to support artists and it breaks ties with traditional models of publishing. By positioning players as supporters it could represent a new and more ethical audience/creator relationship.

Ethical Constraints

Shared but bounded resources allow for more tactical and thoughtful approaches to gameplay while echoing the reality of extraction. For an approximate example, *Age of Empires II* (Ensemble Studios, 1999) did not model forest regrowth, which led to wood depletion in competitive play. Whereas Dwarf Fortress (Bay 12 Games, 2006) populates the map with trees and then allows the same trees to self seed new ones, this leads to maps becoming dense with vegetation or becoming desert unless the player manages their extraction of wood responsibly. The ethical meaning of trees is also systematised through interactions with the race of elves sometimes present in Dwarf Fortress; they place an upper limit on the number of trees a player can “kill” each year and are offended by the player attempting to trade anything made from wood.

The morality encoded in the gameplay system has meaning; design it to balance competition with mutual flourishing. Early versions of Sim City (Maxis, 2013) attempted to model player behavior impact on the semi-local environment creating ‘locations’ for players to debate environmental policies, a small step towards this principle.

Ritual

Favor supporting personal ritualised animistic relationships.

Encouraging house rules or creating modding tools for a game. In the card game *Shithead,* (Traditional, 1980s) the winner is allowed to instantiate a new rule for that period. Modding tools provided with *Morrowind* (Bethesda Game Studios, 2002) reposition some players as designers. This empowers players to shape the world around them to view themselves and each other as valid sources of culture in dialogue with the studio system. And finally it allows for communities to build around specific modders, for communities to reflect their own values in how they themselves are represented (be those political or cultural qualities) within games they play and how they play them.

CONCLUSION

Bao fuses tactile, contextual and mechanical eco-conscious themes to create a game that enacts the physicality of organic custodianship. Its cycles of growth and repetition mirror those of the natural world. By using Graeber and Wengrow’s (2021) notion of custodianship, Scott-Fordsmand’s (2025) ethnophilosophical method and Kimmerer’s (2013a, 2013b, 2021) framework of reciprocity this thesis shows how observing global south games in their context can reveal social and philosophical

understandings absent in the global north. In conjunction with de Voogt, Zhang et al. (2023), and Ismael (2002), it is possible to abstract the forces present in Bao that have the potential to raise eco-consciousness in their players and apply them to future games.

At the same time, evidencing ethnophilosophical claims is fraught with the risk of over simplification. The design framework presented here is not exempt from this danger. I wish to emphasise that this work is in no way definitive and there is much to study.

Tracing the connection to conscientious land management present in Bao today back to its ancient prehistory origins is far outside the scope of this thesis but may prove fruitful in future research. Equally an analysis of the other hundreds of varieties of mancala could reveal new insights.

Despite these limitations, this thesis demonstrates the continuing relevance of Bao's game design. As the pressure to raise eco-consciousness globally rises, Bao offers potentially ancient tools to nurture this way of thinking. It acts as a valuable reminder that design across all fields can learn much from global south traditions.

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