# ECOSYSTEM

**Hajar Choukrani and Marcel Kuper**

Illustration by Benjamin Baharanyi

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**ABOUT THE AUTHORS**

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**ABOUT THE ILLUSTRATOR**

BENJAMIN BAHARANYI is an artist. His artistic approach is rooted in a deep appreciation of nature and its interaction with humanity. His art focuses primarily on trees, a living metaphor for current environmental challenges. Through detailed depictions of roots, bark, and leaves, Benjamin illustrates the essential symbiosis between humans and nature. His works question deforestation, encourage reforestation, and celebrate trees as a source of life.

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**An ecosystem includes all living things, such as humans, plants, animals, and microorganisms, along with the non-living parts of their environment that they interact with. This interaction between living and non-living components is what forms an ecosystem. The ecosystem approach refers to studying how these parts are connected and work together as an integrated system. It can be applied to understanding ecosystems of any size, whether at the planetary, regional, or local level. Adopting an ecosystem approach is considered a way to manage natural resources sustainably for the future.**

## Concept

Diverse groups—researchers, educators, citizens, Indigenous communities, institutions, and even children—each have their own ways of thinking about, describing, and interacting with and within ecosystems. Differences in perspective can sometimes lead to misunderstandings and conflicts. This contribution explores different definitions of ecosystems and the ecosystem approach, drawing attention to associated controversies and challenges, and its connections to climate change and natural resource governance.

The *ecosystem* as a concept has evolved and faced backlash since its initial conception in the early twentieth century within the field of ecology (Golley, 1991; O'Neill, 2001). Initial definitions

1 This text has been edited for language and clarity using OpenAI's ChatGPT. All original ideas, research, and interpretations are the sole contributions of the authors.

focused on the interconnections between organisms. Later, conceptions expanded to include ideas such as the *ecosystem approach*, *ecosystem services,* and *ecosystem-based management*. These new associated concepts highlighted an increasing recognition of the multifaceted nature of ecosystems.

The concept first emerged in 1935 when Tansley defined an ecosystem as a fundamental unit of ecology, involving all the interactions between living organisms—such as humans, plants, animals, and microorganisms—and their physical environment, including water, soil, and air (Barrow, 2006; Chapin et al., 2011).

Interactions in an ecosystem imply that when one element (A) affects another (B), B in turn affects A. This cycle of actions and reactions makes it difficult to target a specific part of the ecosystem, as intervening in one area inevitably alters the entire interconnected system. By recognizing that ecosystems are defined by intricate multidirectional interactions and interdependencies, this implies that optimizing any single role cannot occur in isolation.

One major challenge in studying ecosystems is determining their size and boundaries. Ecosystems exist on various scales, from small to large, making it difficult to precisely identify where one ecosystem ends and another begins, or how various ecosystems overlap and interconnect (Chapin et al., 2011).

Now how do these debates relate to the *ecosystem approach*? An ecosystem approach encompasses both a methodology and a mindset, facilitating a comprehensive understanding of complex challenges and their consequences (Barrow, 2006). It examines the interactions among living organisms and their non-living environment, viewing them as interconnected and interdependent systems (Bocking, 1994). Applied across all scales—globally, regionally, and locally—the ecosystem approach attaches particular importance to environmental pressures in a context of rising population pressure and widespread ecological changes (Chapin et al., 2011). The holistic and interdisciplinary

nature of the ecosystem approach requires collaboration across and interaction between exact and social sciences.

The ecosystem approach also analyses ecosystems' benefits, known as *ecosystem services*. These services are categorized into provisioning services (e.g., food, fiber, and water); regulating services (e.g., climate regulation, water quality, and disease control); and cultural services (e.g., recreational, aesthetic, and spiritual experiences) (Millennium Ecosystem Assessment, 2005).

Some experts criticize the *ecosystem services* concept, arguing that it often frames nature as a collection of resources, valued primarily for economic benefit. According to the critics, such perspective risks oversimplifying the intricate connections within ecosystems and prioritizing short-term human needs over long-term sustainability. Additionally, economic assessments often fail to capture the cultural and spiritual value of ecosystems for traditional communities. Recognizing Indigenous rights to maintain healthy ecosystems, for example, highlights the importance to respect non-material interconnections alongside tangible benefits (Kull et al., 2015).

**Conflicts are not merely obstacles but an integral dynamic of the social fabric of ecosystem management.**

Since the mid twentieth century, many ecosystems have been seriously damaged worldwide. Human activities have significantly altered the Earth's surface and disrupted the natural cycles, leading to substantial environmental and climatic impacts. Human actions have altered the functioning of ecosystems, including freshwater and marine environments. For example, alterations in land use—such as the conversion of forests into farmland (intensive agriculture) or urban areas (urbanization)—have been major drivers in the extinction of species and in biodiversity loss. These shifts in land use have reduced the capacity of natural areas, such as watersheds, to purify water. This has in turn reduced the accessibility of drinkable water.

Similarly, the destruction of wetlands has increased communities' vulnerability to floods and storms (Hemba et al., 2020; Sutton-Grier & Sandifer, 2019).

In recent years, literature increasingly refers to the necessity of effective *ecosystem management* (Finlayson et al., 2017, 2019; Munguía & Heinen, 2021) , presented as a holistic approach that integrates social and environmental factors to achieve sustainability. The literature highlights how management frameworks should move beyond treating ecosystems primarily as bio-geophysical providers, and instead acknowledge the complex social, cultural, and political landscapes involved (Heilig, 1997). Key actors in ecosystem management face conflicting stakeholder priorities, and navigate in the context of power imbalances, regulatory constraints, and financial limitations. The literature points to how conflicts are not merely obstacles but an integral dynamic of the social fabric of ecosystem management (Maczka et al., 2021). Traditional top-down management strategies often fail to address these conflicts because they tend to overlook the complex social dynamics at play.

**While participatory approaches are often promoted as essential for managing resources sustainably, they can sometimes mask deeper inequalities.**

In addition, climate change is reshaping ecosystems at an unprecedented rate, altering weather patterns, biodiversity, and resource availability. Navigating these challenges requires an inclusive approach that integrates diverse priorities and values of all stakeholders—local communities, policymakers, scientists, and industry leaders. This explains the necessity of participatory methods where stakeholders are actively engaged in decision-making processes. By directly involving stakeholders in decision-making, participation fosters engagement and promotes a deeper understanding of others' interests (Schroeter et al., 2016). Such inclusive governance is essential for sustainable resource management, as it ensures that all voices are heard

and that the strategies implemented are resilient in the face of both current and future challenges.

However, while participatory approaches are often promoted as essential for managing resources sustainably, they can sometimes mask deeper inequalities (Cornish et al., 2023). Not everyone involved has equal access, influence, or power, which can affect the outcomes. Recognizing these imbalances is crucial to come to equitable strategies that can robustly face climate challenges. Deciding who to include, when and how to involve them adds layers of complexity to the process, making it a challenging yet necessary step toward meaningful participation.

## Case Study

The Gharb plain in northwestern Morocco is home to temporary wetlands known as *merjas*, which have agricultural, cultural, and ecological relevance. Various stakeholders - including local communities, agricultural institutions, and hydraulic organizations – have different opinions on what matters most. The merjas ecosystem faces challenges such as competing land-use demands, and differing priorities among stakeholders. This divergence in stakeholder perspectives highlights the multifunctionality of *merjas* and underscores the challenge of balancing ecological conservation with socio-economic development (Choukrani, Lacombe, et al., 2023).

Historically, the *merjas* were referred to as natural ecosystems, or marshlands, characterized by rich biodiversity and semi-aquatic environments (Célérier, 1922; Le Coz, 1964; Sauvage, 1959). In the 1960s, merjas were recognized for their role as buffer zones, capable of temporarily storing floodwaters from direct rainfall or overflowing rivers and streams (Choukrani, Kuper, et al., 2023; Choukrani, Lacombe, et al., 2023). Already back then, this ecological function underscored the importance of these zones in mitigating environmental challenges and enhancing the region's resilience to hydrological extremes. Moreover, merjas were home to aquatic groups of buttercup plants, along with

reeds and rushes. Local populations used the reeds and rushes for practical purposes, such as constructing homes or making mats (Le Coz, 1964).

However, the early 1900s marked the beginning of a significant shift in perception, transforming “wetlands” into “drylands”. The implementation of drainage networks transformed the *merjas* from natural ecosystems into land designated for drainage (Le Coz, 1964). On the one hand, these drainage projects - aimed at drying out the *merjas* - led to the degradation and disappearance of much of the biodiversity that once thrived there. On the other hand, the *merjas* zones were integrated into space oriented to agricultural self-sufficiency for food security and export.

With changing perceptions in land-use practices, the *merjas* case has become emblematic of the tension between conservation and development objectives. Certain stakeholders, particularly agricultural and hydraulic institutions, emphasize the wetlands’ value as water buffer zones. This perspective is rooted in an ecological consideration of *merjas’* capacity to regulate water flows and mitigate flooding risks, thereby protecting agricultural lands (within the state-managed irrigation perimeters), and urban infrastructure.

However, most local communities view the *merjas* through a different lens, seeing them as integral components of an agricultural and cultural ecosystem (Choukrani, Kuper, et al., 2023). To these communities, the *merjas* represent not only a source of agricultural productivity but also a reservoir of cultural heritage and identity. The natural seasonal drying of wetlands facilitates pastoralism and off-season cultivation, practices that are deeply embedded in the socio-economic fabric of the local communities. This duality of *merjas*—as productive lands and bearers of cultural identity—emphasizes the intricate relationship between humans and their environment, highlighting the depth and complexity of human-environment interactions in the Gharb plain.

Due to the interconnected nature of ecosystems and conflicting interests between stakeholders, the focus on a single stakeholder's perspective would likely compromise essential services valued by different stakeholders.

This brings along significant challenges in ecosystem management. Let us explain this with an example. A 1956 decree established a framework for transferring *merja* lands to the private domain of the state, allowing for partial redistribution to farmers and local communities. However, by that time, in the Sidi Ameur *merja*, parts of the land had already been distributed informally to local communities. Clashing interests and contradictory claims – in absence of official documentation specifying the legal status of their lands – resulted in ongoing uncertainty over land tenure. This has become a significant obstacle in balancing ecological preservation, agricultural productivity, and social equity within these landscapes. The lack of clarity in land access and ownership, combined with disputes over land use and rights, has led to persistent conflicts among farmers, local communities, and state authorities (Choukrani, Imache, et al., 2023).

**When elaborating effective ecosystem management, a single focus on these technical aspects is problematic.**

Moreover, there are often also technical aspects to consider. In managing the sustainable use of *merjas*, it is crucial to understand the intricate network of interactions within these ecosystems and their surrounding environments. This includes assessing the hydraulic connections of *merjas* with streams, irrigation and drainage systems, and aquifers. But it also requires evaluating their proximity to farms and urban centers, which presents both economic opportunities and pollution risks.

However, when elaborating effective ecosystem management, a single focus on these technical aspects is problematic. Instead, a balanced approach that thoughtfully integrates economic,

social, and ecological considerations, is the best path towards preserving the integrity and diversity of these natural systems across various temporal and spatial scales (Chapin et al., 2011). Rather than focusing solely on technical solutions or cost-saving measures, it is essential to adopt an approach that considers the needs of all stakeholders, with particular attention to marginalized groups.

Managing *merjas*, therefore, demands a holistic perspective that recognizes their multifaceted functions—ranging from flood regulation and biodiversity support to agricultural productivity and cultural heritage. This approach involves participatory processes that prioritize diverse stakeholder perspectives, fostering dialogues that bridge the gap between ecological conservation and socio-economic development (Choukrani, Imache, et al., 2023). Through inclusive dialogues, a shared vision for the sustainable management of *merjas* can be cultivated—one that respects and integrates their ecological, agricultural, and cultural dimensions.

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