

Applying the ecosystem approach to global bioethics: building on the Leopold legacy

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ABSTRACT

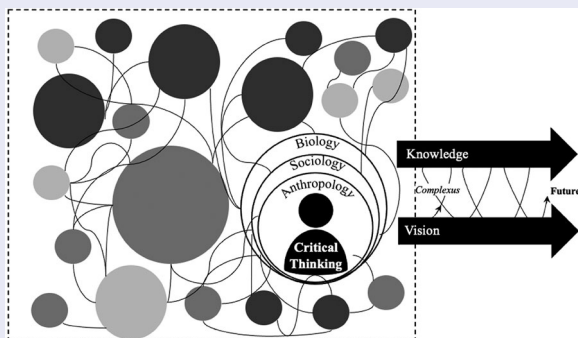
For Van Rensselaer Potter (1911–2001), Global Bio-Ethics is about building on the legacy of Aldo Leopold (1887–1948), one of the most notable forest managers of the twentieth century who brought to light the importance of pragmatism in the sciences and showed us a new way to proceed with environmental ethics. Following Richard Huxtable and Jonathan Ives’s methodological ‘Framework for Empirical Bioethics Research Projects’ called ‘Mapping, framing, shaping,’ published in *BMC Medicine Ethics* (2019)), we propose operationalizing a framework for Global Bio-Ethics by hybridizing approaches in empirical bioethics and ecosystem management. We explain this framework using the metaphor of forest management. This mixed approach is articulated through three phases: (1) mapping the “landscape” to build a working theory, (2) framing the “scene” to prepare the fieldwork, and (3) shaping bioethics “tools” to stimulate cooperation. Applying this methodology, an adaptive management cycle is outlined to help ensure that political processes are sustainable and socially acceptable, still based on strategic and ethical thinking, but also capable of reshaping failing policies.




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To flesh out the metaphor [Terrain and Landscape], we have a sense of where we are, and we have sense of what we want to do with the land (in the form of questions or issues we wish to explore) – but before we can landscape the terrain in front of us, we need to know what it is we have to work with. Are there hidden boulders? What kind of soil is there? Are there areas too dense and impenetrable to be worth attempting to shape? Are there natural lines that we can build into our design or do we have to excavate the lot and re-build from scratch? (Huxtable & Ives, 2019, p. 2)

Introduction

The debate about integrating various sciences, policies, and social values is gaining strength in Sociology¹, and this has direct implications for Bioethics in the twenty-first century. One major bioethics challenge is to integrate health, human activity, and biodiversity.² An evident way forward is to dive into Van Rensselaer Potter's (1911–2001) work, specifically his *Global Bio-Ethics* (1988).³ In *Building on the [Aldo] Leopold Legacy* (1887–1948), Potter (1988) introduces a complex and dynamic view of bioethics as bridging humanity and the environment. This globality is not solely analytic but normatively action-oriented.⁴ At its heart is the connection of Science and Society (Boudreau LeBlanc, Aenishaenslin, et al., 2022). A notable strength of bioethics is anchored in its interdisciplinarity, its applied focus, and its attention to mediation in practice (Rhodes & Ostertag, 2022; Wilson, 2014); that is, bioethics has the ability to engage in knowledge production and translation that accelerates advances in both Science (*a fortiori* research) and Society (including policy, technology, practice, and so on).⁵ However, shifting from a theoretical model of knowledge translation⁶ to a technique requires specific attention, *a fortiori*, to communication and innovation governance, and by extension, to the need for analytical and decision tools (Mermet, 2019). “Translation” goes beyond mediating stakeholder interests – it involves negotiating means, meanings, justifications, and cultures. “Translators” build values to generate a sense of future actions encompassing the *singular* but also moving towards a *collective* view. And this is where we need to involve bioethicists.

Drawing upon a Potterian Bio-Ethics (Boudreau LeBlanc, Aenishaenslin, et al., 2022; Potter, 1988), this article aims to conceptualize a methodological framework for an ecosystem(ic) bioethics⁷ that integrates approaches in empirical bioethics and ecosystem management. This opens up several debates in bioethics about the nature of its methodology, including its *Standard of Methodological Rigor in Research* (Adler & Zlotnik Shaul, 2012), the room for *Life Sciences in Empirical Bioethics Methodologies* (Mertz & Schildmann, 2018), and the urgent need (we would argue) for rigorous *Methods of Reflexive Balancing* to lead toward *Pragmatic, Interdisciplinary and Reflexive Bioethics* (Ives, 2014). Starting with the reflexive methodology of Jonathan Ives (Munthe et al., 2019; Samuel et al., 2019), we scale up the thinking to the social process (Boudreau LeBlanc et al., *In Press*). Following Huxtable and Ives's (2019) explanation using the forest management metaphor, two questions drive this theoretical study:

How to operationalize global bioethics in mobilizing “knowledge of how to use knowledge”? (see Potter, 1971, p. 1)

How do we acknowledge that “ethical values cannot be separated from biological facts”? (Potter, 1971, p. 1; Potter, 1988, p. vii)

Ultimately, we propose a three-phase model in which organizational problems are iteratively remapped and reframed to reshape failing policies.

Theoretical premisses

In Global Bioethics, the number of scholars studying medical care from a broader biological perspective is increasing. Most remind us of the Potterian perspective (Chaffee, 2017; Lecaros, 2013; Lee, 2017; Miller, 2018; Morar & Skorburg, 2016), which set the foundation for a philosophy integrating the medical and environmental dimensions as two sides of the same coin, whether for public health, clinical care, or landscape management.⁸ Over the years, the Potterian perspective has been criticized for its appearance but not its substance, i.e. often reduced to a “strong naturalism” (Racine, 2008).⁹ The *Bios* means biology in its broadest sense. Potter, an evolutionary biochemist and professor of oncology at the McArdle Laboratory for Cancer Research at the University of Wisconsin–Madison, associated this *Bios* with the philosophy and biography of Leopold, a notable forester of the twentieth century and professor of wildlife management in the Agricultural Economics Department at the University of Wisconsin.¹⁰ Henceforth, bioethics is not framed as a purely academic enterprise, but as an action – that is, an “applied ethics”. Following the Leopoldian logic articulated in *The Land Ethics*, *Ethical Sequence*, and a *Biotic Community* (Leopold, 1949), bioethics is an ethics of being and acting in the “Bios”.

Here, we focus on the influence on bioethics of the philosophy of science and complexity thinking.¹¹ In reframing Global Bioethics (into a “Global Bio-Ethics”), we explore a new area to operationalizing bioethics – methodologically, politically, and administratively. Samuel et al. (2022) have, for example, highlighted the ethics organizational space (or “ecosystem”) in analyzing issues emerging in biobanking. Using the case of social media research, Samuel et al. (2019) described a sociological methodology for bridging an *Ethics Ecosystem* (macro) to a personal ethics (micro) with governance networks involving multiple regulating scales and actors. Whitehouse and Whitehouse (2020) advance the perspective of Beaver and Whitehouse (2017) on *If, How and When* the Potterian bridging “Bio” and “Ethics” view can join proactively the socio-political debate surrounding the integration of human activities, ecology, and values (Boudreau LeBlanc, Aenishaenslin, et al., 2022) to take responsibility in the face of the emerging Anthropocene. The case of antimicrobial use – which will follow us throughout this article – is an example of the complexity of becoming accountable for human activity and environmental retroactivity (Beaver & Morar, 2019; Morar, 2019; Munthe, 2019; Munthe et al., 2019).

Ecosystem-based management requires conceptual and terminological translations before transferring it into applications to the social context. Indeed, the advancement of the ecosystem approaches under the umbrella of Sustainability contributes to the transfer of learnings between health and environment applications (Charron, 2014). However, sustainability must constantly reshape the vision of the future, or what Potter calls “cultural adaptation”: the future must be livable, acceptable, and always aim for “better”. Potter’s criticism reminds us that people and communities play a role in defining the meaning of “sustainability”. A more recent explanation of sustainability translates it into a place for consensus: “adaptive co-management by communities to

support the resilience of social-ecological systems” (Olsson et al., 2004). The concept of “socio-system”, “human ecosystem” or “autecology” links to Leopold’s “biotic community” (1949), i.e. a complex assemblage of beings (biotic) nested in an open context (Land) within which sets of things (abios), artifacts, and ideas (social) interact.¹² Adding the “ecosystem” to the community means that the *bios* (the organism) and the *abios* (chemistry) deeply interact. And adding the “collective” to the community involves nesting a socio-cognitive disposition to multi-specific, multi-factorial, multi-scale (Levin, 1992) and multi-dimensional (Pickett & Cadenasso, 2002) biological assemblages. The *actors* in the community are numerous and diverse, including humans (rational beings) and other animals, plants, fungi and microorganisms, as well as technical, social, economic and political systems. Thus, actors are sensitive beings, things, processes, and phenomena – each in dynamic and complex interaction with each other.

The methodological framework

The goal – teleology

The goal here is to reconcile short- and long-term perspectives and responsibility-taking. The intention is to outline the approach proposed by Boudreau LeBlanc (2023b), which is at the intersection of Potter and Leopold’s works. The approach has the potential to guide policy strategies ethically, that is, mobilizing power to influence change while avoiding past mistakes, injustices, and other forms of bias. We must abandon linear thinking, which confines actors to independent realms of competencies. Instead, we ought to shift to systems thinking, respect areas of competencies, and manage the “landscape” of shared responsibilities. For instance, antimicrobial governance must bridge the source (antimicrobial use, *a fortiori* a medical technic) and its stochastic feedback (antimicrobial resistance, which involves basic sciences, *a fortiori* Ecology & Evolution). But those two realms (source and feedback) are distributed in different circles of practical professions, political departments, and academic faculties.

Consequently, case design in bioethics should foster knowledge translation to learn and progress (Hull, 2009). Let’s call this the adaptive management cycle (AMC) of the “landscape of shared responsibility” (Boudreau LeBlanc, 2023a). However, AMC requires an ethics to “govern” its transition phases – all changes are not necessarily desirable (short-term), even if advised by a wise and well-trained bioethicist. We instead suggest having an ethics-methodological framework that focuses on the environment of responsible conduct and innovation in project management (the long-term, Boudreau LeBlanc, 2023a): the *Ecosystem of Bioethics* (a nod to Beever and Whitehouse, 2017). Mobilizing techniques in change theories (Reinholz & Andrews, 2020), we pursue the *Mapping*, *Framing* and *Shaping* of Huxtable and Ives (2019):

- (1) *Mapping* the bioethics “landscape” to build a working theory of change (Boudreau LeBlanc, Aenishaenslin, et al., 2022);
- (2) *Framing* the bioethics “scene” to prepare the fieldwork for ethical change (Boudreau LeBlanc, Williams-Jones, et al., 2022);
- (3) *Shaping* the bioethics “tools” to cooperate toward changes (Boudreau LeBlanc & Williams-Jones, 2023).

Adding to Research & Development project management (technical R&D), **Figure 1** proposes the Reflexive & Deliberative iteration (i.e. ethical R&D) (Boudreau LeBlanc, Williams-Jones, et al., 2022). Transition phases must perform this prospective bioethics, be reflexive, and become a driving force (**Figure 1**'s *Iteration Loop*) to shift knowledge from recommendations to policy (for methodological insights, see Boudreau LeBlanc, Williams-Jones, et al. 2022) that set a desirable view for “a livable third millennium” (Potter & Whitehouse, 1998). To achieve this goal, bioethics must prioritize norms, reframe values, and reshape technical standards and moral standings. Consequently, bioethics moves beyond the strict (anthropo) *centrism* of individual care and human rights, which is indeed needed – for instance, using antimicrobials is a short-term imperative in healthcare and agriculture. However, we call for a complementary (reflexive balancing) *ecocentric* bioethics that integrates the context (*eco-* in its broader sense) – for instance, antimicrobial resistance prevention is a long-term imperative involving ecologically-based actions, such as preventing the situation of biodiversity loss (Morar, 2019). Then, this *reflexive balancing* (Ives, 2014) shifts bioethics from strict axiological (values) to epistemological (facts) analysis: *Which perspective or statement is true or false? What value criteria should drive our decision?*

Starting point – epistemology

Ives (2014), Ives and Draper (2009), Huxtable and Ives (2019) propose a “pragmatic, interdisciplinary, and reflexive” approach to empirical bioethics research projects (**Figure 2**). This method proceeds through a “reflexive balancing” (Ives, 2014). But unlike similar initiatives popularized in policy and qualitative research, Ives’ (2014) approach aims to avoid the naturalistic fallacy. Reflexivity is subject to bias, prejudice and sophism, and in particular the naturalistic fallacy that emerges from an overvaluation of the pertinence of theoretical (scholastic) knowledge in contrast to the human and natural experience. For example, a frequently encountered naturalistic fallacy case is the proposal of a means to be systematized – as the change of practice (e.g. reduction of antibiotic use) – based on “natural” scientific claims (the Laboratory 1 & 2 in **Figure 2**) to justify political goals and actions (see the space for an *in situ* experimentalism). However, the long-term end should not be (strictly) about this naturalistic perspective but also based on a more profound ethical value: the “ought to be” instead of a “has been” or a “predict to be”. For example, the goal could be to improve care and mitigate the risk of antimicrobial resistance, which could serve both health and environmental values. Consequently, the purpose should not strictly focus on the short-term antimicrobial performance applied on a targeted pathogen species, because these substances cause a selective pressure that produces broader consequences and long-term uncertainties.

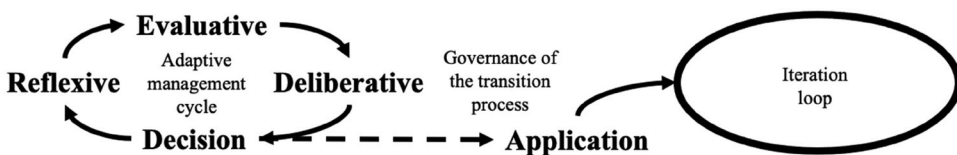


Figure 1. Bioethics R&D to advance a prospective adaptive transition.

The logic proposed by Ives is to map those deep values in light of facts so as to ensure that we do not create other problems through our actions, such as deterioration in the quality of care and increase in disease transmission (in both animals and humans) by overly reducing antimicrobial use (AMU). This is a genuine concern for farms (and hospitals) with low production and financial returns, and no other AMU-reduced options for ensuring the health of their animals (and humans). Deeper ethical values are about responsibility, i.e. duty and accountability, and deeper (basic) scientific facts, about biological understanding (Boudreau LeBlanc et al., 2023).

Huxtable and Ives explains the mapping exercise as a literature review and the identification of conceptual gaps in current models and theories.

In a research project, led by their research questions, the researcher(s) will seek to understand the “state of the art” and identify what is (not) known, specify gaps in the literature, identify further questions, and identify existing proposals for addressing such questions. This phase should enable the researcher(s) to work out what further work is now needed and (if needs be) hone their research questions and intended approach accordingly. (Huxtable and Ives 2019, p. 2)

However, mapping is not just about review but also about synthesis and constructive criticism. In practice, it means involving a collective (e.g. several laboratories) before engaging in project management – better than a synthesis, we should involve those who make these and engage them in meta-synthesis. (Boudreau LeBlanc, Williams-Jones, et al., 2022) Once the vision of the research project (the Mapping) is established, it is necessary to *frame* the range of possible operational pathways with the

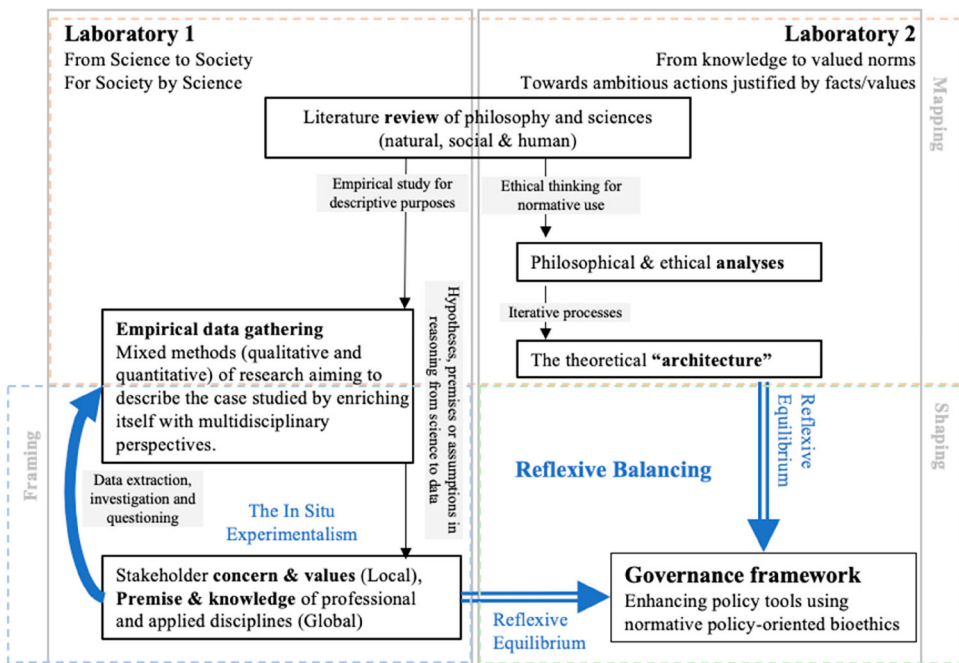


Figure 2. A reflexive, interdisciplinary, and pragmatic bioethics. Adapted from the work of Ives and Draper (2009, p. 257).³³

scientific community and amongst stakeholders (Boudreau LeBlanc, Williams-Jones, et al., 2022). To operate those pathways, we need a reflexive governance based on a broader ethics (Hull, 2009).

Thus, reflexive balancing requires bioethicists to work within multidisciplinary teams whose members contribute to setting the phases of *mapping*, *framing*, and *shaping*. To overcome reflexive naturalistic fallacies, bioethicists must engage in both local (inter-personal) and social (inter-institutional) dialogue, but in an organic manner that distributes investigations on the quality of the input, output and reasoning. Draper and Ives (2009) build from a passive *Reflective equilibrium* to a more proactive rational analysis. It is “proactive” because reflexive balancing not only deals with ethical dilemmas, it also builds a socio-intellectual “architecture” to orient the management of the situation under study, which then allows the techniques to co-evolve with the case (Boudreau LeBlanc, 2023a). Balancing the *ethical reasoning / context* in teams and community is the starting point to overcome ethical recommendation passivity and the risk of biases, prejudices, and sophisms.

Ethical norms derive neither from reason nor from biological observation and experience but rather from the interaction between ethical reasoning and context, as in the method of reflective equilibrium. Hence, ethical norms are not biological laws, but rules created by human social activity. (Racine, 2008, p. 100)

Empirical bioethics must be *embodied* in a lived (*in situ*) experience for several reasons, notably transparency, accountability, and leadership. But *How do bioethicists become self-responsible while advising other stakeholders on responsibility?* (Cribb, 2020; Hedgecoe, 2010; Turner, 2009) The answer, we suggest, is by creating an AMC of the “landscape of shared responsibility”:

$$\frac{\text{Facts}}{\text{Values}} + \frac{\text{Experiences}}{\text{Learning}}$$

In methodological jargon, this means complexity instead of linearity (Boudreau LeBlanc et al., 2023). We need to reframe our very logic to advance practices and change theories (Reinholz & Andrews, 2020). These ground rules refer to a collective bioethics that frames the values of a collective of actors regarding the (biotic) community’s limits, resources, power, and so on. The aim is to plan the shaping of the social assemblage with a deep awareness of the context, thereby enabling the required comprehensive transparency and progression.

The framework

An ecosystemic bioethical approach expands *mapping* to proactive syntheses in Ives’ (2014) framework. Mapping is not only about reviewing; it is about landscape annotations – such as topography and toponomy, or even details about the *land*, past and futur (Boudreau LeBlanc et al., *In Press*). It is about encoding and translating ethics into a toolbox for practice. Thus, it goes beyond autonomy, human rights, and property over labor, lands, things, beings or concepts (e.g. intellectual property). Instead, it embraces the Potterian perspective of responsibility, human duty, and accountability towards the environment shaping.¹³ This ethics paradigm shifts the perspective from the singular to the collective.¹⁴

Operationalizing this shift makes sense if we consider this more comprehensive understanding and use of *synthesis*.

The concept of “ecosystemic” values builds on the epistemology of a reflexive, interdisciplinary and pragmatic bioethics to overcome the naturalistic fallacy, but emphasizes the importance of raising awareness about the context.¹⁵ Syntheses become the cornerstone. For instance, a geographer who uses the Earth map as a tool (a synthesis) has a general vision of the globe (a global thinking) without burdening local actions with the complex logistics and high financial cost of the genesis of this large-scale synthesis. Indeed, individual geographers do not map the Earth before their fieldwork; they rely on the results of previous collective work (Boudreau LeBlanc et al., *In Press*). Ecosystemic approaches operationalize the “global” by bringing a local project management process closer to synthetic tools. Global thinking helps managers constructively criticize their practices, assumptions and functioning. Anchored in collective works (e.g. our geographers), ecosystemic approaches require integrating the different viewpoints (the “system”) of the experts in practice (analogue to the topography, toponymy and other annotations), including managers in charge (e.g. the shift towards responsibility) and the community in action (recognizing the need for respect).

The “collective” and “community” are the cornerstone of this approach. It gives a practical meaning to the system, which has to bridge the singular to the context. Unfortunately, norms and standards do not integrate well in the real world to inform the policy-shaping process.¹⁶ Yet, Potter’s bioethics could live up to the practical needs of these policy-making dynamics. Potterian bioethics is not about one confined collective (see [Figure 3](#)’s three laboratories) that would have the burden of virtuous leadership. Instead, Potter proposes a dialogical system of collectives (micro-actor) bouncing back and forth between each other (meso-network) and, as a (macro) system, bouncing collectively off changes in the same context (macro-habitat, eco). [Figure 3](#) builds on Ives’ (2014) framework but draws on the principle-based philosophy of sustainability proposed by Norton (2005):

- (1) *Experimentalism*, as a principle of critical reflexivity to assess and reduce uncertainty;
- (2) *Localism*, as a principle of comprehensive sensitivity to assess and measure reality;
- (3) *Multiscale analysis*, as a principle of extensive investigation in search of critical mechanisms and phenomena.

The approach is about *shaping* the bioethics ecosystem that ties collectives into a social constructive dialogue; but it is definitely not about “shaping” one physical or moral (e.g. enterprise) person. In short, it is about planning and setting the scene between laboratories and the World ([Figure 3](#), see Boudreau LeBlanc, 2023a). The critical asset is synthesis (e.g. our example of the Earth map): complexity is handled gradually through layers of frameworks. Indeed, Earth geography is gaining precision with time, consequent to local scientific and humanities knowledge. Nobody expects a geographer working for a city to travel the world every time a building site survey is carried out. These syntheses could emerge in an Agreement of Principles or Worldwide Declaration, only if we shift our attention from the points of form (briefly) stated to their underlying justification. A useful Agreement or Declaration would appear as a navigational map that shows the mechanisms

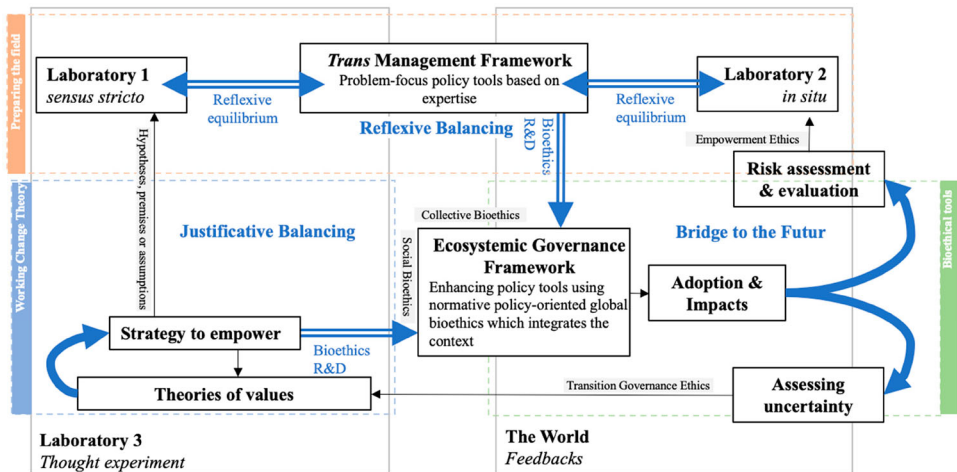


Figure 3. Methodology of an ecosystem bio-ethics.

describing the context behind these agreed to and declared Principles. The map should describe the functioning “layers” of this contextual (physical, political, cultural, and so on) organization that set the initial condition and will for change. In practice, this justification system must describe the worldview (e.g. from the United Nations standpoint¹⁷) down to daily life and community examples, concerns, and values – from Google Earth to the more participative start-up of Maps.me or Waze. After that, normative options and strategic mechanisms can be deliberated per organizational scale¹⁸ to manage functioning contextual problems (Boudreau LeBlanc et al., *In Press*). When theories are translated into practical tools, *synthesis* becomes useful – as maps and a compass – for unraveling complex ethical issues.¹⁹ Those issues emerge from the dynamic value systems and the complex management process of sharing responsibilities among various stakeholders.

Scaling to **Figure 3** necessitates changing the focus of empirical bioethics research from *centrism* to systems thinking. This means shifting the urge to solve a particular health infectious disease or a specific biodiversity loss to the context of its human (social, economic, managerial, etc.) assemblage.²⁰ Indeed, *what is framing the systems?* And *which framing could best allocate the common resources for sustaining this complex-problem solving?* Thus, the upcoming bioethics agenda and bioethicists’ object of study should no longer be biological research, practices and institutions. This field of research and practice needs to take on the role of global bio-ethics and move from criticisms of biological technologies and knowledge application (in health, agriculture, engineering, etc.) to the broader interface between Science (discovery and innovation) and policies (norms, standards, regulations, incentives, etc.) in Society (values, orientations, goals, etc.). In practice, this means studying the concept and operationalization of responsibility in action by adopting an adaptive research process. In short, the *Mapping-Framing-Shaping* adaptive cycle enables an examination of the power dynamics at the organizational scale and can then, both in situ and in practice, help empower communities in documenting, identifying, and improving their governance policies.

Toward a global thinking in practice

The Ecosystem Bio-Ethics continues the metaphor deployed by Huxtable and Ives (2019). Forest landscape management recalls Potter's (1988) metaphor comparing bioethics to land use planning, mainly through the Leopoldian lens. Leopold's philosophy radically transformed how we enact sciences, techniques, and ethics in the environmental fields of study. This framework contribution guides the authorities in charge of (techno)social initiatives to empower their in situ position as critical actors (Boudreau LeBlanc, 2023a). At first glance, Leopold's involvement in the U.S. Forest Service inspired wildlife management, as he advanced the basics of forest epidemiology in applied ecology and within public agencies. Under the "Leopold Legacy" (Potter, 1988), the treatment of forests for insect outbreaks, fire, and herbivory becomes an AMC effort instead of "surgical" interventions decontextualized from complex forest dynamics.

Viewed through a deeper analytical lens, the Leopold legacy is also inspiring for the broader field of management (Meadows, 2009), which applies to both medicine and ecology. Health care services must act on two fronts: (1) the intervention and (2) the environment contextualizing the intervention, for instance, in physician antibiotic use, industrial pharmaceutical production, political planning of resource allocation, administrative arbitration of data access and protection for biomonitoring and wildlife surveys. Medicine (or any other human practice) must contextualize its interventions at the patient, population, and community levels, and even beyond, as a local milieu (e.g. Québec city) interacts with others, in the broader landscape of Canada (Lee, 2017). This is Leopold's great contribution to the ecosystem approach, which, applied to wildlife management, involves intervening in a forest with an awareness of the broader consequences foreseeable from the knowledge of ecological succession, biogeochemical cycles, trophic cascades and so on.

Yet, the challenge is not acknowledging the importance of Global Thinking (remember the Earth map), but explaining *How to bring it down in situ?* (Law & Urry, 2004, remember the geographers' collaborative works). Methodologically, the challenge is to mobilize actors in a collective whose singular actions are nested in a context that is out of their control (Law & Urry, 2004). This multidimensional context is full of resources and uncertainties (Funtowicz & Ravetz, 2008), including disciplinary background, academic affiliation, public relationships, etc., which opens a whole new "landscape" to "Sketch here and there" (a nod to Leopold). To deal with these uncertainties, we need (1) knowledge, (2) norms, and (3) values. But the missing link is not in those three structuring elements (Norton, 2008).

Leopold's philosophy is similar to Rawls' *Theory of Justice as Fairness*. Both base their approaches on cooperation (or *co-operation*). Norman Daniels, who advances the idea of the *Reflective equilibrium* and *fair procedure* with Daniels and Sabin (2003), also has similarities with the Potterian *vivid* process of enacting knowledge transfer (between ideas, reality, and action). In sum, these approaches can be complementary, informing each other to improve their rationale (e.g. values, methods, and ontology). For example, Upshur's (2008) synthesis of Daniels' (1985) *Just Health Care* highlights three vital elements to construct an ethical justification: health, health care, and healthy state of life. Similarly, Leopold outlines Land Health, adaptive land use, and the "ethical sequence" of biotic communities.²¹

Phase 1: mapping the “landscape” of theories

The “field” (a metaphor) within which research projects grow, evolve or disappear refers to *Where* the study is conducted from a *Landscape* multidimensional perspective.

To build the metaphor, we are looking in-depth from multiple different angles to identify hidden tracks, perils, dips, rock formations or ravines that were not visible to us during the mapping stage but will affect what we are able to do with the land. Some of these may prove to be avoidable, some may be removable, and some may be fixed features of the landscape that we have no option but to accept and design around. Here, more finely-grained perspectival information is gathered – essentially from experienced travelers who have already traversed the terrain – which (again) might shed light on what is (not) known, reveal further questions, and/or indicate possible ways forward. (Huxtable & Ives, 2019, p. 3)

Mapping involves actions upstream of the terrain preparation, such as immersive fieldwork to raise awareness of the upcoming operation of the projects.²² In relation to the field, we need good “walking boots” and instruments to “observe the landscape” and “circulate on the territory”, including a “map” and a “compass”. This map requires the (upstream) work of “cartography” to visualize and produce a rigorous and integrated conception of the terrain properties (remember geographers). Maps “frame” the field boundaries through sketching (e.g. topography), making it easier to design the work (e.g. logging). But those sketches should be knowledge-based (e.g. ecology). For example, water system knowledge should precede road map planning to avoid unnecessary infrastructure construction and flooding. This reverse natural fallacy is imperative for human culture and policy, as knowledge brings insights to daily conversations about the causes and consequences of long-term cascading phenomena.²³

These knowledge mappings are often reduced to a strategic plan for enterprises initiating *n* operations. Indeed, *shaping* a plan, a social assemblage, even disciplinary knowledge on how to improve resource allocation, recruit allies, calibrate instruments, and so on should be our end goal.²⁴ We need tools (sometimes rudimentary) to *reshape* these know-hows based on field realities. Responsible planning and project management involve actions *upstream*²⁵ and iterations, as the design and experience raise awareness about the terrain particularities and allow the sketching of conceptual boundaries, such as *Which values? What facts?* Bioethicists intervene at this stage, facilitating the translation and negotiation of facts and values under local conditions and realities. *Terrain* refers to the current “landscape” of *shared responsibilities* and the prospective one when *responsibility has been shared* (the “is / ought to” duality). Mapping implies the comprehensive study of the actors’ and networks’ power, knowledge and will, in order to clearly outline convergent or divergent interests and constraints (Boudreau LeBlanc & Williams-Jones, 2023). According to Leopold (1949, p. 156), social and ecological co-operation can emerge within communities from a well-documented and acknowledged *common ground* (The Land Ethic).²⁶ From the enterprise sector’s perspective, “co” emerges from a clear “rule of the game” setting a common ground (or playing field, to continue with the sports analogy), which are called “conditions of existence” or ecological niches in biology. In business, they refer to state and market laws that provide a common frame on which all parties could agree and build upon, unless their application is flexible, favoring one competitor over another. Starting there, with the need for

mapping what is common and different, we shall explore the relevancy of an Agreement that is set either locally or worldwide (International Declaration) to speed up these searches for common ground. Ecosystem approaches in health and biodiversity management provide such a “co” link, operationalizing these Ground rules through open dialogues across the political, scientific, and philosophical milieus, and a common Principle-based approach easy to mobilized by the local policy-making process (Figure 4).

However, an Agreement is nothing more than a piece of paper without wider sociological processes to embody and operationalize its agreed-upon principles.²⁷ Figure 4 shows how the advancement of human society, according to the Potterian view, is transformed by complex interdependence that links the “critical person” to the “biological world” (Boudreau LeBlanc, 2023a). If we use the Intergovernmental Panel on Climate Change (IPCC) as an example to materialize this sociological process of interdisciplinary collaboration, the biologist provides a physical bio-map of the impact of climate change on biological systems (1st degree); the sociologist provides a strategic socio-map of the social actors, power dynamics and consequences on societal structures (2nd degree); and the anthropologist provides the anthropo-map of human beliefs, cultures and values (3rd degree). The three degrees are assembled as a principle-based system ready for constructive criticism on the overall Bio-Ethics organizational convergence for a Global Thinking Council on the Future (Morin, 1992; Morin, 2015; Potter, 1971). Mapping the general facts/values and inevitabilities/possibilities is the starting point, as the United Nations has done to a certain extent with the Sustainable Development Goals (SDGs) and the related network that advances them. But this is only the first step. We then need to reframe our way of thinking and acting (Morin, 2006).

Phase 2: framing to situate the terrain

Framing arises as an image or vision capturing a view of a landscape (Huxtable & Ives, 2019). This *in-action* “image” is commonly deployed as a “theory of change” (Reinholz & Andrews, 2020) or even a “transition vision”. As Loorbach et al. (2016) explains, an image captures only a specific moment (local) in time, but not the movement or direction of the objects in the image (global). Indeed, information about the “before, during, and after” is needed to encapsulate the complexity of landscape change.²⁸ Huxtable and Ives (2019) acknowledge two missing pieces: the natural path of change (the predicted “is”) and the envisioned path for change (the valuable “ought to”). Both framings are needed to set the scene of ethics work, which leads, among other actions, to the treatment of dilemmas and the development of compromise solutions. Here, we propose a more

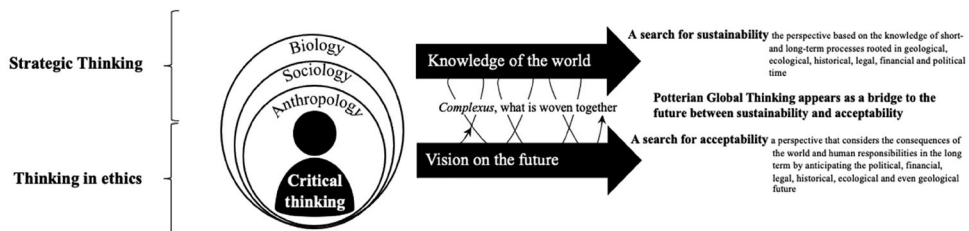


Figure 4. Ecological model of the philosophical knowledge organization.

proactive bioethics to set upstream this techno-socio-intellectual scene (Boudreau LeBlanc, 2023a). The framing should become a collective process – collaboration, communication, and education – enacted as an ethic-action conducted by/for the community (Abma et al., 2010; Frauenberger et al., 2017). In practice, this perspective shifts the focus of “responsible conduct” from the singular researcher, laboratory or enterprise to the policy program of resource allocation, guiding principles, and incentive strategies (funding and regulations) (Boudreau LeBlanc et al., 2023). But who should carry out this (collaborative and comprehensive) framing task?

Recognizing the value of a general knowledge *mapping* of facts, values, norms, and intermediaries in preparation of *framing-to-shaping* the terrain opens the way to an increased involvement of new forms of expertise to accompany the good management of projects. We argue in favor of the broader inclusion of consulting expertise beyond technology or strategy. For instance, philosophers and biologists *sensus lato* have the instruments, knowledge, and vision to conceptualize these mapping translations and can produce useful tools and thought experiments to try several framings of the terrain before engaging specific changes (Boudreau LeBlanc, Williams-Jones, et al., 2022).²⁹ Among those experts, ethicists provide the moral coordinates to calibrate the “compass” of sophisticated tools, since they have the expertise and will to voice the concerns of visible, invisible and silent individuals and communities (i.e. making explicit values and interests). Consequently, we must stop reducing the advice of these experts to technical or legal reports on consent and ownership procedures (ethicists) or species monitoring (biologists). We ought instead to consult them at multiple stages – *upstream* at the conception of a project, *mid-stream* during implementation, and *down-stream* for impact assessment – to profit from their knowledge and expertise in translating theory into practice. Thus, Ecosystem bioethics refers to facilitators assembling action tools, expertise, and persons. “Before we start our project of landscaping the terrain, we need to examine what is out there and create a ‘map’ that will help us navigate and plan” (Huxtable & Ives, 2019, p. 2) and annotate our key levers to “navigate and plan”.

In mainstream methodologies, we tend to pass from (roughly) mapping to shaping without properly framing the specific situation. Huxtable and Ives (2019) posit the process as “shaping,” or landscaping the terrain, on a better vision for the future (Figure 5)³⁰:

Armed with an intimate understanding and knowledge of the terrain, the designer can build a vision for what s/he wants, and explain why certain features have to be in certain places – sometimes for aesthetic reasons, sometimes for pragmatic reasons, and often times aimed at an artful blending of the two. Sometimes, to reach the vision, a great deal of effort will be put into removing or overcoming an obstacle, but sometimes it may be more desirable or necessary to work around it or amend the vision to accommodate it. (Huxtable & Ives, 2019, p. 2)

Norton’s philosophy on adaptive ecosystem management emphasizes these two scales of translation: the ecology of habitat (macro theoretical) and the geography of habitation (micro theoretical).³¹ Under this perspective, the human is no longer the common denominator or the “center” of translation (strong anthropocentrism). The landscape poses a dialectical bridge between local human life and the global habitat giving meaning to the maxim “Think global, Act local”, referring to the idea of multiscale

analysis. The framing must guide the process of interdisciplinary studies and delineate the bioethics' terrain (Boudreau LeBlanc, 2023a).

Potter uses Leopold's work and biography to illustrate the type of expert (basic) advice and the place of the (fundamental) expert in project management. Leopold also used maps to navigate (1) the territory with knowledge of (2) the geography of its landscape and (3) the ecology of its habitat. This geography and ecology were made accessible to him by the knowledge compiled in the reference manuals of applied and fundamental sciences, and enabled Leopold to appreciate phenomena that were (almost) invisible to the naked eye, such as the zoning of dwellings or ecological niches. Moreover, Leopold's eye was critical and proactive; through the tools of his journal, he made the "here and there sketches" to understand the territory of the "Sand County Almanac" (1949). Leopold is thus not only the first bioethicist as Potter asserts, but should also be considered the first multispecies ethnologist as Rademacher et al. (2019) intend to qualify Latour's theories. Leopold's notes on territory have translated the word of this invisible ecosystem into scientific communications, through academic teaching, and during collaborations with partners that influenced the direction of landscape planning policies. Through his work, Leopold not only conceived The Land Ethics theory, he brought it to life within the community of Almanac. Under this Potterian perspective, an ethic becomes an actionable mechanism – and no longer an abstract theory or a declaration hung on a wall – for managing issues commonly shared within a community (Figure 5).

Situating a problem's scales and patterns is necessary to frame its contextual phenomena, and for understanding the system of procedures in light of its consequences and its value. However, mapping everything mechanistically is by definition impossible, as shaping a situation alters the very phenomenon contextualizing the management process. Nonetheless, both Norton (2005) and Ives (2014) emphasize the importance of understanding and justifying choices first (Figure 4's center), before intervening on others, the social or the ecological (the result of Figures 4 and 5's multi-scale analysis). However, we can learn from fields that already carry out initiatives based on these

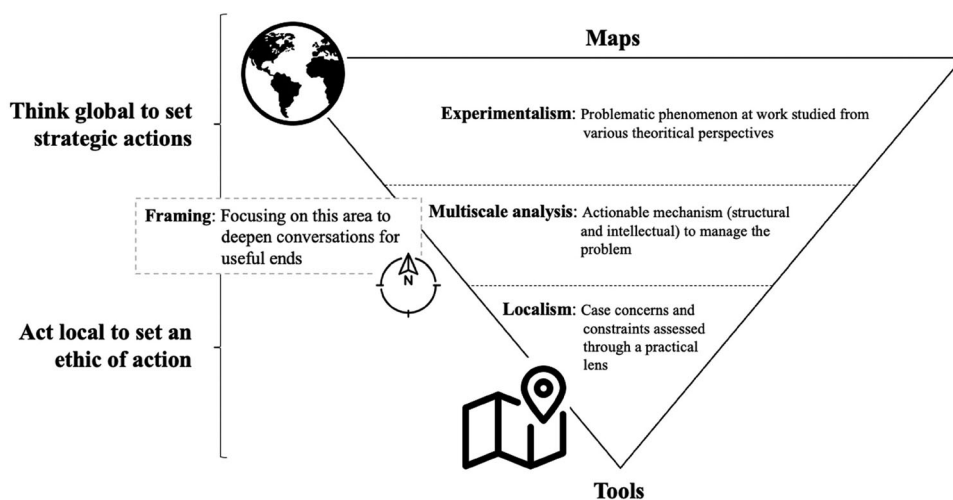


Figure 5. Framing as a multiscale process to tool local actions.

multiscale mapping analyses. For instance, ethnologists reflect on culture while mobilizing knowledge from an expert writing within and beyond the community. This allows for the construction of new knowledge hypotheses (transferable/universalizable) on culture, philosophy and methodology, while remaining applied locally.

Potter (1971) proposes a new bioethics view that *maps* theories globally but *frames* problems in situ (Kuhn, 1962). This translational bounding requires a methodological bridge that transcends traditional disciplinary boundaries. Max-Neef (1932–2019) proposes the foundations for a transdisciplinary knowledge organization (2005). The (micro) scale of theory-making includes a (weak) empirical interdisciplinarity integrating qualitative and quantitative research logics. On a broader scale, it envisages a (strong) rational interdisciplinarity between the goals of descriptive, normative, and appreciative knowledge and practices. At one point, a gap emerges between scales as some methodologies are anchored in an experimentalism or localism (Figure 5). Good empirical methods build on hypotheses, experiences and validations (*in vitro*, *in situ*, *in silico*, etc.). But, good reflexive methodologies build on the self-understanding and introspection of the author's position in local settings when making observations, interpretations and communicating. Norton (2005) proposes reconciling these two approaches through a multi-scale analysis. In line with Whitehouse and Whitehouse (2020), Beever and Whitehouse (2017), the following section outlines the need for (and a *How*) a transdisciplinary bioethics to support a broader-scale co-shaping process to advance policy-making.

Phase 3: shaping to democratize critical thinking on norms and standards

The *Mapping-to-Framing* efforts ease the distribution of roles according to competencies in multi-actor systems. Bioethics can “shape tools” that accompany management leaders in sharing responsibilities with self-criticism, for instance, by embedding by design a model of corporate procedural accountability into the governance process. Engaged bioethicists could provide tools that empower the community and foster the evaluation of the leader's strategic development plans, decision-making and organizational accountability. Shaping means accompanying this *in situ* project management preparation, evaluation and progression in the conception and evaluation of the governance setting (Abma et al., 2010). However, bioethic(ists)' actions in this governance milieu must be done with care, responsibility and pragmatism (Boudreau LeBlanc, Williams-Jones, et al., 2022). Global bioethicists should not seek to “shape” the Global regarding everything (holism), which would be far too arrogant and intellectually (and pragmatically) misguided. The view of a better world should not impose a particular vision, but instead aim for shaping an environment that is suitable for critical thinking and the rise of contextual awareness. Global bioethicists could thus “shape tools” that prepare a theoretical, linguistic, physical, etc., terrain to “collectively reshape” iteratively our lived environment for improving the pertinence and efficacy of the dialogue.

The innovation, here, is to focus both on the case and its context. To prevent reductionism, we build on the Leopoldian “co-operation” view of community processes (Abma et al., 2010; Beever & Whitehouse, 2017; Samuel et al., 2019). Cribb (2020) emphasized that bioethical wisdom does not come from knowing everything or from objective knowledge. Indeed, even bioethicists face the uncertainty of management and the risk

of falling into the naturalistic fallacy. But Potter underlines the wisdom of valuing dialogue that situates a body of knowledge by how to use that knowledge. Consequently, the shaped tool is for building an appropriate habitat to iteratively specify or refocus the techno-socio-intellectual system framing to improve the relationship between leaders and the community (Figure 5). As an engaged forester, Leopold illustrates this multiscale experience by having an ecological map on the one hand to navigate in the County Almanac, and a critical eye on the other to orientate himself beyond its sandy appearance. This “Act Local, Think Global” multiscale analysis disposition allows the manager to observe the empirical environment (the sand county) while becoming aware of its overall organization (its multifaced ecosystem).³²

In this new approach to bioethics, the bioethicist is no longer seen as an external (or objective) actor involved in a paternalistic or imperialistic “dialogue” with a patient or a community. Rather, they provide philosophical guidance for improving the habitat of critical thinking for engaging in a constructive dialogue with stakeholders. Abma et al. (2010) thus call for a return to maieutic, that is, the Socratic approach to questioning the individual about the proper practice of their profession. This reflective and individual method has the advantage of being sensitive to the particularities and dynamism of reality (therefore subjective). Moreover, this dialectical interrelationship between professionals and bioethicists allows for an exchange of knowledge and consolidates tools for better sharing responsibility. For instance, ethics frameworks – as a tool for improving decision making and responsible conduct in practice – are created by engaged bioethicists, with professionals, and for the collective interest, and when done well, include marginalized, vulnerable, no-voice, and invisible persons and groups. In line with Abma et al.’s model, bioethics should search for new ways to respond to complex and dynamic professional realities.

Landscapes are always in motion, images in continual transformation. Picturing local concerns and realities is a never-ending enterprise (Norton, 2005) because the ball is always rolling (Figure 6). Consequently, Leopold introduces to our geographer’s metaphor the idea of a “pencil” to annotate the map and record the compass positions. Mertz and Schildmann (2018) outline that the “cartographic delineations posed by the natural sciences” set certain physical markers for framing human activities and behaviors. Certain “facts” are inseparable from a particular “value”. This nuances the naturalistic fallacy criticism: Newtonian laws (e.g. gravity) make many human desires (e.g. flying) impractical without tools (e.g. flight). Similarly, the biological “fact” of climate change renders unacceptable and irresponsible an unlimited use of petroleum products (Jonas, 1979). This fact makes using resources, technologies, and any commodities a concern of environmental justice, and thus of ethics and human survival. In pursuing this logic, bioethics can provide practical knowledge to support such decision-making without reducing other human realities.

According to Potter, this practical wisdom is “a knowledge on how to use knowledge”. Figure 6 clarifies this kind of knowledge. Boudreau LeBlanc, Aenishaenslin, et al. (2022) explain “ecological resilience” as a model of appreciative knowledge aimed at advancing a collective ethics in the form of an empowerment ethics driven by the community, rephrasing Leopold’s “Ethical Sequence” and “Land Ethic”. Returning to the case of the world SDGs or a Local Antibiotic Agreement, a collective ethic would mean having not only a code, but also scenarios, strategies and even methods that are

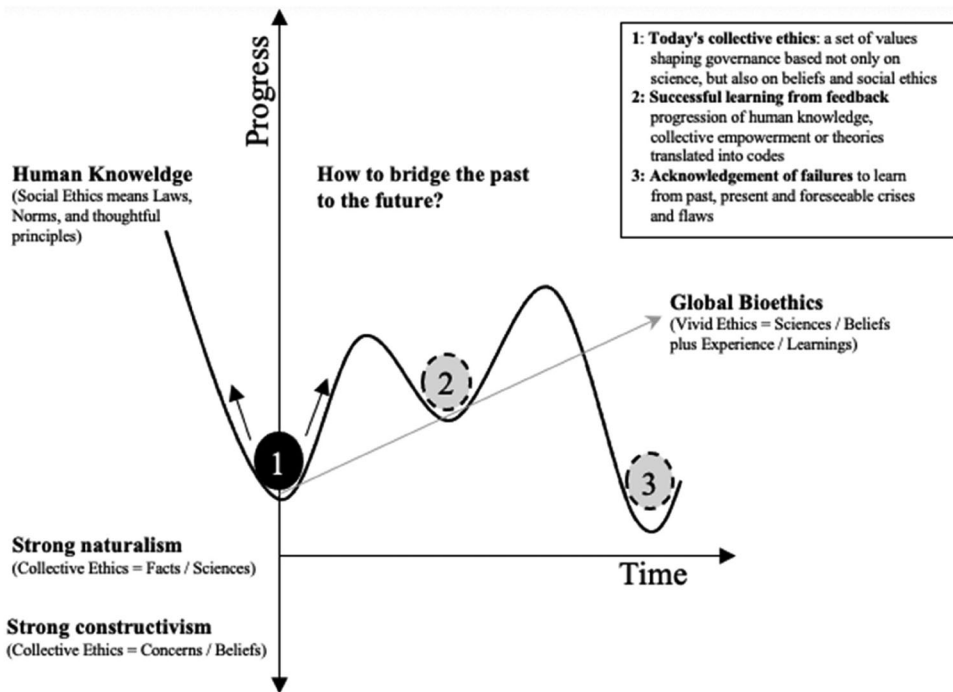


Figure 6. Shaping as managing for ecosystem resilience.

intelligible, comparable and transferable. These would all be archived and posted in open format to elicit feedback on their application, which would then become a hypothesis to test and so build the code of the future (SDG 2.0 or Agreement 2.0). Thus, empowerment means constantly confronting the local community's bio-ecological realities with the visions proposed by an inter-generational science/humanities-driven social ethics that addresses the targets, means and ends of people and ecosystems. This synthesis of the Bio-Ethics Potterian view reframes Leopold's criticism of classical ethics in *The Land Ethics*. Land ethicists must advance the Ethics Theory in practice (forestry), and advancing theories necessitates environmental philosophy, applied ecology and management techniques.

The "ecological resilience" concept (Holling, 1973) relates to the AMC dynamics (Holling & Gunderson, 2002). At first glance, resilience refers to species and functional biodiversity that dynamically bridges the scales of ecological organization (Peterson et al., 1998). But the AMC move towards action – localism, experimentalism, and multiscale – enables the prediction of ecosystem transformation trajectories by proactively connecting intervention with the model of ecological succession. Thus, it is possible to compare the (expected) natural pattern with the (desired) AMC plan (Holling, 1996). Continuing the metaphor, ecological succession occurs naturally through the transition of ecosystems to alternative, more or less stable states. Applied to Society, human organizations also change over time (e.g. enterprises emerge and disappear) depending on their inner programming (e.g. workforce, finances and creativity), internal factors (e.g. sectorial competition), and external pressures (e.g. resource allocation in a context of COVID-like

hazards). A part of this organizational assemblage is under the control of each enterprise; another is under the power of the sectorial collective; the last is indirectly influenceable or practically out of reach. AMC proposes a dynamic that acts simultaneously in these three dimensions.

Each tipping point (Milkoreit et al., 2018) corresponds to a stable state of empowerment ethics conceived upstream (1, 2 and 3 in [Figure 6](#)). Each becomes an alternative collective choice; but some are more successful and valuable in terms of fairness, responsiveness, trustworthiness, and so on. Coherent with the Leopoldian Land Ethics, the choice orients the value and duty of human conduct toward the environment (shifting the passive biotic community view to a collective power and responsibility). The value of this empowerment ethic may progress or regress depending on the collective choice (Potter, 1988); the role of bioethics is to track this social-intellectual trajectory and to outline what constitutes success by shedding light on courses of action that have led to a better future according to experimentalism, localism and multiscale analyses. If we showcase and study ethical successes and failures, we could develop knowledge about such an ethical sequence. These trajectories and analyses require the following:

- (1) Maps – conceived from the collective process of surveying social positions,
- (2) Frames – allowing for interdisciplinary dialogue to understand the value system dynamics,
- (3) Shapings – leading to cultural and intellectual shifts in applied sciences and policymaking.

Preparing the terrain means shifting from tipping point 1 towards a better future in light of 2 instead of 3 ([Figure 6](#)). Thus, preparing involves bioethicists building practical tools for reflection and action – i.e. translating the ethical goal into methodological ideas (criteria, methods, protocols, approaches, instruments, etc.). This means bioethicists' having one foot in the singular case and the other in contextual policy-making/theory-building. In practice, it implies advancing the research-action concept by involving theoreticians in the field: within the enterprise and looking for allies in the Policy and Science realms. We propose the model of community-based action-ethics practices (Boudreau LeBlanc, Williams-Jones, et al., 2022) to set a driving force within society and so lead, simultaneously, to (infra)structural, cultural, and intellectual changes that are based on both facts and values.

Conclusion

Bioethics research projects – and bioethicists – have an important role to play before, during, and after the design of scientific or policy initiatives with social consequences. Continuing the forest ecosystem metaphor, sustainability through AMC aims to increase ecosystem resilience and reduce biodiversity loss. Consequently, forest managers should give responsible (ethical and strategic) guidance on forest operations and studies. This practical wisdom makes changes in the ecosystem understandable based on the observation of relative indicators and knowledge of applied sciences. Due to the actors' interdependence in ecosystems, bioethicists must seek to improve the value of these relative indicators, professional observations, and applied knowledge, notably by raising

awareness of injustices and broader complex dynamics of power in society. Ecosystems are ever-changing, which causes more or less environmental biodiversity or societal injustices, but rarely with a social-ecological convergence of interests. These changes and convergences must be the core object of study of ecological and societal bioethics, that is, an *eco-socio-bioethics*. This global vision of bioethics, which combines intervention with an adaptive cycle of contextual awareness, should be applied in practice to every situation – in the literal sense of ecosystems, and as a metaphor for health, work, innovation, etc.

A growing recognition of nature as a key element of ethics is emerging in the literature, including the idea of ecological resilience. However, as Potter explains, we are missing the guideposts for integrating nature into society (and vice-versa) or the Bio-Ethics weaving. Metaphorically, knowledge of the road network helps one to circulate in an unknown environment but requires (1) a previous collective work to sketch the map and benefits from (2) an ongoing work retrieving the “hotspots” of human culture and biodiversity in nature for learning and protecting our collective habitat. More broadly, this two-way improvement (learning/protecting) is about constructing a common sense of valued environment, no-voice actors, invisible beings, marginalized groups, etc., and recruiting a collective awareness of the environment that ought to be valued. In our geographic metaphor, even if the applied sciences of ecology should precede the local geography mapping, it quickly enters a process of coconstruction and translation, making the question of “who precedes who” between ecologists and geographers irrelevant in practice. As such, we suggest moving beyond the naturalistic fallacy in bioethics to instead talk about methods for a more sophisticated reflexive balancing in philosophical justificative reasoning that could scale the reflective equilibrium up to collective processes. We recommend building global bioethics on the principle of cooperation, and more deeply on the legacy of Leopold and Rawls, who explain it as a “co-operation” dynamics. To do so, the methodological framework of the ecosystem (ic) approach to health and biodiversity can provide a solid ground on which to bind rational and empirical bioethics as a global process of an eco-socio-system management.

Notes

1. See Peter and Catherine Whitehouse discussion in *Social Construction in Action* (Whitehouse & Whitehouse, 2020).
2. In terms of health, we acknowledge whether clinical, public, or even One health. Human activity means behaviours and all forms of productivity and strategy for sustainability development or degrowth. Biodiversity is rooted in biological theories but can also be used as social and/or ecological concepts.
3. The Potterian perspective is distinct from ethics applied to biomedicine (the popular meaning of bioethics). Here, emphasis is given to Bio-Ethics as a reminder the Potterian definition extends beyond the medical.
4. See the concept of a “Bioethical creed” and the “Science of survival”.
5. As we have argued previously (Boudreau LeBlanc et al., 2021), the philosophical thought experiments used in bioethics foster the advancement of Science hypotheses, premises, and postulates, and the comprehensive understanding of the context and the case complexity (de Langavant, 2001; Wilson, 2014).
6. See the *Deep Transdisciplinary Organization* conceived by Manfred Max-Neef (1932–2019, 59).

7. Usually the term used is “ecosystem approach”. In French, there is a difference between an “ecosystemic” and “ecosystem” approach, which is important to emphasize here in order to avoid unfortunate confusion – the first qualifies the (intellectual) organization of the methodology, the other poses the (empirical) object of study.
8. See the 2022 Special Issue of the journal *Global Bioethics* where Cheryl Macpherson (Macpherson, 2022) emphasized the need to rethink *What Global Bioethics Means collectively?*
9. The introductory chapter of *Global Bioethics: Building on the Leopold Legacy* responds to this critique of the fallacy and the difference between the Potterian thesis and those pursued by the Georgetown School (Potter, 1988). The view instead translates “Bios” into “Real world” (Potter, 1996) – the so-called “is” as given by Potter in the introduction of *Global Bioethics*.
10. Connecting with Aldo Leopold philosophy and biography, Potter’s “bio-ethics” is based on the pragmatism of William James (1842–1910), Charles Peirce (1839–1914) and John Dewey (1859–1952), as explained in Bryan Norton’s work (Norton, 2005). Here we will based the framework on Norton’s principle of sustainability: localism, experimentalism, and “globalism” (proceeding as multiscale analyses).
11. Biology is not about the “beauty of species” and the harmonic balance of ecosystems, as emphasized by the thinkers in environmental ethics, who brought out its romantic current, including John Muir. As an academical discipline, biology is about methods to understand species (both ugly and beautiful) and ecosystems (through their balance and imbalance), following an *a priori* symmetric principle of values focusing, among others, on functioning keystone species in light of (elementary and functional) biodiversity. Aesthetics, as in the vocabulary of Aldo Leopold “Integrity, Stability, and Beauty”, should be interpreted in light of broadscale landscape phenomena, as ecological succession and biogeochemical cycles, which flows with elegance for the expert eye trained in basic sciences, equipped and in love with observing the movements of nature.
12. See Bruno Latour’s Actor-Network Theory and the concept of “sciences in action” collectives.
13. Potter explains human duty in terms of respect, as a disposal to compassion, skilled leadership or competency, and as an awareness to complexity and uncertainty or humility. He also understands the environment shaping in its broadest sense (natural, social, and intellectual), notably in introducing the concept of “cultural adaptation”.
14. Acknowledge a shift from right and autonomy (*auto-* and *-nomy* as the “rules of one”) to responsibility.
15. See John Law and John Urry’s explanation on *Enacting the social* (Law & Urry, 2004) unpacking the context.
16. Most often, a collective (e.g., an enterprise) becomes a patchwork of moral compromises and political tug-of-war, and may not achieve any meaningful progress towards a more secure, sustainable future for the social-ecological communities in question.
17. See for instance the UNESCO *Universal Declaration on Bioethics and Human Rights* in Paris, 2005.
18. See the Subsidiarity principle, e.g., the individual up-to institutional or social level.
19. See the annotations now available on maps platforms, providing forums for comments and star ratings on the various services and places, which ease the singular choice of consumers depending on their own standards, tastes and values.
20. The conversation started in 1970 with the emergence of public health, to shift biomedicine to health promotion. Before that, there was the legacy conversation between conservation management and applied ecology at the origin of the biodiversity concept, notably the nuance between structural (or elementary) and functional (or organizational) biodiversity.
21. See in the ecology jargon the functional biodiversity, environmental management, and organizational resilience concepts.
22. The “setting the scene” in management literature; the “hypo-thesis” in natural science, literally *on which* the thesis is based on; or the “pro-position” in the policy and deliberation practices, literally the *upstream* claim of positioning.
23. We need to value ecological knowledge to manage ecosystem concerns (e.g., water system), while acknowledging human values to manage individual behaviours (e.g., planning,

- construction and home) is vital for our survival (e.g., to not being flooded) and at least for fairness in procedures and (metaphorically) for Nature/Nurture cooperation.
24. Acknowledge the power of allocation for coordination and collaboration, of recruitment for expanding the power and knowledge, and of “calibration” for monitoring and tracking processes, evaluation, and progress.
 25. Think of financial, but *a fortiori* social-intellectual, resources, and this cost must be shared collectively (remember the geographers).
 26. This first lens given to what surrounds us – *Thinking like a mountain* to borrow his poet’s pen – can be applied to a second lens to everything that contextualizes us.
 27. See Edgar Morin’s model of existence. The ecological model draws attention to multi-scale knowledge organization structures: the (subjective) criticism is incorporated in a being, a society and an objective habitat (Boudreau LeBlanc et al., 2021).
 28. The *Wicked problem* concept in the management literature outlining that decisions have to be made with the knowledge of half of a puzzle. The whole image is never complete and capturing the big picture is an ongoing working process. As a metaphor, we need to turn attention to the method of systematizing image capture (a video) rather than the technology that increases its precision (its pixel).
 29. See above the illustrative explanation of this with the figure of geographers, Earth mapping, and local building surveys.
 30. Consensus-building processes lead to the adoption of a strategic plan for digital development, as Paquet et al. (2021) point to this type of preparatory moment upstream of developing and implementing public policies, scientific studies and technological actions.
 31. See Norton (2005) philosophy of sustainable management in terms (1) *Understanding*, (2) *Justifying*, and (3) *Intervening*.
 32. This appreciative disposition is different from descriptive multi-scale methods studying the relationship between behavior, populations (e.g., the country) and the species (e.g., the International), although it is complementary (Boudreau LeBlanc, Williams-Jones, et al., 2022).
 33. This framework was applied in Boudreau LeBlanc, Williams-Jones, et al. (2022) to the case study as an adaptive management cycle to guide (strategically and ethically) technosocial initiatives. The framework was used to “shape bioethics tools to introduce critical thinking in an early stage of reflection” during a four-year PhD thesis project (2018–2022). The synthesis and the roadmap to use those tools led to the current paper.

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