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Control, care, and conviviality in the politics of technology for sustainability

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ABSTRACT

This article discusses currently neglected distinctions between control, care, and conviviality in the politics of technology for sustainability. We conceptualize control as the ambition to maintain fictitious borders between hierarchically ordered categories such as subjects and objects. This ambition is materialized into a wide range of Modern technological innovations, including genome editing and deep sea mining. Contrasting with control, we conceptualize values of care that constitute socio-technical practices where connections are prioritized over categories and hierarchy is countered with egalitarian commitment. In caring practices, objects are thus treated as subjects, often within political contexts that are dominated by ambitions to control. Building on care, we explore hopes for conviviality as mutualistic autonomy and decolonial self-realization to orient plural socio-technical pathways for moving beyond Modernity. We argue that such pathways are crucial for democratic transformations to sustainability. We illustrate our concepts using two brief case studies of agricultural developments. The first case discusses the politics of control in agricultural biotechnologies in Belgium. The second case reports on care within rural people's coping strategies in a south Indian "green revolution" landscape laden with control. In conclusion, we emphasize the need to situate attempted materializations of control, care, and conviviality in specific historical junctures. Situated understandings of the interplay between control, care, and conviviality can help realize sustainability that does not reproduce the centralizing, control-driven logic of Modern technocratic development.

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Introduction

As imperatives for transformations to sustainability emerge more strongly around the world, so do pressures to govern the transformations from above, to serve powerful interests, and to maintain socio-economic inequalities. Attempts are made to control sustainability from technocratic "war rooms," to accelerate it from the driving seat, to assess using expedient performance indicators, and to maximize "value" for financial investors. Such attempts, we argue, represent modernist *ambitions to control* (Stirling 2019). They prioritize hierarchical orderings across societies and natures. This process marginalizes values of care for vulnerable and damaged socio-ecologies and hopes for convivial societies based on democratic mutualism and self-realization.

Ambitions to control are central to modernity. They are materialized through modern sciences and technologies, often with serious "unintended" socio-ecological consequences. They shape modernizing programs such as standardization of production,

disciplining of labor, disqualification and assimilation of alternatives, objectification of nature, and marginalization of uncertainties (Arora 2019). Ambitions to control are central to many influential proposals for transformations to sustainability centered on the role of new technologies.

Consider, for example, the Breakthrough Institute's *Ecomodernist Manifesto*, which observes a long-term trend of "decoupling of human well-being from environmental impacts" (Asafu-Adjaye et al. 2015, 11). Calling for optimism about the promise of technological innovations (cf. Hamilton 2015), Asafu-Adjaye et al. (2015, 23–24) claim that "next-generation solar, advanced nuclear fission, and nuclear fusion represent the most plausible pathways toward the joint goals of climate stabilization and radical decoupling of humans from nature." Ecomodernists' ambitions to control lead them to believe that they can stabilize the climate, and realize transformations to sustainability, by intervening in reality with surgical *precision*, changing *only* what

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they desire by using the “right” technologies that can neatly *decouple* humanity from nature. Decisions of choosing the “right” technologies are to be made by the market and the state (with their “experts”), which the ecomodernists’ believe to be the real drivers of modernization. Such decisions are considered too important to be left to messy “politics and democratic choices in the making of possible socio-ecological futures” (Fremaux and Barry 2019, 7).

In contrast with Modernist ambitions to control, emergent sustainability transformations build on *values of care* for neglected and damaged ecologies. Materialized in diverse practices, caring is “much more than a moral stance” (Puig de la Bellacasa 2017, 4). Instead it points to “moral acts” constituted by openness, adaptability, and humility. Caring practices recognize the relations between humans and nonhumans that make action possible (Latour 2005). They admit uncertainties and precariousness associated with their techniques and knowledges (Arora 2019). Rather than “scaling up” finished processes and diffusing end-products to achieve rapid sustainability “transitions” (van den Bosch and Rotmans 2008; Delina 2017), caring transformations to sustainability facilitate adaptation, ongoing tinkering, fine-tuning, and repair of processes and products by users situated in their settings.

In addition to control and care, we explore a third proposal for sustainability transformations based on distributed struggles driven by *hopes for conviviality* across societies. Inspired by Gandhian experiments with building autonomous alternatives to colonial Modernity, particularly in the form of “tools for conviviality” (Illich 1973), such struggles militate against the “radical monopoly” of technocrats. Driven by ambitions to control, technocratic coloniality structures societies around the widespread use of Modern technologies such as hybrid varieties of seeds and toxic agrochemicals that enable monocultural farming. In contrast to such technologies, convivial techniques are promoted and developed through democratizing egalitarian relations within and between societies and their wider environments. Through institutional transformation of whole societies, involving plural pathways of socio-material change beyond Modernity, conviviality hopes to materialize “general self-realization” based on caring for one’s own needs while equally helping others in theirs (Gandhi 1997; Illich 1973). Such self-realization might be crucial for sustainability as constituted by ecological integrity, social justice, and human wellbeing.

In the following section, using insights on the politics of technology from a diverse set of studies,

we develop the three concepts of control, care, and conviviality. We then illustrate the concepts using two examples of transforming socio-material politics of agricultural development. In the final two sections, we specify the connections between control, care, and conviviality and highlight the three concepts’ key political implications for transformations to sustainability.

Control, care, and conviviality

We argue that ambitions to control are materialized into technologies, values of care in practices, and hopes for conviviality across societies. Materialization here points to configuring socio-political aspirations into technological artifacts (Winner 1986; Akrich 1992); conditioning socio-technical practices by human values (Moser 2006; Arora 2019); and orienting whole societies through hopes and imaginaries (Jasanoff and Kim 2015). Materialization in any of these forms is rarely direct or straightforward (Joerges 1999). Premeditated ambitions and values cannot simply be built into technologies and practices. Constraints and deviations are routinely encountered. For instance, materials involved in developing a technological artifact might not work as desired or expected, which necessitates adjustments including using new materials, acquiring of new skills, or altering the design of the technology itself (Arora and Glover 2017). Such constraints and deviations make materialization a political process, raising questions about relations of power. In technological development, these questions include who benefits from the extraction or development of new materials, who is made to acquire new skills in order to remain employed, who is disproportionately harmed by social and environmental impacts of new designs, and what kind of (Modern) worlds are built at the expense of others that are disqualified as “Traditional” or “Underdeveloped.”

Control is arguably the most widely prevalent and deeply rooted ambition in Modernity (Stirling 2019). Through the development of technologies and governance institutions, ambitions to control populations and nature have been central to Modern nation-building (Gorz 1980; Scott 1998; Mitchell 2002). Equally central have been ambitions to control or expel workers, through technological developments that deskill work through “automation” and hamper collective bargaining (Noble 1984). Within this overarching thrust for control in Modernization, situated practices constituted by values of care have nevertheless remained widespread across fields such as parenting, craftwork, education, and healthcare. Caring practices may however be devalued or made invisible inside homes, hospitals, and workshops (Tronto 1993;

Martin, Myers, and Viseu 2015). They may also be made subservient to ambitions to control pervading Modern institutions, as has arguably been the case in government attempts to manage the COVID-19 pandemic (Stirling 2020).

Conviviality highlights societal visions that have been disqualified from the space of development and progress by Modernity, particularly as part of (settler) colonial projects extending European control (Escobar 2018). Convivial visions are based on hopes for sustainability articulated by decolonial social movements such as the water protectors standing firm against the Dakota Access Pipeline in the United States and the Adivasi carers of sacred mountains who are resisting bauxite mining in Orissa, India (Kumar 2014; Estes 2019). Constituted by autonomous and caring relations between humans, and with nature, visions of conviviality hope to move societal institutions and infrastructures beyond Modern ambitions to control.

Control

A general expression of ambitions to control is found in the enactment of bordering. In modern societies, borders often begin their life as discursive formations. They divide the world into reifying categories such as Nature and Culture, Objects and Subjects, Self and Other, Male and Female, Black and White, Rationality and Superstition, Individual and Collective, Developed and Underdeveloped, and indeed Modern and Traditional. Through reification, each of these abstract constructs is confused with the (complex and heterogeneous) reality that it purportedly describes. Each category is, as a result, made more concrete than it ever can be. Whitehead (1929) describes such reification as the “fallacy of misplaced concreteness.” Reification thus expresses the ambition to control realities and identities that are complex, heterogeneous, and interconnected by bundling them into concrete categories.

Performing this ontology of categorical bordering, ambitions to control are comprehensively materialized into technological instruments such as dams on rivers and pesticides on crops. For examples of materialization of reifying categories in engineering efforts for Modernizing development, see Shiva (1989), Sachs (1992), and Mitchell (2002). In particular, as a reifying category groups together entities that are *believed* to be the same or similar, it is conveniently deployable in projects of standardizing industrialization (e.g., through mass production and technology diffusion) and large-scale “resource” extraction (e.g., through industrial agriculture, mining, and smelting). This is discussed in more detail later.

Accompanying such engineering for homogeneity among entities grouped by a category, are legitimating claims that categories provide accurate descriptions of reality (Callon 2007). If some aspects of reality are encountered as deviant or unfitting, in relation to the description provided by a category, those aspects may be formatted until they fit the description. Driven by techno-scientific knowledges and artifacts from Modernizing agencies, the history of international development is replete with examples of such formatting of societies and communities encountered as “underdeveloped” (Rist 2008; Sachs 1992). Under extreme expressions of control, deviant aspects of encountered realities are violently disciplined, incarcerated, exploited, or expelled, while homogenizing identities such as “Indigenous” or “Black” are imposed on diverse peoples (Quijano 2000). Such violent forms of (colonial) control may be viewed as materializing *orders of domination*.

In processes of engineering reality, attempts may sometimes be made to redefine categories. Such redefinition may be geared toward assimilating entities that are successful in resisting the engineering efforts. It may also attempt to exclude rebellious entities that were hitherto considered to be captured by a category. In general, redefinition may entail the adding of new dimensions or new meanings to a category. Redefinition thus shifts categorical borders. For example, while the Western middle-class White Man remains overrepresented in the category “human” (Wynter 2003), the borders of the latter have shifted considerably since the early colonial era of the sixteenth century (Quijano 2000).

Some categorical divisions of identities (e.g., between Self and Other) are materialized through technological instruments of control such as fences, walls, tools of surveillance, and weapons. Such instrumental manipulation is directed firstly at humans who are “Othered” on the basis of categorical differences across race, class, gender, religion, caste, ethnicity, sexuality, rationality, and nationality. Specifically, by controlling movements and connections across (categorical) borders, technological instruments are deployed to facilitate “divide and rule” (see e.g., Christopher 1988). Such control is discriminatory. For example, national borders can be open for the international circulation of market goods and intellectual property. They may also allow a few privileged people from another side to cross over easily to the Self, through immigration windows and doors, while forcing many to dig tunnels or use precarious dinghies (Bauman 1998).

Technological instruments such as fences are also used to manipulate Objectified nature, for example in Modern conservation zones (e.g., wildlife parks), with the ambition to materialize the discursive

border between Nature and Culture (Adams and Hutton 2007). This border and the related one between Objects and Subjects, are materialized into a wide range of Modern instruments. By treating nonhuman entities (in Nature) as Objects that lack agency, and therefore “inferior” to Subjects who act, modern cultures develop technological instruments aimed at controlling Objectified Nature and its dynamics, if only to facilitate incessant resource extraction (Arora 2019). In addition to extractivist instruments of industrial mining and nuclear power which yield toxic wastes, disasters, and death (Cardoso 2015; Steinhauser, Brandl, and Johnson 2014), examples of such technologies include:

- Hydroelectric dams that arrest riverine ecosystems and displace thousands of “Othered” people from their homes and lands (Mitchell 2002; Baviskar 2019).
- Toxic chemicals deployed across farms, factories, and homes that inflict violence during and after use on marginalized workers, consumers, and Othered living beings (Shiva 1989; Davies 2019).
- Genome editing to perform highly uncertain “targeted modifications” in whole species of plants and animals (with even more uncertain ecological consequences) (Agapito-Tenfen et al. 2018; Sirinathsingji 2019).

Many of the technologies embedding Modern ambitions to control Nature (reified and objectified), are now promoted as solutions to climate change and central to sustainability (see e.g., Asafu-Adjaye et al. 2015).

Objectification of Nature points to a second aspect of control: hierarchical ordering between categories on different sides of the borders. As noted, entities categorized as passive Objects are considered “inferior” to active Subjects. Similarly, humans aligned with the “Self” are “superiorized” as compared to those who are “Othered” (on the basis of gender, race, class, caste, ethnicity, and other “cultural attributes”). This hierarchical ordering is done as part of a wider process of *stratification* of groups of people and regions (e.g., Quijano 2000; Boatcă 2015). As the coercive power of Modern coloniality, such stratification has been materialized through technological instruments deployed by (state) power. For example, border walls built around settler colonies may be used to repel and expel others considered “inferior” on the basis of race, nationality, or religion (Madrigal 2019). Similarly, surveillance instruments may be used aggressively against “inferiorized” people within societies.

Stratifying instruments are developed and deployed to centralize power and accumulate value and knowledge, derived from the circulation of

things across borders. The things circulated “globally” during the Modern-colonial era include traded goods, resources, skills, knowledges, and data. Within such cross-border circulation, stratification as centralization and accumulation by and for some people and regions, is afforded through technologies such as those for media and communications (to spread advertisements, propaganda, and entertainment across globalizing markets); logistics and other supply chain management models; large ports and harbors (as central nodes in global networks of circulation); high-capacity servers that store and process data, and other electronic network infrastructure (see e.g., Crawford and Joler 2018). Crucial to stratification are deterministic economic models and financial instruments that promote the centralization of value and knowledge production. The same models and instruments also aim to construct interrelated people as Individual Rational consumers in “efficient” markets (Callon 2007).

Care

Privileging interdependence, rather than the division of reality into hierarchically ordered categories, relational values of care are characterized by a reflexive commitment to *egalitarianism* (Arora 2019). Caring is egalitarian in its attitude to the affording of agency. It is intersubjective, in that nonhuman entities are approached as subjects (instead of Objects). And, subjects are treated not as atomistic individuals, but rather as interconnected in diverse relational webs that afford and constrain agency. Similarly, values of care do not subscribe to Modern hierarchies like those between Male and Female, Black and White, and Rationality and Superstition. Nor does care extend any stratification between practices considered ethical and affective (Mol 2008, 84).

This means that the relations through which caring engages with others are more horizontal than the presumptively vertical and deterministic relations of control. Treating others as different but equal (Escobar 2006), caring is geared toward contributing to pathways for social and ecological justice through solidarity and collective action (Stirling 2014). In this way, care does not reduce interdependence to commodified flows (across borders) and stratification between categorized groups. Nor is it geared toward the integration of “inferiorized” groups into realities or identities attached to a “superiorized” category, through assimilationist instruments deployed by state power (Wolfe 2011).

Processes for materializing values of care are focused on heterogeneous relations constituting practices. Thus, care is not materialized directly into technologies but rather into diverse assemblages of

interdependent people, values, interests, technologies, and biophysical processes. Such assemblages are *situated* rather than universal; provisional rather than stable. This means that caring practices do not push for the “scaling up” of their (finished) processes, or the widespread diffusion of their products. Instead, they promote decentralized adaptation, tinkering, fine-tuning, and repair their processes and products across situated practices of use and disposal (see de Laet and Mol 2000).

Embodied across practices in myriad ways, care cannot be reduced to “a moral stance” (Puig de la Bellacasa 2017, 4). As caring is materialized in/through actions performed by assemblages, it is not about people making value judgements about others. Instead, caring is about “engaging in practical activities” (Mol 2008, 75), ranging from “caring about” others to “taking care of” them (and oneself) (Tronto 1993, 106; Foucault 1996 [1986]). Thus, the concept of care is constituted by practical aspects that combine dispositions that are ethical and affective (Puig de la Bellacasa 2017). These dispositions are enacted in practices, as concerns and responsibilities that enable reciprocal wellbeing. As noted above, based on the egalitarian commitment underpinning care, these others can be ecological processes and beings in nature that have been Objectified, damaged, or neglected. The others can also be people, techniques, and knowledges that have been “inferiorized” or marginalized by practices and technologies of control.

For example, agroecology, permaculture, and other marginalized forms of agriculture approach soils as living. This points to mutually caring interactions between humans and soil, which recognize soil’s relations with biodiversity. In contrast to Modern industrial agriculture that involves heavy use of synthetic fertilizers aimed at increasing soil’s efficiency to increase productivity at the expense of all other relations (Puig de la Bellacasa 2017, 169–216), permaculture and agroecological farming involve slow and labor-intensive practices that draw upon “inferiorized” knowledges of farmers and farmworkers. By showing that agricultural practices can care for (and be nurtured by) Objectified or neglected forms of life, agroecology and permaculture help unravel the adverse implications of dominant control-driven agricultural infrastructures (Holt-Giménez 2006).

Caring practices can help to reveal how control is a fallacy (Stirling 2014). Despite concerted and systematic attempts, control cannot be fully realized. Social and ecological realities approached as Objects in the development and use of Modern technologies, can actually entail multiple unpredicted and unanticipated effects. Adapting to such uncertain

effects is a central aspect of caring practices. Caring adaptation, however, can be suppressed, muted, and made invisible through stratifying processes of control and domination. Documenting caring adaptation/negotiation therefore requires close horizontal attention.

Caring practices point to the importance of egalitarian humility among human designers, manufacturers, and users who defy the ambition to control and dominate nature and “inferiorized” human beings. Practicing humility, care implies the *admitting of uncertainties* in practices of design, production, use, and disposal of technologies (Arora 2019). Admitting uncertainties is not just about highlighting cognitive dissonance. Nor is it about pointing to gaps in knowledge. Instead, this admitting recognizes that reality is complex and multiple, and uncertainties are inherent to all knowing. They do not disappear once a phase in knowledge production or technological development process is “finished.” Uncertainties are always present, in the form of incompleteness, ambiguity, and ignorance (Stirling 2015).

Assemblages of care can include technologies that are designed to extend ambitions to control. Such caring practices make use of the “interpretive flexibility” associated with many technologies (Bijker 1995). This flexibility implies that a technology designed as an instrument of control can be repurposed, used, and disposed of with care. However, one only needs to consider serious challenges such as rapidly declining insect populations driven in part by the use of synthetic fertilizers and pesticides of industrial agriculture (Sánchez-Bayo and Wyckhuys 2019) to imagine that the use or disposal of many Modern industrial technologies is critically governed by the already materialized ambitions to control. In industrial societies, therefore, caring practices are often constrained by the widespread use of technologies of control.

We have to be cautious to not romanticize “care” as an innocent and self-evidently desirable set of values. Such caution is critical for transforming Modern practices of knowledge production (underpinned by ambitions to control) into practices of care (Haraway 2011; Murphy 2015). Feminist technoscience scholars foreground a *politics of care* for making visible any controlling (bordering and stratifying) relations across otherwise “caring” assemblages. They pose questions such as who does the work of caring, for whom, and for what purpose. For example, Murphy (2015) illustrates how feminist self-help interventions focused on the clinical level to improve access to pap smear tests for women in United States and Canada toward the end of the twentieth century were approached as caring

practices. However, this approach neglects the racialized inequalities and post-colonial geopolitics that constitute global health infrastructures. While much of the research to verify the causes of cervical cancer is conducted in the global South, and the disease remains widespread in Southern regions that were colonized, most women living in these regions are unable to access the tests for cervical screening.

Conviviality

Our third concept for grappling with the politics of technology for sustainability is inspired by Gandhian thought and in particular by Illich's (1973) work on "tools for conviviality." For Illich, socio-ecological interdependence is political and mediated by tools in society. These tools are not just technological artifacts, but also institutions such as schools and factories (Vetter 2018). Practices within and beyond such institutions might also be approached as "tools." As Illich (1973, 34) highlights, "school curricula or marriage laws are no less purposely shaped social devices than road networks." Therefore, Illich focuses on possibilities for institutional transformations toward convivial *societies*, within which struggles are waged for technologies that are not shaped by ambitions to control and dominate (Gorz 1980, 19).

Illich (1973, 65) emphasizes the problem of societal control by centralizing institutions and structures associated with Modern industrialization across capitalist and "socialist" societies (Gorz 1980), in which technocrats hold "radical monopoly" over (institutional) design. In such industrial societies, Illich argues that the use of machines has gone too far. It has exceeded social and ecological limits. As a result, machines destroy ecologies and end up ruling over people. Through its radical monopoly, technocracy marginalizes alternatives by institutionalizing society around its designs that materialize ambitions to control. In this way, technocratic tools undermine freedom and cultural diversity (Pimbert 2015). They also presuppose and impose a stratified society that centralizes power through policy and policing (Gorz 1980). Critically, this implies *colonization by technocracy* of possible futures in society.

To undo this colonization, inspired by Gandhian thought including especially the writings of J.C. Kumarappa (Gerber 2020, 246), Illich (1973) articulates hopes for conviviality through autonomy and self-realization. Like Gandhi's (1997) *Swaraj* or self-rule, as freedom from colonial Modernity for the whole of society and all of its parts across interrelating communities (Terchek 1998), Illich's understanding of *autonomy* is holistically relational, mutualistic, and egalitarian. An individual helps

themselves to act, while equally helping others (and in return, receives help from others). Such mutualism can reduce dependence on Modern machines and commodities by using tools that are "least controlled by others" (Illich 1973, 31). Gorz (1980) extends autonomy to include "decentralized self-regulation" in nature, which must not be submitted to "control" or "correction" by a regulating authority of human experts. Regulation of nature by technocratic experts is argued to also compromise people's autonomy through "a growing submission of individuals to institutions" (Gorz 1980, 18).

Self-realization points to autonomous communities and neighborhoods imagining and creating tools, "according to their own tastes, and to put them to use in caring for and about others" (Illich 1973, 24). Self-realization thus highlights collective creativity that is caring for and about (ecological) others. These others include vulnerable humans; the reservoirs of minerals, trees, and water constituting nonrenewable nature; *and* the flows between the sun, wind, soils, plants, and animals constituting the "cycle of life" (Kumarappa 1945).

Care for the reservoirs of nonrenewable nature might mean that they are left on and in the ground, through creative resistance against industrial resource extraction and against all attacks on "indigenous" ways of living (Estes 2019; Kumar 2014). Caring for the flows in the cycle of life implies nonviolent nurturing of their cooperation and continuity in time and space (Kumarappa 1945). Caring for the flows can, for example, be done through agricultural practices such as permaculture and agroecology discussed above. These flows help constitute the assemblages in which people can collectively enact self-realization based on *caring creativity*. Generalizing such self-realization across diverse practices, hopes for conviviality help imagine and materialize possibilities for plural pathways to decolonize society as a whole (Escobar 2018).

Therefore, in addition to resistance against extractivist Modernity, self-realization points to caring creativity that helps develop a diverse range of autonomous "tools" for realizing plural pathways of socio-material change that diverge from Modernity (Arora et al. 2019). The diversity of tools and plural pathways are not meant to fully replace standardized products and processes that are the hallmark of Modern industrial societies. Illich sees effectiveness and efficiency in society as resulting from standardization in some situations (e.g., for road and transport planning to prioritize bicycles rather than motor cars). However, such standardization is always promoted in combination with multiple autonomous pathways of change (cf. Stirling 2009). Each of these pathways beyond Modernity comprises its own knowing, designing, and valuing

practices co-produced with mutualistic autonomy and decolonial self-realization. To build such co-existing plural pathways, hopes for conviviality point to two interrelated socio-material struggles.

The first centers on the *decolonization of innovation* in society, such that no institutional (technocratic) power is able to monopolize or control knowledge production and technological development. This might necessitate democratization of institutions to give primacy to the knowledges and techniques developed by communities of diverse practitioners ranging from workers and peasants to craftspeople and forest peoples. To facilitate the development of such knowledges and techniques, communities are supported to intensify autonomy from colonial Modernity (while struggling for equality and mutualism within and across communities).

The second struggle seeks to foster the production and sustenance of plural decolonial *pathways of socio-material change beyond Modernization* in each area of socioeconomic activity. Such pathways are composed of creative caring practices performed by autonomous assemblages. They develop convivial knowledges, designs, values, and techniques. Conviviality thus implies the promotion of co-existing cultural and cognitive diversity in every community and neighborhood. This implies the promotion of decolonial diversification based on caring creativity to materialize social and ecological self-realization for the historically “inferiorized” and “objectified” by Modern coloniality.

Transforming socio-material politics of agricultural development

Based on ethnographic research in South India and scholar activism (as defined below) in the politics of biotechnologies for genetically modifying plants in Belgium, we briefly explore below how control, care, and conviviality are materialized in different agricultural strategies. To map control, we focus on how bordering and stratifying is attempted through the development of new technologies. For care, we explore how “Objects” are approached as subjects in practices, through a commitment to egalitarianism and the admitting of uncertainties. And conviviality is examined through emergent possibilities for decolonization in society, through autonomy and self-realization, to resist technocratic coloniality and to realize plural pathways of socio-material change diverging from Modernity. Throughout this analysis, we attempt to study interactions between the materialization of control, care, and conviviality.

The illusion of control: field trials with gene-edited crops in Belgium

In the short term, the legislation should be altered such that crops with small DNA adaptations obtained through genome editing are not subject to the provisions of the GMO Directive but instead fall under the regulatory regime that applies to classically bred varieties.

Flemish Institute of Biotechnology, Position Statement on Genome Editing, 2018

In European Union (EU) member states, the authorization to “voluntarily disseminate” genetically modified organisms (GMOs) must adhere to biosafety measures stipulated in the EU GMO Directive 2001/18/EC. This directive mandates labeling and assessments of food safety and environmental risks associated with genetically engineered products. European GMO legislation has been a site of struggle since its inception (Levidow 2001). While consumers, civil society organizations, and peasant and organic farmer associations stress the importance of good biosafety regulations and transparency to safeguard consumer choice, health, and safety, corporations emphasize how regulations stifle innovation and trade.

As part of scholar activism in Belgium around the role of publicly financed research institutes in demands for European deregulation of GMOs, one of us has analyzed parliamentary discussions (2007–2019), mainstream media articles (2007–2019), and public information requests to regulating authorities (2016–2019) while doing participant observation at multiple public events around biotechnology (2010–2019). This work reveals that Belgian research institutes’ attempts to influence European legislation intensified with the arrival of a new set of techniques for genetic manipulation, also referred to as gene editing.

Around 2012, corporations and their allies started referring to gene-editing techniques as “new breeding techniques” in an effort to rebrand GMOs. This strategy aimed to ease the dissemination of new genetically modified (GM) plants in Europe (Holland 2016). Nevertheless, in 2018, the European Court of Justice (ECJ) ruled that the GMO Directive 2001/18/EC also covers organisms developed using gene-editing techniques, including the popular CRISPR/Cas9 (Gutwirth and van Dijk 2020). In this case, corporations and their allies thus failed to shift the boundaries of existing categorization of GMOs. If they had succeeded in shifting the boundaries by placing the new GMOs outside the existing regulated category, corporations would have been able to avoid labeling, to complicate traceability, and to circumvent the precautionary principle.

Aiming for control through field trials

In efforts to materialize ambitions to control through agricultural GMOs (as detailed below), field trials form a crucial step. It is here that companies demonstrated the testing of new crops in *quasi* real-life conditions. In Belgian Flanders, GMO field trials have been an important communication and public engagement tool (Krom, Dessein, and Erbout 2014; Raeymakers 2012) while forming part of a larger effort to transform biotechnology research into economic growth (van Dyck and Arora 2018).

In July 2018, two newspapers reported the existence of an authorized but “secret” field trial of gene-edited maize in Belgium using CRISPR/Cas9. The ostensible aim was to learn about the plants’ response to environmental changes. The failure to inform the wider public about the existence of the field trials provoked widespread consternation, especially since it had happened with the knowledge and agreement of three Belgian ministries for public health, innovation, and agriculture (van Horenbeek and Debusschere 2018).

Using a public information request, we learned that the Flemish Institute of Biotechnology approached the Belgian authorities in Spring 2016 to clarify whether a field trial with maize genetically modified using CRISPR/Cas9 fell within the scope of existing GMO regulations. While the EU urges European member states not to take hasty decisions on the matter, Belgian authorities opted to create a *fait accompli* and decided to exclude the CRISPR/Cas9-maize from GMO regulations.¹ A year later, when the ECJ clarified that gene-editing techniques cannot bypass the EU’s GMO directive, Belgian authorities swiftly moved to regularize the field trial, mainly through assurances of governmental oversight on the adherence to biosafety measures for avoiding the dissemination of pollen or maize kernels in the environment or the food chain (Grymonprez 2018).

For the third replication of the field trial, in 2019, its executors went through the legal procedures for GMO field trials. This included submitting a technical report for review by an expert biosafety panel and organizing a public consultation. While the public raised questions about the benefits, sustainability, and socio-economic effects of using GMOs in agri-food, the Belgian authorities choose not to address any of these concerns during the consultation (Federal Health Agency 2019a). Following the EU’s GMO directive, a permit was granted based on assurances of adherence to the usual biosafety measures during field trials (Federal Health Agency 2019b).

According to a report from the public consultation, in contrast to “controlled” laboratory

conditions, the complexity of real ecosystems risked proliferating “unintended interactions between GMOs and other organisms” (Federal Health Agency 2019a, 3). Aiming to control such risks, field trial plots were kept small (a few acres) and “highly monitored.” Maize plants were labeled, counted, and planted at regular intervals. They were also surrounded by conventional hybrid control plants. In addition, the removal of male flowers prevented the spread of pollen and the seeds were harvested manually. Also, the plot was fenced off to minimize interactions of the GM maize with humans and larger mammals, with the aim of materializing the categorical border between Nature and Culture. Such materialization of ambitions to control approaches plants, pollen, seeds, and mammals (and even consuming humans) as Objects lacking autonomous agency. Their actions were believed to fully confirm to the “accurate” descriptions provided by the controllers of field trials, with little or no room for “unintended interactions.”

The field trial’s ultimate goal was to enable the dissemination of the GMO plants into the environment and the agri-food system. The very basis of GMO plants that are “better suited” to “human needs” expresses Modern ambitions to control nature. Here humans are homogenized as having the same needs. Their divergent views on GMOs, as expressed during the public consultation, are marginalized. Ambitions to control are also evident in the language used to describe interventions in the genome of plants. Metaphors of “surgical interventions,” “precision breeding,” and related to computer coding (e.g. “GMO 2.0,” “on and off-switching of genes,” “small accurate adaptations”) are widely used. Such metaphors attempt to convince policy makers and wider publics that things are fully *under control* in the execution of genetic modification (Gheysen et al. 2018). Crucially, such metaphors yet again reveal how Nature is objectified in the materialization of ambitions to control in the development of GM technology. Nature’s autonomous agency is obscured. And biotechnologists are presented as Subjects producing “accurate knowledge.” Rather hubristically, they are the superior beings in control of *their* Objects in/as Nature.

Yet, the presumed accuracy of an intervention cannot be equated to predictability in its outcome (Stirling 2018). More critical scientists have shown how small genetic changes can produce large-scale ecological effects (Bortesi et al. 2016; Jupe et al. 2019). However, rather than taking this seriously, Belgian authorities followed researchers from the Flemish Institute of Biotechnology in arguing that public concerns about biosafety were unwarranted “because of the application of various risk *control*

measures during the field test” (Federal Health Agency 2019b, 2). Thus in the field trials, Belgian policy authorities and Flemish biotechnology researchers aligned with each other in following ambitions to control by Objectifying Nature. They failed to countenance how their ambitions to control were not only fictions but also fallacies. Ecological processes were not their Objects to control. Instead, as revealed by caring practices and as embedded in hopes for conviviality, ecologies manifest through relational actors whose autonomy from technocratic coloniality and generalized self-realization are critical for sustainability transformations.

Care and survival in a South Indian green revolution landscape

As part of the so-called Green Revolution (GR), international ambitions to increase agricultural yields were materialized through monocultures of hybrid wheat and rice for national food security from the 1950s through the 1970s. Technological packages of “high-yielding varieties” of seeds, agrochemicals, and assured irrigation (often through groundwater extraction), coupled with pricing and procurement policies, were disseminated to achieve the geopolitical objectives of controlling social discontent and stemming communist influence in newly independent postcolonial countries (Cullather 2010; Perkins 1997). In India, this technology-driven agricultural intensification was promoted as a development strategy to improve wellbeing of smallholders and landless workers. The violence and plunder of colonial rule that contributed to producing the poverty of smallholders and landless workers was eliminated from technocratic diagnoses of the problems of hunger and poverty, and from the proposed development solutions (Patnaik and Patnaik 2016). A large body of literature since the 1970s has highlighted the failure of the GR in terms of its own stated objectives of addressing rural poverty and inequality, in addition to ecological critiques centered on declining groundwater levels and chemical pollution (Frankel 1971; Shiva 1989; Farmer 1977; Kumar 2016).

During ethnographic fieldwork over seven months in 2017–2018, open-ended life history interviews with 24 smallholders and landless workers (both male and female) in two villages of northern Tamil Nadu outline an increasingly precarious cultivation landscape shaped by GR technologies since the 1970s (Arora et al. 2018; Sharma and Gajendran 2018). The interviews focus on “critical events” in workers’ and farmers’ lives, continuity and change in livelihood practices, personal accounts of GR transformations, and how people evaluate these

changes in the region that have occurred over the course of their lives. Additionally, the analysis presented here is informed by ethnographic notes on people’s socio-eco-technical milieu in 2017–2018 and by previous research on long-term changes in agrarian structures, caste, class, and gender dynamics in these villages and the region more broadly (Farmer 1977; Harriss 1982; Harriss-White and Janakarajan 2004).

Cultivators juggled between a few varieties of hybrid rice, while coping with erratic rainfall and sinking water levels in open wells. The three rice cultivation seasons in a year, promoted during the GR, have given way to ad hoc planting schedules as farmers select rice varieties with varied maturing periods or are compelled to leave (parts of) their land fallow based on the availability of water in wells. As a consequence, for landless women workers, transplanting and weeding that used to be their primary avenues of employment are no longer reliable. The summer months are particularly difficult, as the limited available work is shared among a large number of women for meager wages. For farmers, the most distressing forms of precariousness arise from unremunerative crop prices and entanglement in complex formal and informal credit arrangements for buying seeds and agrochemical inputs. In state-run procurement markets, farmers camp sometimes for several days to sell paddy at lower than the minimum support price declared by the government.

Coping with and struggling against control

Instead of the controlled landscape of ever-increasing agricultural productivity and universal prosperity promised by the GR, a number of unpredicted and uncertain effects have been produced including volatile crop prices and declining availability of water for irrigation. Among households relying on agricultural incomes, farmers and workers are adapting, tinkering, and repairing lives and livelihoods through practices such as buying and sharing of water from wells and using micro-credit for consumption needs and for small investments in farming.

People with marginal landholdings, unable to afford irrigation, have been attempting to grow rain-fed finger millets and groundnuts. And having a cow or two helps some households survive, as milk tends to fetch a good price in the market. Women and older men spend significant parts of their day caring for the cows, taking them out for grazing in uncultivated fields and in the silted water reservoirs (tanks) that once played a crucial role in irrigation and groundwater recharge (Janakarajan

2003). In extremely dry periods that have been frequent in the last decade, however, fodder is also difficult to access. Modern ambitions to control disregard boundaries of GR farms, creating the socio-ecological conditions in which most adaptation and repair practices are individualized. These individualized coping practices are focused on dealing with immediate needs, showing that the precarious post-GR landscape seems to offer limited possibilities for caring practices to rebuild damaged and neglected rural livelihoods and ecologies without shifts in institutional and policy frameworks (Vasavi 2012; cf. Blaikie 1985). The necessity of such shifts highlights the importance of materializing hopes for conviviality across whole societies.

Values of care are dormant, even as state-level farmers' unions and established agroecology groups in other sub-regions mobilize for institutional shifts to support ecologically regenerative farming practices. While these organized groups were not locally active in the region of our research, close horizontal engagement revealed that everyday forms of political organizing to realize equality are prevalent among women workers performing agricultural tasks in collectives. Mostly women have been employed to perform the only remaining unmechanized skilled tasks in the cultivation process—transplanting paddy seedlings in flooded fields and weeding (in rice and groundnut). Through mutualistic interdependence and careful organizing, Dalit women largely from landless households have successfully bargained for better wages and more dignified working conditions within control-driven GR agriculture. These struggles also challenge casteist “inferiorization” in and beyond the fields, most prominently around quality, preparation, and modes of serving food and exclusion from accessing the village commons. The ambition to control the organizing efforts of women workers is, however, resurgent in the form of transplanting machines that have been appearing on large farms. Many large farmers and state agricultural officers argue that these transplanting machines will solve the “labor problem.”

Hoping for conviviality?

In discussions of groundwater depletion in Tamil Nadu, a consistent theme is the neglect and loss of water reservoirs or tanks that were integral to local agricultural landscapes. Tanks were simultaneously a common resource (for water, fishing, and trees) and a public institution comparable to the village temple (Mosse 1997). Tanks were often maintained using unpaid labor by Dalits, even as Dalits themselves could be prohibited from use for fishing or irrigation. The majority of lands irrigated by tanks were

controlled by landowning dominant castes (Harriss 1982).

While the neglect of tanks began under British colonialism (Mosse 1997), it continued in the GR period as governments facilitated groundwater extraction by dominant castes using subsidized electricity. The GR's promotion of technologies of control, ostensibly for socio-economic development, failed to address gendered and casteist inequalities that structure farming practices. In the two Northern Tamil Nadu villages, Dalit women's mobilization for rights to access the tanks reasserts their value as multi-use village commons, rather than as irrigation instruments controlled by landowning farmers. Women articulate these struggles in terms of social justice and dignity, not simply as demands for accessing natural resources. Defying categorical borders between Culture and Nature, between the Symbolic and the Material (Mosse 1997), these struggles are constituted by values of care and hopes for conviviality. While these struggles by the most marginalized groups may not, by themselves, succeed in building socio-ecologically just and sustainable agricultures, they are critical for charting directions of sustainability transformations. They show that materializing hopes for conviviality requires challenging intersecting power relations of gender, caste, and class, as well as institutional shifts across the whole of society.

Caring practices for regenerating water reservoirs, shifts toward “indigenous” rice varieties, and more diverse cropping systems with millets and groundnuts can help move beyond the radical monopoly of the GR's technocracy, if they simultaneously struggle against multiple socio-economic and cultural inequalities with which farming practices are deeply entangled. Many emergent agroecological movements across India, supporting plural pathways and constituting practices of knowing, such as in organic agriculture, permaculture, and zero-budget natural farming, are working toward this possibility for a convivial society (Khadse et al. 2018; Brown 2018).

In other parts of the world, peasant movements are building on “indigenous knowledge practices” to promote *in situ* approaches to preserving agrobiodiversity and dealing with environmental stresses such as droughts and floods. For instance, seeds bred through *in situ* approaches, are based on mutualistic co-evolution of seeds with their socio-ecological environments. By defying separations of Nature from Culture, this dynamic cultural biodiversity stands in sharp contrast with Objectifying genetic engineering for homogenous commercial seed varieties that are registered in the European seed catalogue as distinct, uniform, and stable (Serpolay et al. 2011). Such peasant movements are thus attempting

Table 1. Materializations of control, care, and conviviality across different political dimensions.

Dimensions of political processes	Domination	Control	Care	Conviviality
Prevalent ontology	Categorically bounded India: by helping to create conditions of famine and underdevelopment, self-serving colonial exploitation sets the stage for the "Green Revolution" (GR)	Categorically bordered India: the GR "high-yielding varieties (HYV) package" frames food security as national self-sufficiency through enhanced productivity of cheap calories through monocultures of wheat and rice. Belgium: the understanding of GMO field trials as semi-controlled environments with clear insides and outsides	Interactively relational India: emergent grassroots actions and socio-ecological relations condition durable regional variabilities in the uptake of GR and in adaptation practices	Holistically relational India: the politics of agroecology encompasses whole societies and material cultures (including plural human-nature relations)
Mode of engagement	Totalizing Othering India: "superiorized" interests colonize territory; dispossess targeted castes and classes; "inferiorize" and exploit through gendered racialization; objectifying "inferiorized" people alongside extracted "natural resources." Belgium: "superiorized" interests colonize territory; objectifying "inferiorized" people alongside extracted "natural resources"	Instrumental manipulation Belgium: materializing control relations to "engineer" for high performance, by manipulating selected crop genes, in ostensibly "Objective" ways. India: instrumental "industrial tools" of GR include subsidized private groundwater extraction for monocultures of just a few hybrid varieties of cereals, (re)producing marginalization of smallholders and workers	Reflexive commitment India: local cultural-ecological conditions push back against GR varieties. Seasonal variations switch between rainfed and irrigated crops and fallows. Manual plowing co-exists with tractors. Welfare entitlements reduce dependence of landless workers on dominant castes, opening up spaces for egalitarian struggles. Belgium: ECJ ruling acknowledges scientific uncertainty and affirms precaution as guiding principle for GMO assessment. Freedom of information request by civil society reveals influence of corporate lobbying	Immersive equality India: pluralities of interests and identities engage with each other in multiple ways on equal terms, across social movements, struggling against overarching gradients of power or privilege that "inferiorize" particular actors and "superiorize" others
Manner of materialization	Identity imposition India and Belgium: entire new identities are created and rigidly imposed as a means to violent "inferiorization," devastating objectification, and unbridled exploitation	Comprehensive instrumentalization India: GR policies entrench marketization around agrochemicals, seed dealing, and procurement of credit, also through public extension services. Belgium: public policies instrumentalize in favor of biotech interests through tax shelters, public-private partnerships, and erosions of EU biosafety regulations using field trials	Assemblages of practices India: women's work groups bargain for higher agricultural wages, dignified work, struggle to use village commons interwoven with challenging casteism. Struggles for accountability and welfare entitlements are intrinsic to livelihoods	Socio-material wholes Belgium: civil society demands to assess field trials in their full socio-ecological context, to include intersecting socio-economic drivers and ecological impacts. India: agroecology social movements entangled with environmental change in farming (and beyond)
Affordance of agency	Subject over all else General: one class of social actors privileged as the "superiorized" Self, enjoy cultural-political norms under which patterns of entitlement and valuation uphold their interests (and recognize only their identities)—essentially Objectifying "inferiorised" Others	Subject over Object Belgium: notional "switching" of genes "on" and "off," as directed by biotechnologists as a class of "superiorized" subjects-who-know. India: individualizing of risk and coping strategies. Multiple cropping seasons aggravate extraction of groundwater as an object (to serve human subjects' needs constructed by the GR model). "Inferiorized" laboring classes are displaced by mechanization	"Objects" approached as subjects India: <i>in situ</i> practices (of seed breeding and exchange) based on principles of cultural biodiversity and dynamism, to highlight caring for nature's agency in interdependent co-evolution of seeds with their socio-ecological milieus	Su/o-jects entangle as collectives India: nurturing conditions of democratic parity across multiple dimensions of relations between humans and with nature. Contrasting social and ecological actors thus enjoy institutional norms under which patterns of innovation and valuation repair the damage associated with "inferiorization" and Objectification (for socio-ecological justice). Former colonial "Objects" are thus engaged with/as decolonial subjects
Propagating processes	Violent oppression India: conditions of dispossession from	Technocratic determinism Belgium: expert hegemony in (policy)	Autonomous reciprocity India: practices of labor exchange and working	Mutualism for decolonial self-realization India: hopes for conviviality enable

(continued)

Table 1. Continued.

Dimensions of political processes	Domination	Control	Care	Conviviality
	land and water established through colonial, gendered, and casteist violence, continuing in post-colonial times, also in the form of dominating violence directed against objectified nature	narratives of standardization and economic growth. India: enforced standardization of agrarian practices implicated in the GR model based on “modern” techno-sciences (e.g., HYV monocultures and focus on calories for (mal)nutrition)	women’s inter-caste solidarity employed to cope with economic and ecological distress. Enabling of complex adaptation to local settings” (e.g., uncultivated land used for grazing and fodder). Equal access for all to village commons	struggles against injustices produced by power and privilege. Autonomy and self-realization between interrelated interests and actors throughout wider socio-material wholes, with the potential to enable more comprehensively mutualistic relations, within and across societies, free from deeper and wider gradients of coloniality in all its forms including caste and gender

to decolonize agriculture to help build a convivial society based on self-realization and autonomy (Naylor 2017). A society in which institutional transformations support biodiverse seeds that contribute to building plural agricultural pathways beyond Modernity, and in which the agency of both people and plants are mutualistically nurtured.

Discussion

The above cases have attempted to illustrate the materializing of control, care, and conviviality in particular contexts and their histories. We hope to have highlighted the importance and relevance of arguably crucial political distinctions that currently remain neglected. For transformations to sustainability, it matters critically whether technologies, practices, and institutions are constituted by ambitions, values, and hopes articulated here as “conviviality,” “care,” and “control.” Key implications of our analysis developing these three concepts are shown as columns in Table 1, with a fourth column outlining the extreme case of control in “domination.” Rows of Table 1 distinguish between five different political dimensions of the materialization of control, care, and conviviality.

“Prevalent ontology” in the first row of Table 1 refers to the generally established ways of approaching and performing (and so helping to shape) the world. In the second row, “mode of engagement” points to ways in which subjects, objects, and their contexts are considered to relate to one another. The “manner of materialization” then addresses key means by which these patterns become materialized in their respective political situations (into technologies, practices, and institutions). The “affordance of agency” focuses on how agency is enabled or constrained around different possible loci. And “propagating processes” focuses on some major dynamics through which ambitions to control, values of care, and hopes for conviviality might be extended from particular settings outward into the wider world.

In each cell of Table 1, a label is coupled with a schematic reference to selected aspects of the empirical discussion earlier. Together, we hope that this helps make clearer, and accountable, the political distinctions proposed in this article. In short, the table foregrounds nuances in connections between the concepts of control (and its extreme form “domination”), care, and conviviality across particular settings. This may help account for hierarchical orderings in regulation and policy making to move beyond narrow “science-based” technical assessments toward promoting the co-existence of plural socio-material pathways. We also hope to contribute to articulating and orienting contemporary struggles against the unsustainable forces of globalizing

Modernity constituted by control and domination. At the same time, we highlight a perennial challenge, namely that of realizing dynamic continuity and cooperation across struggles by linking currently isolated pockets and practices of care into deeper and more expansive political cultures of conviviality.

Conclusions

It is crucial to locate materializations of conviviality, care, and control in particular political contexts. Central to this analysis is the need to attend to historic junctures when possibilities are expanded for practices to be strongly conditioned by the values of care and hopes are nurtured for realizing convivial societies. It is crucial that care and conviviality are not approached as essentialized sets of values and hopes, which can be attributed to certain practices and societies. Such essentialization simply mirrors and helps entrench the Modern logic of reifying control. Instead, by recognizing situated patterns of care and conviviality, across their materialization in different contexts, it might become possible to engage in transformations to sustainability through mutualistic autonomy rather than centralized control, egalitarian justice instead of continuing “inferiorization,” and decolonial self-realization as opposed to standardizing modernization.

Central to achieving such autonomy, justice, and self-realization in transforming societies toward sustainability are the democratic politics of social-environmental activism and public policy. We propose that directing greater attention to distinctions between control, care, and conviviality, activism and policy can help steer sustainability “transitions” and transformations away from Modernity. This means moving away from ambitions to control toward materializing values of care in practices and hopes for conviviality across societies. For example, prominent “decarbonizing transformations” to tackle climate change are reenacting Modern extractivism by promoting technologies such as nuclear power and electric cars (using lithium and uranium among other extractive “resources”). Such transformations materialize ambitions to control Objectified Nature and “inferiorized” people. In contrast, through egalitarian and democratic remaking of urban and rural infrastructures, caring transformations might promote practices such as bicycling and walking. Caring and convivial interventions by policy makers and activists can also offer support for neighborhoods and communities to harvest their own energy from the sun and the wind at a microscale without breaking the continuity and cooperation of “cycles of life.”

Transformations hoping for conviviality by decolonizing innovation require not only political struggles against technocratic coloniality but also the

production of knowledges and techniques by practitioners such as smallholders practicing permaculture and agroecology, craftspeople experimenting with nontoxic materials, and forest peoples caring creatively for complex socio-ecologies. It is through the latter that plural socio-material pathways to sustainability beyond Modernity may be realized.

It is imperative that sustainability transformations orient societies away from Modern bordering and stratification toward interactive and holistically relational ontologies of care; from instrumental manipulation toward a reflexive commitment to deepening democracy and equality; from technocratic policy making toward practical politics of care and self-realization; from glorifying the agency of (some) human subjects toward appreciating the agency of autonomous collectives producing diverse tools; and from orders of techno-scientific determinism to plural decolonial ways of knowing with each other. It is through such caring and convivial transformations that values and hopes for sustainability have been materialized in the past. And it may be through such transformations that the promises of sustainability are realized in the future.

Notes

1. After a similar incident in Germany, the European Commission’s letter to competent authorities in June 2015 asks that governments should “await, as much as possible, the outcome of the Commission’s legal interpretation before authorizing a deliberate release of organisms obtained with new plant breeding techniques,” since “the deliberate release of products which are subject to the rules of the EU GMO legislation without appropriate prior authorization, is illegal.” Letter obtained through Freedom of Information request, quoted in Holland (2016, 13).

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